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

FORM 10-Q

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

For the quarterly period ended March 31, 2020

OR

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

For the transition period from ___________ to ___________

Commission File Number 001-36407

ALNYLAM PHARMACEUTICALS, INC.
(Exact Name of Registrant as Specified in Its Charter)

Delaware **(State or Other Jurisdiction of Incorporation or Organization)**	**77-0602661** **(I.R.S. Employer Identification No.)**
675 West Kendall Street, Henri A. Termeer Square Cambridge, MA **(Address of Principal Executive Offices)**	**02142** **(Zip Code)**

(617) 551-8200
(Registrant's Telephone Number, Including Area Code)

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

Title of Each Class	Trading Symbol(s)	Name of Each Exchange on Which Registered
Common Stock, $0.01 par value per share	ALNY	The Nasdaq Stock Market LLC

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 x 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 x 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	x	Accelerated filer	☐
Non-accelerated filer	☐	Smaller reporting company	☐
Emerging growth company	☐		

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

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

At April 30, 2020, the registrant had 114,819,151 shares of Common Stock, $0.01 par value per share, outstanding.

INDEX

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CAUTIONARY NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Quarterly Report on Form 10-Q contains forward-looking statements within the meaning of the federal securities laws, Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. We intend these forward-looking statements to be covered by the safe harbor provisions for forward-looking statements contained in the Private Securities Litigation Reform Act of 1995 and are including this statement for purposes of complying with those safe harbor provisions. All statements other than statements of historical facts contained in this Quarterly Report on Form 10-Q are forward-looking statements. In some cases, you can identify forward-looking statements by terminology such as "may," "will," "should," "could," "expects," "plans," "intends," "anticipates," "believes," "estimates," "predicts," "potential," "continue," or the negative of these terms or other comparable terminology. These forward-looking statements include, but are not limited to, statements about:

- risks related to the direct or indirect impact of the COVID-19 global pandemic or a future pandemic, such as the scope and duration of the outbreak, government actions and restrictive measures implemented in response, material delays in diagnoses of rare diseases, initiation or continuation of treatment for diseases addressed by our products, or in patient enrollment in clinical trials, potential clinical trial, regulatory review or supply chain disruptions, and other potential impacts to our business, the effectiveness or timeliness of steps taken by us to mitigate the impact of the pandemic, and our ability to execute business continuity plans to address disruptions caused by the COVID-19 or a future pandemic;
- our views with respect to the potential for RNAi therapeutics, including ONPATTRO, GIVLAARI, lumasiran, patisiran, inclisiran, vutrisiran and fitusiran;
- our plans for additional global regulatory filings and the continuing product launches of ONPATTRO and GIVLAARI;
- our expectations regarding the advancement of lumasiran and inclisiran through regulatory review and toward the market;
- the progress of our research and development programs;
- our current and anticipated clinical trials and expectations regarding the reporting of data from these trials;
- our expectations regarding potential market size for, and the successful commercialization of, ONPATTRO, GIVLAARI or any future products, including lumasiran and inclisiran;
- the timing of regulatory filings and interactions with or actions or advice of regulatory authorities, which may affect the design, initiation, timing, continuation and/or progress of clinical trials or result in the need for additional pre-clinical and/or clinical testing or the timing or likelihood of regulatory approvals;
- our ability or, with respect to inclisiran, our partner's ability, to obtain and maintain regulatory approval, pricing and reimbursement for ONPATTRO, GIVLAARI or any future products, including lumasiran and inclisiran;
- the status of our manufacturing operations and the construction of our manufacturing facility and any delays, interruptions or failures in the manufacture and supply of ONPATTRO, GIVLAARI or any of our product candidates by our contract manufacturers or by us;
- our progress continuing to build and leverage commercial and ex-United States, or U.S, infrastructure; successfully launching, marketing and selling our approved products globally;
- our ability to successfully expand the indication for ONPATTRO in the future;
- the possible impact of any competing products on the commercial success of ONPATTRO and GIVLAARI and our product candidates and our ability to compete against such products;
- our ability to manage our growth and operating expenses;
- our expectations regarding our STAr pipeline growth strategy and our ability to meet or exceed our *Alnylam 2020* guidance for the advancement and commercialization of RNAi therapeutics;
- our expectations regarding the length of time our current cash, cash equivalents and marketable debt and equity securities will support our operations based on our current operating plan;
- our belief that the funding provided by our strategic financing collaboration with Blackstone should enable us to achieve a self-sustainable profile without the need for future equity financing;
- our dependence on third parties for development, manufacture and distribution of products;
- our expectations regarding our corporate collaborations, including potential future licensing fees and milestone and royalty payments under existing or future agreements;
- obtaining, maintaining and protecting our intellectual property;

- our ability to attract and retain qualified key management and scientists, development, medical and commercial staff, consultants and advisors;
- the outcome of litigation or other legal proceedings;
- the risk of government investigations;
- regulatory developments in the U.S. and foreign countries;
- the impact of laws and regulations;
- developments relating to our competitors and our industry; and
- other risks and uncertainties, including those listed under the caption Part II, Item 1A, "Risk Factors" of this Quarterly Report on Form 10-Q.

The risks set forth above are not exhaustive. Other sections of this Quarterly Report may include additional factors that could adversely affect our business and financial performance. Moreover, we operate in a very competitive and rapidly changing environment. New risk factors emerge from time to time and it is not possible for management to predict all risk factors, nor can we assess the impact of all risk factors on our business or the extent to which any factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statements. Any forward-looking statements in this Quarterly Report on Form 10-Q reflect our current views with respect to future events and with respect to our business and future financial performance, and involve known and unknown risks, uncertainties and other factors that may cause our actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by these forward-looking statements. Factors that may cause actual results to differ materially from current expectations include, among other things, those described under Part II, Item 1A, "Risk Factors" and elsewhere in this Quarterly Report on Form 10-Q. Given these uncertainties, you should not place undue reliance on these forward-looking statements. Except as required by law, we assume no obligation to update or revise these forward-looking statements for any reason, even if new information becomes available in the future. You are advised, however, to consult any further disclosure we make in our reports filed with the SEC.

This Quarterly Report on Form 10-Q may include data that we obtained from industry publications and third-party research, surveys and studies. Industry publications and third-party research, surveys and studies generally indicate that their information has been obtained from sources believed to be reliable, although they do not guarantee the accuracy or completeness of such information. This Quarterly Report on Form 10-Q also may include data based on our own internal estimates and research, including estimates regarding the impact of the COVID-19 pandemic on our financial statements. Our internal estimates have not been verified by any independent source and, while we believe any data obtained from industry publications and third-party research, surveys and studies are reliable, we have not independently verified such data. Such third-party data, as well as our internal estimates and research, are subject to a high degree of uncertainty and risk due to a variety of factors, including those described in Part II, Item 1A, "Risk Factors" and elsewhere in this Quarterly Report on Form 10-Q. These and other factors could cause our results to differ materially from those expressed in this Quarterly Report on Form 10-Q.

ALNYLAM PHARMACEUTICALS, INC.
CONDENSED CONSOLIDATED BALANCE SHEETS
(In thousands, except per share amounts)
(Unaudited)

	March 31, 2020	December 31, 2019
ASSETS		
Current assets:		
Cash and cash equivalents	$ 467,779	$ 547,178
Marketable debt securities	836,346	975,017
Marketable equity securities	38,078	13,967
Accounts receivable, net	75,572	43,011
Inventory	68,300	56,348
Prepaid expenses and other current assets	98,698	80,343
Total current assets	1,584,773	1,715,864
Property, plant and equipment, net	429,814	425,179
Operating lease right-of-use assets	221,280	221,197
Restricted investments	24,725	14,825
Other assets	19,032	18,069
Total assets	$ 2,279,624	$ 2,395,134
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	$ 40,484	$ 49,884
Accrued expenses	183,221	197,201
Operating lease liability	29,043	27,688
Deferred revenue	86,043	77,821
Total current liabilities	338,791	352,594
Operating lease liability, net of current portion	275,782	276,135
Deferred revenue, net of current portion	306,124	318,383
Other liabilities	9,198	9,330
Total liabilities	929,895	956,442
Commitments and contingencies (Note 14)		
Stockholders' equity:		
Preferred stock, $0.01 par value per share, 5,000 shares authorized and no shares issued and outstanding as of March 31, 2020 and December 31, 2019	—	—
Common stock, $0.01 par value per share, 250,000 shares authorized; 113,168 shares issued and outstanding as of March 31, 2020; 112,188 shares issued and outstanding as of December 31, 2019	1,131	1,122
Additional paid-in capital	5,289,966	5,201,176
Accumulated other comprehensive loss	(32,059)	(36,518)
Accumulated deficit	(3,909,309)	(3,727,088)
Total stockholders' equity	1,349,729	1,438,692
Total liabilities and stockholders' equity	$ 2,279,624	$ 2,395,134

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

ALNYLAM PHARMACEUTICALS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF OPERATIONS AND COMPREHENSIVE LOSS
(In thousands, except per share amounts)
(Unaudited)

	Three Months Ended March 31,	
	2020	**2019**
Statements of Operations		
Revenues:		
Net product revenues	$ 71,938	$ 26,291
Net revenues from collaborations	27,538	7,003
Total revenues	99,476	33,294
Operating costs and expenses:		
Cost of goods sold	13,302	3,347
Research and development	169,571	129,127
Selling, general and administrative	126,761	89,608
Total operating costs and expenses	309,634	222,082
Loss from operations	(210,158)	(188,788)
Other income:		
Interest income	5,480	7,525
Other income	23,032	43
Total other income	28,512	7,568
Loss before income taxes	(181,646)	(181,220)
Provision for income taxes	(575)	(695)
Net loss	$ (182,221)	$ (181,915)
Net loss per common share - basic and diluted	$ (1.62)	$ (1.73)
Weighted-average common shares used to compute basic and diluted net loss per common share	112,748	105,400
Statements of Comprehensive Loss		
Net loss	$ (182,221)	$ (181,915)
Other comprehensive income:		
Unrealized gain on marketable debt securities	4,045	360
Foreign currency translation	340	—
Defined benefit pension plans, net of tax	74	—
Comprehensive loss	$ (177,762)	$ (181,555)

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

ALNYLAM PHARMACEUTICALS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(In thousands)
(Unaudited)

	Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Stockholders' Equity
	Shares	Amount				
Balance as of December 31, 2019	112,188	$ 1,122	$ 5,201,176	$ (36,518)	$ (3,727,088)	$ 1,438,692
Exercise of common stock options, net of tax withholdings	976	9	54,212	—	—	54,221
Issuance of common stock under equity plans	4	—	—	—	—	—
Stock-based compensation expense related to equity-classified awards	—	—	34,578	—	—	34,578
Other comprehensive income	—	—	—	4,459	—	4,459
Net loss	—	—	—	—	(182,221)	(182,221)
Balance as of March 31, 2020	113,168	$ 1,131	$ 5,289,966	$ (32,059)	$ (3,909,309)	$ 1,349,729

	Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Stockholders' Equity
	Shares	Amount				
Balance as of December 31, 2018	101,177	$ 1,011	$ 4,175,139	$ (33,213)	$ (2,840,972)	$ 1,301,965
Exercise of common stock options, net of tax withholdings	207	3	11,406	—	—	11,409
Issuance of common stock under equity plans	4	—	(58)	—	—	(58)
Issuance of common stock under benefit plans	12	—	784	—	—	784
Issuance of common stock, net of offering costs	5,000	50	381,850	—	—	381,900
Stock-based compensation expense related to equity-classified awards	—	—	32,541	—	—	32,541
Other comprehensive income, net of tax	—	—	—	360	—	360
Net loss	—	—	—	—	(181,915)	(181,915)
Balance as of March 31, 2019	106,400	$ 1,064	$ 4,601,662	$ (32,853)	$ (3,022,887)	$ 1,546,986

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

Table of Contents

ALNYLAM PHARMACEUTICALS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF CASH FLOWS
(In thousands)
(Unaudited)

	Three Months Ended March 31,	
	2020	**2019**
Cash flows from operating activities:		
Net loss	$ (182,221)	$ (181,915)
Non-cash adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	7,613	3,838
Amortization and interest accretion related to operating leases	9,393	10,255
Stock-based compensation	34,578	32,032
Unrealized gain on marketable equity securities	(24,111)	—
Other	660	(1,075)
Changes in operating assets and liabilities:		
Accounts receivable, net	(32,882)	(15,041)
Proceeds from landlord lease incentive for tenant improvements	—	12,386
Inventory	(11,952)	(7,134)
Prepaid expenses and other assets	(19,958)	(8,988)
Accounts payable, accrued expenses and other liabilities	(14,215)	(24,332)
Deferred revenue	(4,030)	(834)
Operating lease liability	(9,036)	(7,702)
Net cash used in operating activities	(246,161)	(188,510)
Cash flows from investing activities:		
Purchases of property, plant and equipment	(19,617)	(44,049)
Purchases of marketable debt securities	(396,409)	(256,996)
Sales and maturities of marketable securities	539,614	403,697
Purchases of restricted investments	(9,900)	—
Net cash provided by investing activities	113,688	102,652
Cash flows from financing activities:		
Proceeds from exercise of stock options and other types of equity, net	53,869	9,031
Offering proceeds, net of costs	—	381,900
Net cash provided by financing activities	53,869	390,931
Effect of exchange rate changes on cash, cash equivalents and restricted cash	(631)	—
Net (decrease) increase in cash, cash equivalents and restricted cash	(79,235)	305,073
Cash, cash equivalents and restricted cash, beginning of period	549,628	422,631
Cash, cash equivalents and restricted cash, end of period	$ 470,393	$ 727,704
Supplemental disclosure of noncash investing and financing activities:		
Capital expenditures included in accounts payable and accrued expenses	$ 6,619	$ 13,033
Lease liabilities arising from obtaining right-of-use assets	$ 2,939	$ —

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

1. NATURE OF BUSINESS

Alnylam Pharmaceuticals, Inc. (also referred to as Alnylam, we, our or us) commenced operations on June 14, 2002 as a biopharmaceutical company seeking to develop and commercialize novel therapeutics based on RNA interference, or RNAi. We are committed to the advancement of our company strategy of building a multi-product, global, commercial biopharmaceutical company with a deep and sustainable clinical pipeline of RNAi therapeutics for future growth and a robust, organic research engine for sustainable innovation and great potential for patient impact. Since inception, we have focused on discovering, developing and commercializing RNAi therapeutics by establishing and maintaining a strong intellectual property position in the RNAi field, establishing strategic alliances with leading pharmaceutical and life sciences companies, generating revenues through licensing agreements, and ultimately developing and commercializing RNAi therapeutics globally, either independently or with our strategic partners. We have devoted substantially all of our efforts to business planning, research, development, manufacturing and early commercial efforts, acquiring, filing and expanding intellectual property rights, recruiting management and technical staff, and raising capital.

In August 2018, we received approval for ONPATTRO from the United States Food and Drug Administration, or FDA, and began commercializing and generating product revenues in the U.S., and also received marketing authorization for ONPATTRO from the European Commission, or EC. As of March 31, 2020, we have launched ONPATTRO in the U.S., Europe, Japan and in several additional countries. In November 2019, we received approval for GIVLAARI from the FDA and began commercializing and generating product revenues in the U.S. in December 2019. In March 2020, we received marketing authorization for GIVLAARI from the EC, and in April 2020, we launched GIVLAARI in Germany. Regulatory filings in additional markets are pending or planned for 2020 and beyond for both products.

2. BASIS OF PRESENTATION AND PRINCIPLES OF CONSOLIDATION

The accompanying condensed consolidated financial statements of Alnylam are unaudited and have been prepared in accordance with accounting principles generally accepted in the United States of America, or GAAP, applicable to interim periods and, in the opinion of management, include all normal and recurring adjustments that are necessary to state fairly the results of operations for the reported periods. Our condensed consolidated financial statements have also been prepared on a basis substantially consistent with, and should be read in conjunction with, our audited consolidated financial statements for the year ended December 31, 2019, which were included in our Annual Report on Form 10-K that was filed with the Securities and Exchange Commission on February 13, 2020. The year-end condensed consolidated balance sheet data was derived from our audited financial statements but does not include all disclosures required by GAAP. The results of our operations for any interim period are not necessarily indicative of the results of our operations for any other interim period or for a full fiscal year.

The accompanying condensed consolidated financial statements reflect the operations of Alnylam and our wholly-owned subsidiaries. All intercompany accounts and transactions have been eliminated.

Our significant accounting policies are described in Note 2 of the Notes to Consolidated Financial Statements included in our Annual Report on Form 10-K for the year ended December 31, 2019.

Reclassification

Certain prior period amounts in the condensed consolidated financial statements have been reclassified to conform to the current period presentation.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America, or GAAP, requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the condensed consolidated financial statements and the reported amounts of revenues and expenses during the reporting period. The full extent to which the COVID-19 pandemic will directly or indirectly impact our business, results of operations and financial condition, including sales, expenses, reserves and allowances, clinical trials and research and development costs, will depend on future developments that are highly uncertain, including as a result of new information that may emerge concerning COVID-19 and the actions taken to contain it or treat COVID-19, as well as the economic impact on local, regional, national and international customers and markets. We have made estimates of the impact of COVID-19 within our financial statements and there may be changes to those estimates in future periods. Actual results may differ from these estimates.

Liquidity

Based on our current operating plan, we believe that our cash, cash equivalents and marketable debt and equity securities as of March 31, 2020, together with the cash we expect to generate from product sales and under our alliances and strategic financing collaboration, will be sufficient to enable us to advance our long-term strategic goals for multiple years from the filing of this Quarterly Report on Form 10-Q.

Recently Adopted Accounting Pronouncements

In June 2016, the Financial Accounting Standards Board, or FASB, issued new accounting guidance which requires entities to record expected credit losses for certain financial instruments, including trade receivables, as an allowance that reflects the entity's current estimate of credit losses expected to be incurred. For available-for-sale debt securities in unrealized loss positions, the new standard requires allowances to be recorded instead of reducing the amortized cost of the investment. The new standard became effective for us on January 1, 2020 and did not have a significant impact on our condensed consolidated financial statements and related disclosures.

In August 2018, the FASB issued amendments to accounting guidance that eliminate, add and modify certain disclosure requirements on fair value measurements. The new standard became effective for us on January 1, 2020 and did not have a significant impact on our condensed consolidated financial statements and related disclosures.

In August 2018, the FASB issued new accounting guidance to clarify the accounting for implementation costs in cloud computing arrangements (hosting arrangements). The new standard requires a customer in a cloud computing arrangement to determine which implementation costs to capitalize as assets or expense as incurred. Capitalized implementation costs related to a hosting arrangement that is a service contract will be amortized over the term of the hosting arrangement, beginning when the module or component of the hosting arrangement is ready for its intended use. The new standard became effective for us on January 1, 2020 and did not have a significant impact on our condensed consolidated financial statements and related disclosures.

In November 2018, the FASB issued new accounting guidance to clarify the interaction between the accounting guidance for collaborative arrangements and revenue from contracts with customers. The new standard became effective for us on January 1, 2020 using a retrospective transition method. This standard did not have a significant impact on our condensed consolidated financial statements and related disclosures.

In December 2019, the FASB issued amendments to accounting guidance that simplify the accounting for income taxes, as part of its initiative to reduce complexity in the accounting standards. The amendments eliminate certain exceptions related to the approach for intraperiod tax allocation, the methodology for calculating income taxes in an interim period and the recognition of deferred tax liabilities for outside basis differences. The amendments also clarify and simplify other aspects of the accounting for income taxes. We early adopted the amendments as of January 1, 2020, on a prospective basis. The amendments did not have a significant impact on our condensed consolidated financial statements and related disclosures.

3. NET PRODUCT REVENUES

Net product revenues consist of the following:

	Three Months Ended March 31,	
(In thousands)	**2020**	**2019**
United States	$ 42,470	$ 18,760
Europe	21,166	7,531
Rest of World (primarily Japan)	8,302	—
Total	$ 71,938	$ 26,291

	Three Months Ended March 31,	
(In thousands)	**2020**	**2019**
ONPATTRO	$ 66,664	$ 26,291
GIVLAARI	5,274	—
Total	$ 71,938	$ 26,291

The following table presents the balance of our receivables related to our net product revenues:

(In thousands)	**As of March 31, 2020**	**As of December 31, 2019**
Receivables included in “Accounts receivable, net”	$ 49,601	$ 28,082

4. NET REVENUES FROM COLLABORATIONS

Net revenues from collaborations consist of the following:

(In thousands)	Three Months Ended March 31, 2020	2019
Regeneron Pharmaceuticals (Regeneron)	$ 19,503	$ —
Vir Biotechnology (Vir)	6,516	928
The Medicines Company (MDCO)	1,060	1,745
Sanofi Genzyme (Sanofi)	—	4,117
Other	459	213
Total	$ 27,538	$ 7,003

The following table presents the balance of our receivables and contract liabilities related to our collaboration agreements:

(In thousands)	As of March 31, 2020	As of December 31, 2019
Receivables included in “Accounts receivable, net”	$ 25,970	$ 14,929
Contract liabilities included in “Deferred revenue”	152,829	153,117

The following table presents revenue recognized as a result of changes in contract liability related to our collaboration agreements:

(In thousands)	Three Months Ended March 31, 2020	2019
Amounts included in contract liability at the beginning of the period	$ 14,678	$ 928

In order to determine revenue recognized in the period from contract liabilities, we first allocate revenue to the individual contract liability balance outstanding at the beginning of the period until the revenue exceeds that balance. If additional consideration is received on those contracts in subsequent periods, we assume all revenue recognized in the reporting period first applies to the beginning contract liability as opposed to a portion applying to the new consideration for the period.

The following table provides research and development expenses incurred by type, for which we recognize net revenue, that are directly attributable to our collaboration agreements, by collaboration partner:

	Three Months Ended March 31,					
	2020			2019		
(In thousands)	Clinical Trial and Manufacturing	External Services	Other	Clinical Trial and Manufacturing	External Services	Other
Regeneron	$ 4,612	$ —	$ 11,491	$ —	$ —	$ —
Vir	339	52	1,693	294	236	129
MDCO	998	—	266	1,612	10	50
Sanofi	—	17	231	4,826	135	59
Total	$ 5,949	$ 69	$ 13,681	$ 6,732	$ 381	$ 238

The research and development expenses incurred for each agreement listed in the table above consist of costs incurred for (i) clinical and manufacturing expenses, (ii) external services including consulting services and lab supplies and services, and (iii) other expenses, including professional services, facilities and overhead allocations, and a reasonable estimate of compensation and related costs as billed to our counterparties, for which we recognize net revenue from collaborations. For the three months ended March 31, 2020 and 2019, we did not incur material selling, general and administrative expenses related to our collaboration agreements.

Product Alliances

Vir Biotechnology, Inc.

In October 2017, we and Vir Biotechnology, Inc., or Vir, entered into a collaboration and license agreement, or the Vir Agreement, for the development and commercialization of RNAi therapeutics for infectious diseases, including chronic hepatitis B virus, or HBV, infection.

Pursuant to the Vir Agreement, we granted to Vir an exclusive license to develop, manufacture and commercialize ALN-HBV02 (VIR-2218), for all uses and purposes other than certain excluded fields, as set forth in the Vir Agreement. In addition, we granted Vir an exclusive option for up to four additional RNAi therapeutic programs for the treatment of infectious diseases. Under the terms of the Vir Agreement, for each product arising from the HBV program, including ALN-HBV02, we retain the right to opt into a profit-sharing arrangement prior to the start of a Phase 3 clinical trial. In addition, we have the right on a product-by-product basis with respect to each additional infectious disease program that Vir elects to pursue, to opt into a profit-sharing arrangement for each such product at any time during a specified period prior to the achievement of clinical proof of concept for each such product.

Pursuant to the Vir Agreement, Vir paid us an upfront fee of $10.0 million and issued to us 1,111,111 shares of its common stock. Under the Vir Agreement, we may also receive milestone payments upon the achievement of certain development, regulatory and commercial milestones, as well as royalties on the net sales of licensed products ranging from high-single-digit to sub-teen double-digit percentages. In March 2020, we achieved a development milestone relating to ALN-HBV02 and earned 1,111,111 shares of Vir's common stock and a $15.0 million cash payment. Due to the uncertainty of pharmaceutical development and the high historical failure rates generally associated with drug development, we may not receive any additional milestone payments or any royalty payments under the Vir Agreement.

In March 2020, we entered into an amendment to the Vir Agreement to expand our collaboration to include the development and commercialization of RNAi therapeutics targeting SARS-CoV-2, the virus that causes the disease COVID-19. Under the Vir amendments, we and Vir will each be responsible for pre-clinical development costs incurred by each such party in performing its allocated responsibilities under an agreed-upon initial pre-clinical development plan. We and Vir will equally share costs incurred in connection with the manufacture of non-GMP drug product required for pre-clinical development prior to filing an IND for the first product in the coronavirus program. Vir will lead all development and commercialization of any selected development candidates. At clinical proof of concept, we will have an option to share equally in the profits and losses associated with the development and commercialization of the coronavirus program. Alternatively, we may elect to earn development and commercialization milestones and royalties on net sales of products resulting from the collaboration in amounts agreed upon for the coronavirus program.

Unless terminated earlier in accordance with the terms of the agreement, the Vir Agreement expires on a licensed product-by-product and country-by-country basis upon expiration of all royalty payment obligations under the agreement. If Vir does not exercise its option for an infectious disease program, the Vir Agreement will expire upon the expiration of the applicable option period with respect to such program. However, if we exercise our profit-sharing option for any product, the term of the agreement will continue until the expiration of the profit-sharing arrangement for such product.

Either party may terminate the agreement in the event the other party fails to cure a material breach, or upon patent-related challenges by the other party. In addition, Vir has the right to terminate the agreement on a program-by-program basis or in its entirety for any reason on 90 days' written notice.

We identified one performance obligation under the Vir Agreement, as amended comprised of: i) the exclusive license to develop, manufacture and commercialize RNAi therapeutics (including ALN-HBV02 and other infectious diseases), ii) the obligation to deliver four additional development candidates and supply product for each of the RNAi therapeutic programs for the treatment of infectious diseases, and iii) the obligation to deliver a development candidate and supply product for SARS-CoV-2. The license is not distinct from the services, including the obligation to deliver development candidates and supply product, as Vir cannot benefit on its own from the value of the license without receipt of such services and supply.

As of March 31, 2020, the total transaction price was determined to be $105.2 million, comprised of the upfront payment, fair value of non-cash equity consideration at contract inception, the development milestone and variable consideration related to development, manufacture and supply activities. The total transaction price is allocated entirely to the single performance obligation. We utilized the expected value method to determine the amount of reimbursement for these activities. We determined any variable consideration related to sales-based royalties and milestones related to the exclusive license to be constrained and therefore excluded such consideration from the transaction price.

As of March 31, 2020, the aggregate amount of the transaction price allocated to the performance obligation that was unsatisfied was $71.8 million, which is expected to be recognized through the term of the Vir Agreement as the services are performed.

In April 2020, we further amended the Vir Agreement to include up to three additional targets focused on host factors for SARS-CoV-2, including angiotensin converting enzyme-2, or ACE2, and transmembrane protease, serine 2, or TMPRSS2, and potentially a third host target to emerge from Vir's functional genomics work.

Regeneron Collaboration

On April 8, 2019, we entered into a global, strategic collaboration with Regeneron Pharmaceuticals, Inc., or Regeneron, to discover, develop and commercialize RNAi therapeutics for a broad range of diseases by addressing therapeutic targets expressed in the eye and central nervous system, or CNS, in addition to a select number of targets expressed in the liver, which we refer to as the Regeneron Collaboration. The Regeneron Collaboration is governed by a Master Agreement, referred to as the Regeneron Master Agreement, which became effective on May 21, 2019, or the Effective Date. In connection with the Regeneron Master Agreement, we and Regeneron entered into (i) a binding co-co collaboration term sheet covering the continued development of cemdisiran, our C5 small interfering RNA, or siRNA, currently in Phase 2 development for C5 complement-mediated diseases, as a monotherapy and (ii) a binding license term sheet to evaluate anti-C5 antibody-siRNA combinations for C5 complement-mediated diseases including evaluating the combination of Regeneron's pozelimab (REGN3918), currently in Phase 1 development, and cemdisiran. The C5 co-co collaboration and license agreements were executed in August 2019.

Under the terms of the Regeneron Collaboration, we are working exclusively with Regeneron to discover RNAi therapeutics for eye and CNS diseases for an initial five-year research period, which we refer to as the Initial Research Term. Regeneron has an option to extend the Initial Research Term (referred to as the Research Term Extension Period, and together with the Initial Research Term, the Research Term) for up to an additional two years, for a research term extension fee of up to $400.0 million. The Regeneron Collaboration also covers a select number of RNAi therapeutic programs designed to target genes expressed in the liver, including our previously announced collaboration with Regeneron to identify RNAi therapeutics for the chronic liver disease nonalcoholic steatohepatitis. We retain broad global rights to all of our other unpartnered liver-directed clinical and pre-clinical pipeline programs. The Regeneron Collaboration is governed by a joint steering committee that is comprised of an equal number of representatives from each party.

Regeneron will lead development and commercialization for all programs targeting eye diseases (subject to limited exceptions), entitling us to certain potential milestone and royalty payments pursuant to the terms of a license agreement, the form of which has been agreed upon by the parties. We and Regeneron will alternate leadership on CNS and liver programs, with the lead party retaining global development and commercial responsibility. For CNS and liver programs, both we and Regeneron will have the option at lead candidate selection to enter into a co-co collaboration agreement, the form of which has been agreed upon by the parties, whereby both companies will share equally all costs of, and profits from, all development and commercialization activities under the program. If the non-lead party elects to not enter into a co-co collaboration agreement with respect to a given CNS or liver program, we and Regeneron will enter into a license agreement with respect to such program and the lead party will be the "Licensee" for the purposes of the license agreement. If the lead party for a CNS or liver program elects to not enter into the co-co collaboration agreement, then we and Regeneron will enter into a license agreement with respect to such program and leadership of the program will transfer to the other party and the former non-lead party will be the "Licensee" for the purposes of the license agreement.

With respect to the programs directed to C5 complement-mediated diseases, we retain control of cemdisiran monotherapy development, and Regeneron is leading combination product development. Under the C5 co-co collaboration agreement, we and Regeneron equally share costs and potential future profits on any monotherapy program. Under the C5 license agreement, for cemdisiran to be used as part of a combination product, Regeneron is solely responsible for all development and commercialization costs and we will receive low double-digit royalties and commercial milestones of up to $325.0 million on any potential combination product sales. The C5 co-co collaboration agreement, the C5 license agreement, and the Master Agreement have been combined for accounting purposes and treated as a single agreement.

In connection with the Regeneron Master Agreement, Regeneron made an upfront payment of $400.0 million. We are also eligible to receive up to an additional $200.0 million in milestone payments upon achievement of certain criteria during early clinical development for eye and CNS programs. We and Regeneron plan to advance programs directed to up to 30 targets under the Regeneron Collaboration during the Initial Research Term. For each program, Regeneron will provide us with $2.5 million in funding at program initiation and an additional $2.5 million at lead candidate identification, with the potential for approximately $30.0 million in annual discovery funding to us as the Regeneron Collaboration reaches steady state.

Regeneron has the right to terminate the Regeneron Master Agreement for convenience upon ninety days' notice. The termination of the Regeneron Master Agreement does not affect the term of any license agreement or co-co collaboration agreement then in effect. In addition, either party may terminate the Regeneron Master Agreement for a material breach by, or insolvency of, the other party. Unless earlier terminated pursuant to its terms, the Regeneron Master Agreement will remain in effect with respect to each program until (a) such program becomes a terminated program or (b) the parties enter into a license agreement or co-co collaboration agreement with respect to such program. The Regeneron Master Agreement includes various representations, warranties, covenants, dispute escalation and resolution mechanisms, indemnities and other provisions customary for transactions of this nature.

For any license agreement subsequently entered into, the licensee will generally be responsible for its own costs and expenses incurred in connection with the development and commercialization of the collaboration products. The licensee will pay to the licensor certain development and/or commercialization milestone payments totaling up to $150.0 million for each collaboration product. In addition, following the first commercial sale of the applicable collaboration product under a license agreement, the licensee is required to make certain tiered royalty payments, ranging from low double-digits up to 20%, to the licensor based on the aggregate annual net sales of the collaboration product, subject to customary reductions.

For any co-co collaboration agreement subsequently entered into, we and Regeneron will share equally all costs of, and profits from, development and commercialization activities. In the event that a party exercises its opt-out right, the lead party will be responsible for all costs and expenses incurred in connection with the development and commercialization of the collaboration products under the applicable co-co collaboration agreement, subject to continued sharing of costs through defined points. If a party exercises its opt-out right, following the first commercial sale of the applicable collaboration product under a co-co collaboration agreement, the lead party is required to make certain tiered royalty payments, ranging from low double-digits up to 20%, to the other party based on the aggregate annual net sales of the collaboration product and the timing of the exercise of the opt-out right, subject to customary reductions and a reduction for opt-out transition costs.

Due to the uncertainty of pharmaceutical development and the high historical failure rates generally associated with drug development, we may not receive any milestone or royalty payments from Regeneron under the Regeneron Master Agreement, the C5 license agreement, or any future license agreement, or under any co-co collaboration agreement in the event we exercise our opt-out right.

Our obligations under the Regeneron Collaboration include: (i) a research license and research services, collectively referred to as the Research Services Obligation; (ii) a worldwide license to cemdisiran for combination therapies, and manufacturing and supply, and development service obligations, collectively referred to as the C5 License Obligation; and (iii) development, manufacturing and commercialization activities for cemdisiran monotherapies, referred to as the C5 Co-Co Obligation.

The research license is not distinct from the research services primarily as a result of Regeneron being unable to benefit on its own or with other resources reasonably available, as the license is providing access to specialized expertise, particularly as it relates to RNAi technology that is not available in the marketplace. Similarly, the worldwide license to cemdisiran for combination therapies is not distinct from the manufacturing and supply, and development service obligations, as Regeneron cannot benefit on its own from the value of the license without receipt of supply.

Separately, the cemdisiran monotherapy co-co collaboration agreement is under the scope of ASC 808 as we and Regeneron are both active participants in the development and manufacturing activities and are exposed to significant risks and rewards that are dependent on commercial success of the activities of the arrangement. The development and manufacturing activities are a combined unit of account under the scope of ASC 808 and are not deliverables under ASC 606.

The total transaction price is comprised of the $400.0 million upfront payment and additional variable consideration related to research, development, manufacturing and supply activities related to the Research Services Obligation and the C5 License Obligation. We utilized the expected value method to determine the amount of reimbursement for these activities. We determined that any variable consideration related to sales-based royalties and milestones related to the worldwide license to cemdisiran for combination therapies is deemed to be constrained and therefore has been excluded from the transaction price. In addition, we are eligible to receive future milestones upon the achievement of certain criteria during early clinical development for the eye and CNS programs. We are also eligible to receive royalties on future commercial sales for certain eye, CNS or liver targets, if any; however, these amounts are excluded from variable consideration under the Regeneron Collaboration as we are only eligible to receive such amounts if, after a drug candidate is identified, the form of license agreement is subsequently executed resulting in a license that is granted to Regeneron. Any such subsequently granted license would represent a separate transaction under ASC 606.

We allocated the initial transaction price to each unit of account based on the applicable accounting guidance as follows, in thousands:

Performance Obligations	Standalone Selling Price	Transaction Price Allocated	Accounting Guidance
Research Services Obligation	$ 130,700	$ 183,100	ASC 606
C5 License Obligation	97,600	92,500	ASC 606
C5 Co-Co Obligation	364,600	246,000	ASC 808
		$ 521,600	

The transaction price was allocated to the obligations based on the relative estimated standalone selling prices of each obligation, over which management has applied significant judgment. We developed the estimated standalone selling price for the licenses included in the Research Services Obligation and the C5 License Obligation primarily based on the probability-weighted present value of expected future cash flows associated with each license related to each specific program. In developing such estimate, we applied judgment in the determination of the forecasted revenues, taking into consideration the applicable market conditions and relevant entity-specific factors, the expected number of targets or indications expected to be pursued under each license, the probability of success, the time needed to develop a product candidate pursuant to the associated license and the discount rate. We developed the estimated standalone selling price for the services and/or manufacturing and supply included in each of the obligations, as applicable, primarily based on the nature of the services to be performed and/or goods to be manufactured and estimates of the associated costs. The estimated standalone selling price of the C5 Co-Co Obligation was developed by estimating the present value of expected future cash flows that Regeneron is entitled to receive. In developing such estimate, we applied judgment in determining the indications that will be pursued, the forecasted revenues for such indications, the probability of success and the discount rate.

For the Research Services Obligation and the C5 License Obligation accounted for under ASC 606, we measure proportional performance over time using an input method based on cost incurred relative to the total estimated costs for each of the identified obligations, on a quarterly basis, by determining the proportion of effort incurred as a percentage of total effort we expect to expend. This ratio is applied to the transaction price allocated to each obligation. Management has applied significant judgment in the process of developing our estimates. Any changes to these estimates will be recognized in the period in which they change as a cumulative catch up. We re-evaluate the transaction price as of the end of each reporting period and during the quarter ended March 31, 2020, there was no change to the transaction price calculated at December 31, 2019. For the C5 Co-Co Obligation accounted for under ASC 808, the transaction price allocated to this obligation is recognized using a proportional performance method. Revenue recognized under this agreement, inclusive of the amount allocated to the C5 Co-Co Obligation and future cost reimbursements, is accounted for as collaboration revenue.

The following table provides a summary of the transaction price allocated to each unit of account based on the applicable accounting guidance, in addition to revenue activity during the period, in thousands:

	Transaction Price Allocated	Revenue Recognized During		Deferred Revenue		
Performance Obligations	**As of March 31, 2020**	**Three Months Ended March 31, 2020**	**Three Months Ended March 31, 2019**	**As of March 31, 2020**	**As of December 31, 2019**	**Accounting Guidance**
Research Services Obligation	$ 200,600	$ 12,300	$ —	$ 72,300	$ 84,800	ASC 606
C5 License Obligation	108,500	—	—	65,800	65,800	ASC 606
C5 Co-Co Obligation	246,000	4,200	—	239,000	243,000	ASC 808
	$ 555,100	$ 16,500	$ —	$ 377,100	$ 393,600	

As of March 31, 2020, the aggregate amount of the transaction price allocated to the remaining Research Services Obligation and C5 License Obligation that was unsatisfied is $296.8 million, which is expected to be recognized through the term of the Regeneron Collaboration as the services are performed. This amount excludes the transaction price allocated to the C5 Co-Co Obligation accounted for under ASC 808. Deferred revenue related to the Regeneron Collaboration is classified as either current or non-current in the condensed consolidated balance sheets based on the period the revenue is expected to be recognized.

Sanofi Genzyme Collaboration

Collaboration Amendment

On April 8, 2019, we and Sanofi Genzyme entered into an amendment to our 2014 Sanofi Genzyme collaboration, which we refer to as the Collaboration Amendment. Under the Collaboration Amendment, we and Sanofi Genzyme agreed to conclude the research and option phase under our collaboration agreement. In connection and simultaneously with entering into the Collaboration Amendment, we and Sanofi Genzyme also entered into the Amended and Restated ALN-AT3 Global License Terms with respect to ALN-AT3 (fitusiran) and certain back-up products, which we refer to as the A&R AT3 License Terms. The A&R AT3 License Terms amend and restate the ALN-AT3 Global License Terms entered into by us and Sanofi Genzyme in January 2018 to modify certain of the business terms. The material collaboration terms for fitusiran, as previously announced, will continue unchanged.

In connection with entering into the Collaboration Amendment and the A&R AT3 License Terms, we agreed to advance, at our cost, a selected investigational asset in an undisclosed rare genetic disease through the end of IND-enabling studies. Following completion of such studies, we will transition, at our cost, such asset to Sanofi Genzyme. Thereafter, Sanofi

Genzyme will fund all potential future development and commercialization costs for such asset. If this asset is developed and approved, we will be eligible to receive tiered double-digit royalties on global net sales.

No changes were made to our Exclusive License Agreement with Sanofi Genzyme, referred to as the Exclusive TTR License, pursuant to which we have global rights for the development and commercialization of ONPATTRO, together with vutrisiran and all back-up products, which remains in full force and effect.

5. INVENTORY

The components of inventory are summarized as follows:

(In thousands)	As of March 31, 2020	As of December 31, 2019
Raw materials	$ 30,662	$ 15,418
Work in progress	33,412	38,275
Finished goods	4,226	2,655
Total	$ 68,300	$ 56,348

6. FAIR VALUE MEASUREMENTS

The following tables present information about our assets that are measured at fair value on a recurring basis and indicate the fair value hierarchy of the valuation techniques we utilized to determine such fair value:

(In thousands)	As of March 31, 2020	Quoted Prices in Active Markets (Level 1)	Significant Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Cash equivalents:				
U.S. treasury securities	$ 136,492	$ —	$ 136,492	$ —
Money market funds	254,627	254,627	—	—
Marketable debt securities:	—	—		—
Certificates of deposit	5,134	—	5,134	—
Commercial paper	21,792	—	21,792	—
Corporate notes	114,280	—	114,280	—
U.S. government-sponsored enterprise securities	105,297	—	105,297	—
U.S. treasury securities	589,843	—	589,843	—
Marketable equity securities	38,078	38,078	—	—
Restricted cash (money market funds)	1,483	1,483	—	—
Total	$ 1,267,026	$ 294,188	$ 972,838	$ —

(In thousands)	As of December 31, 2019	Quoted Prices in Active Markets (Level 1)	Significant Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Cash equivalents:				
Commercial paper	$ 3,439	$ —	$ 3,439	$ —
U.S. treasury securities	336,693	—	336,693	—
Money market funds	119,882	119,882	—	—
Marketable debt securities:				
Certificates of deposit	4,301	—	4,301	—
Commercial paper	36,474	—	36,474	—
Corporate notes	146,040	—	146,040	—
U.S. government-sponsored enterprise securities	32,488	—	32,488	—
U.S. treasury securities	755,714	—	755,714	—
Marketable equity securities	13,967	13,967	—	—
Restricted cash (money market funds)	1,482	1,482	—	—
Total	$ 1,450,480	$ 135,331	$ 1,315,149	$ —

During the three months ended March 31, 2020 and 2019, there were no transfers between Level 1 and Level 2 financial assets. The carrying amounts reflected in our condensed consolidated balance sheets for cash, accounts receivable, net, other current assets, accounts payable and accrued expenses approximate fair value due to their short-term maturities.

7. MARKETABLE DEBT SECURITIES

We invest our excess cash balances in marketable debt securities and at each balance sheet date presented, we classify all of our investments in debt securities as available-for-sale and as current assets as they represent the investment of funds available for current operations. We did not record any impairment charges related to our marketable debt securities during the three months ended March 31, 2020 or 2019.

The following tables summarize our marketable debt securities:

	As of March 31, 2020			
(In thousands)	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair Value
Certificates of deposit	$ 5,141	$ —	$ (7)	$ 5,134
Commercial paper	21,792	—	—	21,792
Corporate notes	114,592	9	(321)	114,280
U.S. government-sponsored enterprise securities	105,028	275	(6)	105,297
U.S. treasury securities	722,103	4,232	—	726,335
Total	$ 968,656	$ 4,516	$ (334)	$ 972,838

	As of December 31, 2019			
(In thousands)	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair Value
Certificates of deposit	$ 4,303	$ —	$ (2)	$ 4,301
Commercial paper	39,913	—	—	39,913
Corporate notes	146,016	58	(34)	146,040
U.S. government-sponsored enterprise securities	32,487	3	(2)	32,488
U.S. treasury securities	1,092,293	185	(71)	1,092,407
Total	$ 1,315,012	$ 246	$ (109)	$ 1,315,149

ALNYLAM PHARMACEUTICALS, INC.
NOTES TO CONDENSED CONSOLIDATED FINANCIAL STATEMENTS
(Unaudited)

The fair values of our marketable debt securities by classification in the condensed consolidated balance sheets were as follows:

(In thousands)	As of March 31, 2020	As of December 31, 2019
Cash and cash equivalents	$ 136,492	$ 340,132
Marketable debt securities	836,346	975,017
Total	$ 972,838	$ 1,315,149

8. RECONCILIATION OF CASH, CASH EQUIVALENTS AND RESTRICTED CASH

The following table provides a reconciliation of cash, cash equivalents and restricted cash reported within our condensed consolidated balance sheets that sum to the total of these amounts shown in the condensed consolidated statements of cash flows:

	As of March 31,	
(In thousands)	2020	2019
Cash and cash equivalents	$ 467,779	$ 724,959
Restricted cash included in prepaid expenses and other current assets	167	439
Restricted cash included in long-term other assets	2,447	2,306
Total cash, cash equivalents, and restricted cash shown in the condensed consolidated statements of cash flows	$ 470,393	$ 727,704

9. OTHER COMPREHENSIVE INCOME AND ACCUMULATED OTHER COMPREHENSIVE LOSS

The following tables summarize the changes in accumulated other comprehensive (loss) income, by component, for the three months ended March 31, 2020 and 2019:

(In thousands)	Loss on Investment in Joint Venture	Defined Benefit Pension Plans	Unrealized Gains from Debt Securities	Foreign Currency Translation Adjustment	Total Accumulated Other Comprehensive Loss
Balance as of December 31, 2019	$ (32,792)	$ (3,520)	$ 137	$ (343)	$ (36,518)
Other comprehensive income before reclassifications	—	—	1,317	340	1,657
Amounts reclassified from other comprehensive income	—	74	2,728	—	2,802
Net other comprehensive income	—	74	4,045	340	4,459
Balance as of March 31, 2020	$ (32,792)	$ (3,446)	$ 4,182	$ (3)	$ (32,059)

(In thousands)	Loss on Investment in Joint Venture	Defined Benefit Pension Plans	Unrealized Losses from Debt Securities	Foreign Currency Translation Adjustment	Total Accumulated Other Comprehensive Loss
Balance as of December 31, 2018	$ (32,792)	$ —	$ (421)	$ —	$ (33,213)
Other comprehensive income before reclassifications	—	—	346	—	346
Amounts reclassified from other comprehensive income	—	—	14	—	14
Net other comprehensive income	—	—	360	—	360
Balance as of March 31, 2019	$ (32,792)	$ —	$ (61)	$ —	$ (32,853)

Amounts reclassified out of accumulated other comprehensive loss relate to settlements of marketable debt securities and amortization of our pension obligation which are recorded as interest income and other income, respectively, in the condensed consolidated statements of operations and comprehensive loss.

10. EQUITY

Public Offering

In January 2019, we sold an aggregate of 5,000,000 shares of our common stock through an underwritten public offering at a price to the public of $77.50 per share. As a result of the offering, we received aggregate net proceeds of $381.9 million after deducting underwriting discounts and commissions and other offering expenses of approximately $5.6 million.

11. STOCK-BASED COMPENSATION

The following table summarizes stock-based compensation expenses included in operating costs and expenses:

	Three Months Ended March 31,	
(In thousands)	**2020**	**2019**
Research and development	$ 16,049	$ 16,125
Selling, general and administrative	18,529	15,907
Total	$ 34,578	$ 32,032

12. NET LOSS PER COMMON SHARE

We compute basic net loss per common share by dividing net loss by the weighted-average number of common shares outstanding during the period. We compute diluted net loss per common share by dividing net loss by the weighted-average number of common shares and dilutive potential common share equivalents outstanding during the period. Potential common shares consist of shares issuable upon the exercise of stock options (the proceeds of which are then assumed to have been used to repurchase outstanding shares using the treasury stock method). Because the inclusion of potential common shares would be anti-dilutive for all periods presented, diluted net loss per common share is the same as basic net loss per common share.

The following common share equivalents were excluded from the calculation of net loss per common share because their inclusion would be anti-dilutive:

	As of March 31,	
(In thousands)	**2020**	**2019**
Options to purchase common stock	13,609	13,868
Unvested restricted common stock	1,411	717
Total	15,020	14,585

13. COMMITMENTS AND CONTINGENCIES

Litigation

From time to time, we are a party to legal proceedings in the course of our business, including the matters described below. The claims and legal proceedings in which we could be involved include challenges to the scope, validity or enforceability of patents relating to our products or product candidates, and challenges by us to the scope, validity or enforceability of the patents held by others. These include claims by third parties that we infringe their patents. The outcome of any such legal proceedings, regardless of the merits, is inherently uncertain. In addition, litigation and related matters are costly and may divert the attention of our management and other resources that would otherwise be engaged in other activities. If we were unable to prevail in any such legal proceedings, our business, results of operations, liquidity and financial condition could be adversely affected. Our accounting policy for accrual of legal costs is to recognize such expenses as incurred.

Securities Litigation

On September 26, 2018, Caryl Hull Leavitt, individually and on behalf of all others similarly situated, filed a class action complaint for violation of federal securities laws against us, our Chief Executive Officer and our former Chief Financial Officer in the United States District Court for the Southern District of New York. By stipulation of the parties and Order of the Court dated November 20, 2018, the action was transferred to the United States District Court for the District of Massachusetts. On May 8, 2019, the Court entered an order appointing a lead plaintiff, and on July 3, 2019, lead plaintiff filed a consolidated class action complaint, or the Complaint. In addition to the originally named defendants, the Complaint also named as defendants certain of our other executive officers, and purported to be brought on behalf of a class of persons who acquired our securities between September 20, 2017 and September 12, 2018 and sought to recover damages caused by defendants' alleged violations of the federal securities laws and to pursue remedies under Sections 10(b) and 20(a) of the Securities Exchange Act of 1934, as amended, and Rule 10b-5 promulgated thereunder. The Complaint alleged, among other things, that the defendants made materially false and misleading statements related to the efficacy and safety of our product, ONPATTRO. The plaintiff sought, among other things, the designation of this action as a class action, an award of unspecified compensatory damages, interest, costs and expenses, including counsel fees and expert fees, and other relief as the court deems appropriate. All defendants filed a motion to dismiss the Complaint in its entirety on July 31, 2019. The motion to dismiss was fully briefed on September 30, 2019. On March 23, 2020, the Court allowed our motion and dismissed the Complaint without prejudice. On April 13, 2020, the plaintiff filed a motion seeking to amend the judgment to permit the plaintiff to file a further amended complaint. Defendants filed an opposition to that motion on April 17, 2020.

On September 12, 2019, the Chester County Employees Retirement Fund, individually and on behalf of all others similarly situated, filed a purported securities class action complaint for violation of federal securities laws against us, certain of our current and former directors and officers, and the underwriters of our November 14, 2017 public stock offering, in the Supreme Court of the State of New York, New York County. On November 7, 2019, plaintiff filed an amended complaint, or the New York Complaint. The New York Complaint is brought on behalf of an alleged class of those who purchased our securities pursuant and/or traceable to our November 14, 2017 public stock offering. The New York Complaint purports to allege claims arising under Sections 11, 12(a)(2) and 15 of the Securities Act of 1933, as amended, and generally alleges that the defendants violated the federal securities laws by, among other things, making material misstatements or omissions concerning the results of our APOLLO Phase 3 clinical trial of patisiran. The plaintiff seeks, among other things, the designation of the action as a class action, an award of unspecified compensatory damages, rescissory damages, interest, costs and expenses, including counsel fees and expert fees, and other relief as the court deems appropriate. All defendants filed a joint motion to dismiss the New York Complaint in its entirety on December 20, 2019. Plaintiff's response to that motion was filed on February 3, 2020, and defendants filed a joint reply on March 4, 2020. Defendants' motion remains pending.

We believe that the allegations contained in the complaints are without merit and intend to defend the cases vigorously. We cannot predict at this point the length of time that these actions will be ongoing or the liabilities, if any, which may arise therefrom.

14. DEFINED BENEFIT PLANS

We maintain defined benefit plans for employees in certain countries outside the U.S., including retirement benefit plans required by applicable local law. The unfunded benefit obligation corresponds to the projected benefit obligations of which the discounted net present value is calculated based on years of employment, expected salary increases and pension adjustments, offset by the fair value of the assets held by plan. The unfunded benefit obligation was approximately $4.3 million as of March 31, 2020 and December 31, 2019, and is recorded in other liabilities on the condensed consolidated balance sheet. The total net periodic benefit cost for the three months ended March 31, 2020 and 2019 was not material.

15. SUBSEQUENT EVENTS

On April 10, 2020, we entered into a broad strategic financing collaboration with the Blackstone Group Inc., or Blackstone, under which Blackstone will provide up to $2.0 billion to support our advancement of innovative RNAi medicines that have the potential to transform the lives of patients suffering from a range of debilitating diseases. The strategic financing collaboration includes: (1) $1.0 billion in committed payments to acquire 50% of royalties and 75% of commercial milestones payable to us in connection with sales of inclisiran; (2) up to $750.0 million in a first lien senior secured term loan; (3) up to $150.0 million for development of vutrisiran and ALN-AGT, subject to completion of a definitive agreement; and (4) the purchase of $100.0 million of our common stock.

ITEM 2. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS.

Overview

We are a global commercial-stage biopharmaceutical company developing novel therapeutics based on RNA interference, or RNAi. RNAi is a naturally occurring biological pathway within cells for sequence-specific silencing and regulation of gene expression. By harnessing the RNAi pathway, we have developed a new class of innovative medicines, known as RNAi therapeutics. RNAi therapeutics are comprised of small interfering RNA, or siRNA, and function upstream of conventional medicines by potently silencing messenger RNA, or mRNA, that encode for disease-causing proteins, thus preventing them from being made. We believe this is a revolutionary approach with the potential to transform the care of patients with genetic and other diseases. To date, our efforts to advance this revolutionary approach have yielded the approval of two first-in-class RNAi-based medicines, ONPATTRO® (patisiran) and GIVLAARI® (givosiran).

Our research and development strategy is to target genetically validated genes that have been implicated in the cause or pathway of human disease. We utilize a lipid nanoparticle (LNP) or N-acetylgalactosamine (GalNAc) conjugate approach to enable hepatic delivery of siRNAs. For delivery to the central nervous system, or CNS, and the eye (ocular delivery), we are utilizing an alternative conjugate approach. Our focus is on clinical indications where there is a high unmet need, early biomarkers for the assessment of clinical activity in Phase 1 clinical studies, and a definable path for drug development, regulatory approval, patient access and commercialization.

We continue to execute on our *Alnylam 2020* strategy of building a multi-product, global, commercial biopharmaceutical company with a deep and sustainable clinical pipeline of RNAi therapeutics for future growth and a robust, organic research engine for sustainable innovation and great potential for patient impact. Based on our accomplishments to-date, we are confident we will achieve our *Alnylam 2020* goals by the end of 2020. Specifically, our broad pipeline of investigational RNAi therapeutics is focused in four Strategic Therapeutic Areas, or "STArs:" Genetic Medicines; Cardio-Metabolic Diseases; Hepatic Infectious Diseases; and CNS/Ocular Diseases. We now have two marketed products that are within the Genetic Medicines STAr, ONPATTRO and GIVLAARI. ONPATTRO is approved by the United States Food and Drug Administration, or FDA, for the treatment of the polyneuropathy of hereditary transthyretin-mediated amyloidosis, or hATTR amyloidosis, in adults and has also been approved in the European Union, or EU, for the treatment of hATTR amyloidosis in adult patients with stage 1 or stage 2 polyneuropathy, Japan for the treatment of transthyretin, or TTR, type familial amyloidosis with polyneuropathy, and in several additional countries. Regulatory filings in other territories are pending and additional filings are planned for 2020. In November 2019, we received regulatory approval for GIVLAARI from the FDA for the treatment of adults with acute hepatic porphyria, or AHP, and in March 2020, GIVLAARI was granted marketing authorisation by the European Commission, or EC, for the treatment of AHP in adults and adolescents aged 12 years and older. We have also filed a marketing authorisation application, or MAA, for givosiran (the non-branded drug name for GIVLAARI) in Brazil and additional regulatory filings are planned for 2020 and beyond.

We have six late-stage investigational programs, advancing toward potential commercialization. These programs include our wholly owned programs: givosiran for the treatment of adolescent patients with AHP, lumasiran for the treatment of primary hyperoxaluria type 1, or PH1, patisiran (the non-branded drug name for ONPATTRO) for the treatment of transthyretin amyloidosis, or ATTR amyloidosis, with cardiomyopathy, and vutrisiran for the treatment of ATTR amyloidosis. Inclisiran for the treatment of hypercholesterolemia and atherosclerotic cardiovascular disease, or ASCVD, is being advanced by our partner, The Medicines Company (acquired by Novartis AG in January 2020), or MDCO, and fitusiran for the treatment of hemophilia is being advanced by our partner Sanofi Genzyme, the specialty care global business unit of Sanofi.

In December 2019, we reported positive topline results from our ILLUMINATE-A Phase 3 clinical trial for lumasiran, our investigational RNAi therapeutic targeting glycolate oxidase, for the treatment of PH1, and in April 2020, based on the positive ILLUMINATE-A data, we submitted a New Drug Application, or NDA, which was accepted by the FDA. Additionally, in April 2020, we announced that we had submitted an MAA for lumasiran with the European Medicines Agency, or EMA. Lumasiran was previously granted an accelerated assessment by the EMA.

Based on our expertise in RNAi therapeutics and broad intellectual property estate, we have formed alliances with leading pharmaceutical and life sciences companies to support our development and commercialization efforts, including Regeneron Pharmaceuticals, Inc., or Regeneron, MDCO, Sanofi Genzyme, Vir Biotechnology, Inc., or Vir, and Dicerna Pharmaceuticals, Inc., or Dicerna.

In March 2020, we announced an expansion of our exclusive licensing agreement with Vir for the development and commercialization of RNAi therapeutics for infectious diseases to include the development and commercialization of RNAi therapeutics targeting SARS-CoV-2, the virus that causes the disease COVID-19. In April 2020, we further expanded our collaboration with Vir to include up to three human host factor targets relating to susceptibility to coronaviruses, for use in connection with the treatment, palliation, diagnosis or prevention of SARS-CoV-2 and other diseases caused by coronaviruses.

In April 2020, we and Dicerna formed a development and commercialization collaboration on investigational RNAi therapeutics for the treatment of alpha-1 antitrypsin deficiency-associated liver disease, or alpha-1 liver disease. In addition, in

April 2020, we and Dicerna entered into a Patent Cross-License Agreement, pursuant to which each party agreed to cross-license its respective intellectual property related to our lumasiran and Dicerna's nedosiran investigational programs for the treatment of primary hyperoxaluria.

In April 2020, we entered into a strategic financing collaboration with The Blackstone Group Inc., or Blackstone, to accelerate our advancement of RNAi therapeutics. In connection with the collaboration, Blackstone and its affiliates will provide us up to $2.0 billion in financing, including $1.0 billion in committed payments to acquire 50% of royalties and 75% of commercial milestones payable to us in connection with sales of inclisiran, up to $750.0 million in a first lien senior secured term loan, up to $150.0 million towards the development of vutrisiran and ALN-AGT, subject to completion of a definitive agreement and a purchase of $100.0 million our common stock.

We have incurred significant losses since we commenced operations in 2002 and expect such losses to continue for the foreseeable future. As of March 31, 2020, we had an accumulated deficit of $3.91 billion. Historically, we have generated losses principally from costs associated with the establishment of late-stage clinical and commercial capabilities, including global commercial operations, research and development activities, acquiring, filing and expanding intellectual property rights, and selling, general and administrative costs. While we believe 2019 was our peak net loss year, and believe the funding provided by Blackstone should enable us to achieve a self-sustainable financial profile without the need for future equity financing, we expect to continue to incur annual net operating losses for the foreseeable future as we expand our efforts to discover, develop and commercialize RNAi therapeutics. We also anticipate that our operating results will fluctuate for the foreseeable future. Therefore, period-to-period comparisons should not be relied upon as predictive of the results in future periods.

We currently have programs focused on a number of therapeutic areas and as of March 31, 2020, we are generating net revenue from product sales for two marketed products, ONPATTRO and GIVLAARI. However, our ongoing development efforts may not be successful and we may not be able to commence sales of any other products and/or successfully market and sell ONPATTRO, GIVLAARI or any other approved products in the future. A substantial portion of our total revenues in recent years has been derived from collaboration revenues from strategic alliances with Regeneron, Sanofi Genzyme and MDCO. In addition to revenues from the commercial sales of ONPATTRO and GIVLAARI and potentially from sales of future products, we expect our sources of potential funding for the next several years to continue to be derived in part from existing and new strategic alliances, which may include license and other fees, funded research and development, milestone payments and royalties on product sales by our licensees, as well as funding due or available to us under our strategic financing collaboration with Blackstone.

The COVID-19 Pandemic

In March 2020, the World Health Organization declared the outbreak of a novel strain of coronavirus, or COVID-19, as a pandemic, which continues to spread throughout the U.S. and worldwide. We could be materially and adversely affected by the risks, or the public perception of the risks, related to an epidemic, pandemic, outbreak, or other public health crisis, such as the recent outbreak of COVID-19. We are monitoring the global outbreak and spread of COVID-19 and have taken steps to identify and mitigate the adverse impacts on, and risks to, our business posed by its spread and actions taken by governmental and health authorities to address the COVID-19 pandemic. The spread of COVID-19 has caused us to modify our business practices, including implementing a global work from home policy for all employees who are able to perform their duties remotely and restricting all nonessential travel, and we expect to continue to take actions as may be required or recommended by government authorities or as we determine are in the best interests of our employees, the patients we serve and other business partners in light of COVID-19. Given the fluidity of the COVID-19 pandemic however, we do not yet know the full extent of the potential impact of COVID-19 on our business operations. The ultimate extent of the impact of any epidemic, pandemic, outbreak, or other public health crisis on our business, financial condition and results of operations will depend on future developments, which are highly uncertain and cannot be predicted, including new information that may emerge concerning the severity of such epidemic, pandemic, outbreak, or other public health crisis and actions taken to contain or prevent the further spread, among others. Accordingly, we cannot predict the extent to which our business, financial condition and results of operations will be affected. We remain focused on maintaining a strong balance sheet, liquidity and financial flexibility and continue to monitor developments as we deal with the disruptions and uncertainties from a business and financial perspective relating to COVID-19. We will continue to work diligently with our partners and stakeholders to continue supporting patient access to our approved medicines, advancing our product candidates under regulatory review as well as in our clinical studies to the extent safe to do so for patients, caregivers and healthcare practitioners, and ensuring the continuity of our manufacturing and supply chain. For additional information related to the potential impact of COVID-19 on our business, please read Part II, Item 1A, "Risk Factors" of this Quarterly Report on Form 10-Q.

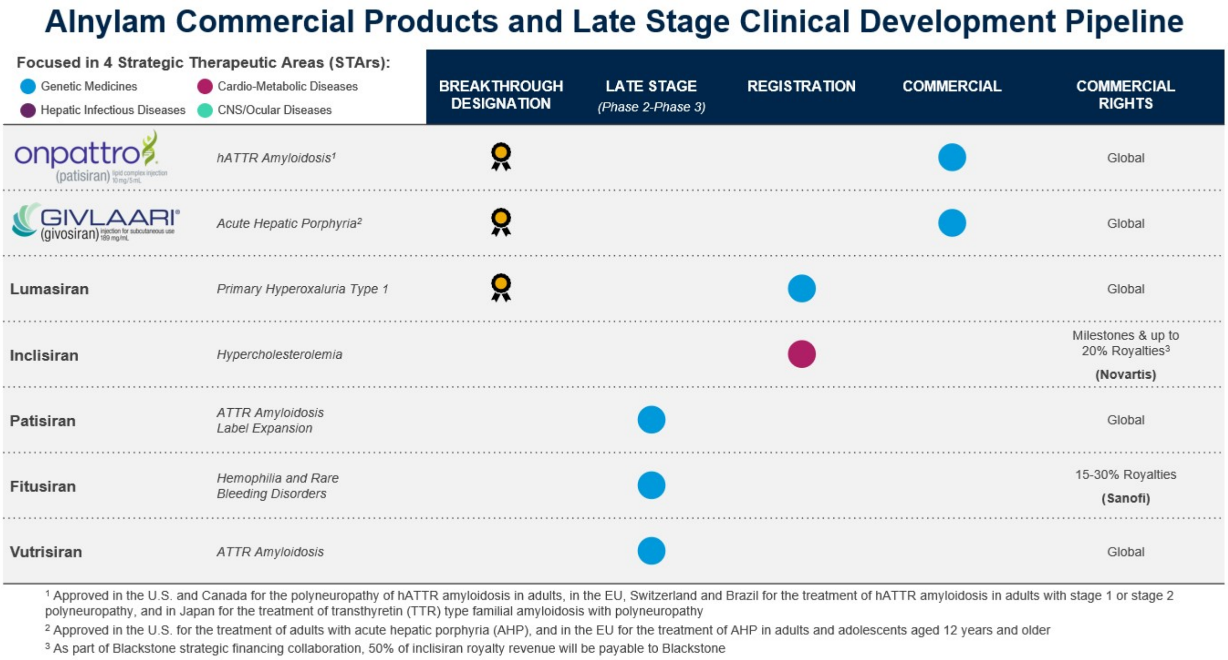
Research and Development

Since our inception, we have focused on drug discovery and development programs. Research and development expenses represent a substantial percentage of our total operating expenses, as reflected by our broad pipeline of clinical development programs, which includes multiple programs in late-stage development.

Our broad pipeline, including two approved products and multiple investigational RNAi therapeutics across all stages of development, is focused in four STArs: Genetic Medicines; Cardio-Metabolic Diseases; Hepatic Infectious Diseases; and CNS/Ocular Diseases.

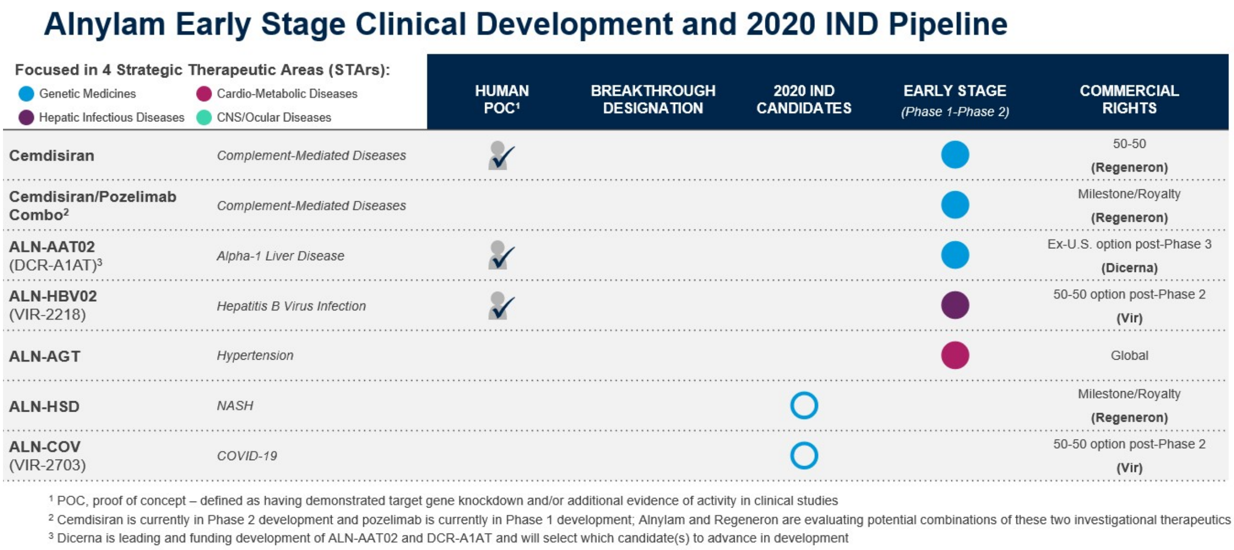
Commercial Products and Late-Stage Clinical Development Pipeline

The chart below is a summary of our commercial products and late-stage development programs as of May 5, 2020. It identifies those programs for which we have received marketing approval, those programs for which we have received Breakthrough Therapy Designation from the FDA, the stage of these programs and our commercial rights to such programs:



Early-Stage Clinical Development Pipeline

The chart below is a summary of our early-stage development programs as of May 5, 2020. It identifies those programs in which we have achieved human proof-of-concept, or POC, by demonstrating target gene knockdown and/or additional evidence of activity in clinical studies, the stage of these programs, and our commercial rights to such programs, as well as programs which we believe could result in an IND or CTA filing in 2020:



During the first quarter of 2020 and recent period, we reported the following updates from ONPATTRO and GIVLAARI commercialization and our late-stage clinical programs:

Commercial

ONPATTRO

- We achieved ONPATTRO net product revenues for the first quarter of 2020 of $66.7 million, and received marketing authorization approval for ONPATTRO in Brazil, and continued progress with market access efforts with recent launches in Italy, Sweden, Israel, Turkey, and Spain.

GIVLAARI

- We achieved GIVLAARI net product revenues for the first quarter of 2020 of $5.3 million, and received marketing authorization approval for GIVLAARI in the EU, and continued progress with market access efforts with initial launch underway.

Late-Stage Clinical Development

- We continued to advance the development of patisiran (the non-proprietary name for ONPATTRO) for the potential treatment of the cardiomyopathy of both hereditary and wild-type ATTR amyloidosis:
  - Continued enrollment in the APOLLO-B Phase 3 study in ATTR amyloidosis patients with cardiomyopathy; and
  - Announced that due to the impact of the COVID-19 pandemic, enrollment delays in APOLLO-B will result in a shift in the enrollment completion date from late 2020 into 2021.
- We continued to advance lumasiran, an investigational RNAi therapeutic in development for the treatment of PH1:
  - Initiated and completed the rolling submission of an NDA to the FDA and submitted an MAA to the EMA;
  - Completed enrollment in the ILLUMINATE-B Phase 3 study in PH1 patients less than six years of age with preserved renal function, and remain on track to report topline results in mid-2020; and
  - Continued enrollment in the ILLUMINATE-C Phase 3 study of lumasiran for the treatment of advanced PH1 in patients of all ages.
- We continued to advance vutrisiran, a subcutaneously administered investigational RNAi therapeutic in development for the treatment of ATTR amyloidosis:
  - Completed enrollment in the HELIOS-A Phase 3 study in patients with hereditary ATTR amyloidosis with polyneuropathy, and remain on track to report topline results in early 2021;
  - Received Fast Track Designation from the FDA for the treatment of the polyneuropathy of hATTR amyloidosis; and
  - Continued enrollment in the HELIOS-B Phase 3 study in patients with hereditary and wild-type ATTR amyloidosis with cardiomyopathy.
- Inclisiran, potentially the first and only siRNA cholesterol-lowering treatment, continued to advance under our partner, MDCO (which was acquired by Novartis AG in January 2020), with acceptance of the NDA and MAA for inclisiran by the FDA and EMA, respectively.
- Our partner, Sanofi Genzyme, continued enrollment in the ATLAS Phase 3 program for fitusiran in patients with hemophilia A or B with and without inhibitors, with topline results expected in the first half of 2021.

There is a risk that any drug discovery or development program may not produce revenue for a variety of reasons, including the possibility that we will not be able to adequately demonstrate the safety and effectiveness of the product candidate. Moreover, there are uncertainties specific to any new field of drug discovery, including RNAi. The success of ONPATTRO, GIVLAARI or any other product candidate we develop is highly uncertain. Due to the numerous risks associated with developing drugs, including those risks associated with the COVID-19 pandemic, we cannot reasonably estimate or know the nature, timing and estimated costs of the efforts necessary to complete the development of any potential product candidate or indication, or the period, if any, in which material net cash inflows will commence from any approved product or indication. Any failure to complete any stage of the development of any potential products or any approved product for an expanded indication in a timely manner or successfully launch, market and sell any approved product, including ONPATTRO and GIVLAARI, could have a material adverse effect on our operations, financial position and liquidity. A discussion of some of the risks and uncertainties associated with completing our projects on schedule, or at all, and the potential consequences of failing to do so, are set forth in Part II, Item 1A below under the heading "Risk Factors."

Strategic Alliances

Our business strategy is to develop and commercialize a broad pipeline of RNAi therapeutic products directed towards our four STArs. As part of this strategy, we have entered into, and expect to enter into additional, collaboration and licensing agreements as a means of obtaining resources, capabilities and funding to advance our investigational RNAi therapeutic programs.

Our collaboration strategy is to form alliances that create significant value for ourselves and our collaborators in the advancement of RNAi therapeutics as a new class of innovative medicines. Specifically, with respect to our CNS/Ocular Disease pipeline, in April 2019, we entered into a global, strategic collaboration with Regeneron to discover, develop and commercialize RNAi therapeutics for a broad range of diseases by addressing disease targets expressed in the eye and CNS, in addition to a select number of targets expressed in the liver.

With respect to our Cardio-Metabolic pipeline, in March 2013, we entered into an exclusive, worldwide license with MDCO (acquired by Novartis AG in January 2020) pursuant to which MDCO was granted the right to develop, manufacture and commercialize RNAi therapeutics targeting PCSK9 for the treatment of hypercholesterolemia and other human diseases, including inclisiran. In March 2018, we entered into a discovery collaboration with Regeneron to identify RNAi therapeutics for nonalcoholic steatohepatitis, or NASH, and potentially other related diseases, and in November 2018, we and Regeneron entered into a separate, fifty-fifty collaboration to further research, co-develop and commercialize any therapeutic product candidates that emerge from these discovery efforts. In April 2020, we entered into a development and commercialization collaboration with Dicerna to advance investigational RNAi therapeutics for the treatment of alpha-1 liver disease.

With respect to our Hepatic Infectious Disease pipeline, in October 2017, we announced an exclusive licensing agreement with Vir for the development and commercialization of RNAi therapeutics for infectious diseases, including chronic hepatitis B virus, or HBV, infection. In March 2020, we announced an expansion of our exclusive licensing agreement with Vir to include the development and commercialization of RNAi therapeutics targeting SARS-CoV-2, the virus that causes the disease COVID-19. In April 2020, we further expanded our broad multi-target existing collaboration for the development and commercialization of RNAi therapeutics for infectious diseases to include up to three additional targets focused on host factors for SARS-CoV-2, including angiotensin converting enzyme-2, or ACE2, and transmembrane protease, serine 2, or TMPRSS2.

With respect to our Genetic Medicine pipeline, we formed a broad strategic alliance with Sanofi Genzyme in 2014. In January 2018, we and Sanofi Genzyme amended our 2014 collaboration and entered into the Exclusive License Agreement, referred to as the Exclusive TTR License, under which we have the exclusive right to pursue the further global development and commercialization of all TTR products, including ONPATTRO, vutrisiran and any back-up products, and the ALN-AT3 Global License Terms, referred to as the AT3 License Terms, under which Sanofi Genzyme has the exclusive right to pursue the further global development and commercialization of fitusiran and any back-up products. In April 2019, we and Sanofi Genzyme agreed to further amend the 2014 Sanofi Genzyme collaboration to conclude the research and option phase and to amend and restate the AT3 License Terms to modify certain of the business terms.

Critical Accounting Policies and Estimates

Our critical accounting policies are described in the "Management's Discussion and Analysis of Financial Condition and Results of Operations" section of our Annual Report on Form 10-K for the year ended December 31, 2019, which we filed with the SEC on February 13, 2020. There have been no significant changes to our critical accounting policies since the beginning of this fiscal year.

Results of Operations

The following data summarizes the results of our operations:

(In thousands, except percentages)	Three Months Ended March 31, 2020	2019	Dollar Change	% of Change
Total revenues	$ 99,476	$ 33,294	$ 66,182	199 %
Operating costs and expenses	$ 309,634	$ 222,082	$ 87,552	39 %
Loss from operations	$ (210,158)	$ (188,788)	$ (21,370)	11 %
Total other income	$ 28,512	$ 7,568	$ 20,944	277 %
Net loss	$ (182,221)	$ (181,915)	$ (306)	— %

Discussion of Results of Operations

Revenues

Total revenues consist of the following:

(In thousands, except percentages)	Three Months Ended March 31, 2020	2019	Dollar Change	% of Change
Net product revenues	$ 71,938	$ 26,291	$ 45,647	174 %
Net revenues from collaborations	27,538	7,003	20,535	293 %
Total	$ 99,476	$ 33,294	$ 66,182	199 %

Net product revenues

Net product revenues consist of the following, by region:

(In thousands, except percentages)	Three Months Ended March 31, 2020	2019	Dollar Change	% of Change
United States	$ 42,470	$ 18,760	$ 23,710	126 %
Europe	21,166	7,531	13,635	181 %
Rest of World (primarily Japan)	8,302	—	8,302	N/A
Total	$ 71,938	$ 26,291	$ 45,647	174 %

Net product revenues consist of the following, by product:

(In thousands, except percentages)	Three Months Ended March 31, 2020	2019	Dollar Change	% of Change
ONPATTRO	$ 66,664	$ 26,291	$ 40,373	154 %
GIVLAARI	5,274	—	5,274	N/A
Total	$ 71,938	$ 26,291	$ 45,647	174 %

Net product sales increased during the three months ended March 31, 2020 as compared to the three months ended March 31, 2019, as a result of the continued, global expansion of ONPATTRO, in addition to sales generated from our second marketed product, GIVLAARI, subsequent to FDA approval and commercial launch in November and December 2019, respectively.

We anticipate net product revenues to decrease during the three months ended June 30, 2020 in comparison to the three months ended March 31, 2020 due to the impact from the COVID-19 pandemic, however, we expect net product revenues to increase for the twelve-month period ending December 31, 2020, as compared to the same twelve-month period in 2019, as we continue to add new patients onto ONPATTRO and GIVLAARI therapy, as well as launch our approved products into additional markets, assuming regulatory approvals.

Net revenues from collaborations

Net revenues from collaborations consist of the following:

(In thousands, except percentages)	Three Months Ended March 31, 2020	2019	Dollar Change	% of Change
Regeneron	$ 19,503	$ —	$ 19,503	N/A
Vir	6,516	928	5,588	602 %
MDCO	1,060	1,745	(685)	(39) %
Sanofi Genzyme	—	4,117	(4,117)	(100) %
Other	459	213	246	115 %
Total	$ 27,538	$ 7,003	$ 20,535	293 %

Net revenues from collaborations increased during the three months ended March 31, 2020 as compared to the three months ended March 31, 2019 primarily due to an increase in revenues recognized in connection with our collaboration agreement with Regeneron.

We expect net revenues from collaborations to increase for the twelve-month period ending December 31, 2020, as compared to the same twelve-month period in 2019, primarily due to increased reimbursable activities and milestones under our existing collaborations, as well as an increase in revenues to be recognized in connection with our collaborations with Regeneron and Vir.

Operating Costs and Expenses

Operating costs and expenses consist of the following:

	Three Months Ended March 31,			
(In thousands, except percentages)	**2020**	**2019**	**Dollar Change**	**% of Change**
Cost of goods sold	$ 13,302	$ 3,347	$ 9,955	297 %
Research and development	169,571	129,127	40,444	31 %
Selling, general and administrative	126,761	89,608	37,153	41 %
Total	$ 309,634	$ 222,082	$ 87,552	39 %

Cost of goods sold. Cost of goods sold includes the cost of producing and distributing inventories that are related to product revenues, third-party royalties, and amortization of licensing rights. Cost of goods sold increased during the three months ended March 31, 2020, as compared to the same period in the prior year, due to the increase in net product revenues and an increase in sales of capitalized inventory. Based on our policy, we record costs associated with the manufacturing of our products as research and development expense prior to FDA approval or until we expect that these costs will be recoverable through commercialization of our products (zero-cost inventory). Certain units of product sold and recognized as revenue during the three months ended March 31, 2020 and 2019 were zero-cost inventory and therefore the cost of goods sold for the three months ended March 31, 2020 and 2019 reflects only a portion of the manufacturing cost of our commercial products. We will continue to sell our zero-cost inventory of GIVLAARI throughout 2020. We anticipate variability in our cost of goods sold as a percentage of net product revenues due to the timing of manufacturing runs and utilization and the depletion of zero-cost inventories, as well as future product launches.

We expect that cost of goods sold will increase for the twelve-month period ending December 31, 2020, as compared to the same twelve-month period in 2019, primarily as a result of an expected increase in net product sales as well as the sale of capitalized inventory.

Research and development. Research and development expenses consist on the following:

	Three Months Ended March 31,			
(In thousands, except percentages)	**2020**	**2019**	**Dollar Change**	**% of Change**
Clinical trial and manufacturing	$ 56,525	$ 34,601	$ 21,924	63 %
Compensation and related	48,163	36,377	11,786	32 %
External services	17,661	13,530	4,131	31 %
Stock-based compensation	16,049	16,125	(76)	(0)%
Facilities-related	15,701	12,227	3,474	28 %
Lab supplies, materials, and other	13,059	8,667	4,392	51 %
License Fees	2,413	7,600	(5,187)	(68)%
Total	$ 169,571	$ 129,127	$ 40,444	31 %

For the three months ended March 31, 2020, the increase in research and development expenses, as compared to the same period in the prior year, was primarily related to the following:

- Increased clinical trials and manufacturing and lab supplies, materials and other expenses as a result of increased preclinical and clinical services related to the advancement of our early- and late-stage programs to support our long-term strategic goals; and
- Increased compensation and related expenses as a result of growth in headcount to support our goals for 2020.

During the three months ended March 31, 2020 and 2019, in connection with advancing activities under our collaboration agreements, we incurred research and development expenses, primarily related to external development and manufacturing services. The following table summarizes research and development expenses incurred, for which we recognize net revenue, that are directly attributable to our collaboration agreements, by collaboration partner:

(In thousands)	Three Months Ended March 31, 2020	2019
Regeneron	$ 16,103	$ —
Vir	2,084	659
MDCO	1,264	1,672
Sanofi Genzyme	248	5,020
Total	$ 19,699	$ 7,351

Selling, general and administrative. Selling, general and administrative expenses consist of the following:

(In thousands, except percentages)	Three Months Ended March 31, 2020	2019	Dollar Change	% of Change
Compensation and related	$ 46,829	$ 30,123	$ 16,706	55 %
Consulting and professional services	38,992	25,826	13,166	51 %
Facilities-related and other	22,411	17,752	4,659	26 %
Stock-based compensation	18,529	15,907	2,622	16 %
Total	$ 126,761	$ 89,608	$ 37,153	41 %

For the three months ended March 31, 2020, the increase in selling, general and administrative expenses, as compared to the same period in the prior year, was primarily related to the following:

- Increased compensation and related and consulting and professional services expenses as a result of increased overall corporate headcount to support long-term strategic growth, and the continued commercialization of ONPATTRO and GIVLAARI.

We expect that research and development expenses combined with selling, general and administrative expenses will increase for the twelve-month period ending December 31, 2020, as compared to the same twelve-month period in 2019, as we continue to develop our pipeline, advance our product candidates, including partnered programs, into later-stage development, prepare regulatory submissions and build-out of our global commercial infrastructure and field team to support ONPATTRO, GIVLAARI and potentially additional product launches, However, we expect that certain expenses will be variable depending on the timing of manufacturing batches, clinical trial enrollment and results, regulatory review of our product candidates and programs, and stock-based compensation expenses due to our determination regarding the probability of vesting for performance-based awards.

Total Other Income. For the three months ended March 31, 2020, total other income increased, as compared to the same period in the prior year, primarily due to unrealized gains in marketable equity securities of $24.1 million.

Liquidity and Capital Resources

The following table summarizes our cash flow activities:

(In thousands)	Three Months Ended March 31, 2020	2019
Net loss	$ (182,221)	$ (181,915)
Adjustments to reconcile net loss to net cash used in operating activities	28,133	45,050
Changes in operating assets and liabilities	(92,073)	(51,645)
Net cash used in operating activities	(246,161)	(188,510)
Net cash provided by investing activities	113,688	102,652
Net cash provided by financing activities	53,869	390,931
Effect of exchange rate changes on cash, cash equivalents and restricted cash	(631)	—
Net (decrease) increase in cash, cash equivalents and restricted cash	(79,235)	305,073
Cash, cash equivalents and restricted cash, beginning of period	549,628	422,631
Cash, cash equivalents and restricted cash, end of period	$ 470,393	$ 727,704

Since we commenced operations in 2002, we have generated significant losses. As of March 31, 2020, we had an accumulated deficit of $3.91 billion. As of March 31, 2020, we had cash, cash equivalents and marketable debt and equity securities of $1.34 billion, compared to $1.54 billion as of December 31, 2019.

Operating activities

Net cash used in operating activities increased during the three months ended March 31, 2020, compared to the same period in 2019, primarily due to the increase in our operating expenses to support overall growth offset by certain non-cash adjustments, including the unrealized gain from our marketable equity securities, as well as changes in certain operating assets and liabilities due to the timing of receipts on accounts receivable, buildup of inventory or payments of prepaid expenses and other assets.

Investing activities

Net cash provided by investing activities increased during the three months ended March 31, 2020, compared to the same period in the prior year, primarily due to a decrease in purchases of property, plant and equipment partially offset by an increase of restricted cash collateral to support letters of credit.

Financing activities

Net cash provided by financing activities decreased during the three months ended March 31, 2020, compared to the same period in 2019, primarily due to net proceeds of $381.9 million received from our January 2019 underwritten public offering, for which similar financing did not occur in 2020, offset by an increase in cash received from the exercise of employee stock options.

Operating Capital Requirements

We currently have programs focused on a number of therapeutic areas and, as of March 31, 2020, have two globally marketed products, ONPATTRO and GIVLAARI. However, our ongoing development efforts may not be successful and we may not be able to commence sales of any other products in the future. In addition, we anticipate that we will continue to generate significant losses for the foreseeable future as a result of planned expenditures for research and development activities relating to our research platform, our drug development programs, including clinical trial and manufacturing costs, the establishment of late-stage clinical and commercial capabilities, including global operations, continued management and growth of our intellectual property including our patent portfolio, collaborations and general corporate activities.

Based on our current operating plan, we believe that our cash, cash equivalents and marketable debt and equity securities as of March 31, 2020, together with the cash we expect to generate from product sales, and under our current alliances, as well as the funds due or available to us a result of the strategic financing collaboration with Blackstone, will be sufficient to enable us to advance our long-term strategic goals for multiple years from the filing of this Quarterly Report on Form 10-Q.

Although we believe the strategic financing collaboration with Blackstone will enable us to achieve a self-sustainable financial profile without the need for further equity financing, in the future, we may seek additional funding through new collaborative arrangements, public or private debt financings, royalty or other monetization transactions or a combination of one or more of these funding sources. Additional funding may not be available to us on acceptable terms or at all. Moreover, the terms of any additional financing may adversely affect the holdings or the rights of our stockholders.

Contractual Obligations and Commitments

The disclosure of our contractual obligations and commitments is set forth under the heading “Management’s Discussion and Analysis of Financial Condition and Results of Operations—Contractual Obligations” in our Annual Report on Form 10-K for the year ended December 31, 2019. There have been no material changes in our contractual obligations and commitments since December 31, 2019.

Recent Accounting Pronouncements

Please read Note 2 to our condensed consolidated financial statements included in Item 1, “Financial Statements (Unaudited),” of this Quarterly Report on Form 10-Q for a description of recent accounting pronouncements applicable to our business.

ITEM 3. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK.

Financial market risks related to interest rates are described in our Annual Report on Form 10-K for the year ended December 31, 2019. As of March 31, 2020, there have been no significant changes to the financial market risks described as of December 31, 2019. We do not currently anticipate any other near-term changes in the nature of our financial market risk exposures or in management’s objectives and strategies with respect to managing such exposures.

ITEM 4. CONTROLS AND PROCEDURES.

Disclosure Controls and Procedures

Our management, with the participation of our Chief Executive Officer (principal executive officer) and executive vice president, Chief Financial Officer (principal financial officer), evaluated the effectiveness of our disclosure controls and procedures as of March 31, 2020. The term “disclosure controls and procedures,” as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act, means controls and other procedures of a company that are designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the 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 a company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the company’s management, including its principal executive and principal financial officers, as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on the evaluation of our disclosure controls and procedures as of March 31, 2020, our Chief Executive Officer and executive vice president, Chief Financial Officer concluded that, as of such date, our disclosure controls and procedures were effective at the reasonable assurance level.

Changes in Internal Control

There were no changes in our internal control over financial reporting during the quarter ended March 31, 2020 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

PART II. OTHER INFORMATION

ITEM 1. LEGAL PROCEEDINGS.

For a discussion of material pending legal proceedings, please read Note 14, Commitments and Contingencies – Litigation, to our condensed consolidated financial statements included in Part I, Item I, “Financial Statements (Unaudited),” of this Quarterly Report on Form 10-Q, which is incorporated into this item by reference.

ITEM 1A. RISK FACTORS

Risks Related to Our Business

Risks Related to Our Financial Results

The current pandemic of the novel coronavirus, or COVID-19, and the future outbreak of other highly infectious or contagious diseases, could have a material adverse impact on our business, financial condition and results of operations, including our commercial operations and sales, clinical trials and preclinical studies.

In December 2019, a novel strain of coronavirus, or COVID-19, was reported to have surfaced and it has now reached multiple regions, countries and cities, including Cambridge, Massachusetts where our primary office and laboratory space is located, and all countries in which we have offices. The COVID-19 pandemic is evolving, and to date has led to the implementation of various responses, including government-imposed quarantines, travel restrictions and other public health safety measures. The extent to which COVID-19 impacts our operations or those of our third-party partners will depend on future developments, which are highly uncertain and cannot be predicted with confidence, including the scope, severity and duration of such pandemic, the actions taken to contain the pandemic or mitigate its impact, and the direct and indirect economic effects of the pandemic and containment measures, among others. The rapid development and fluidity of this situation precludes any prediction as to the full adverse impact of the COVID-19 pandemic. Nevertheless, the COVID-19 pandemic may adversely affect our business, financial condition and results of operations.

In response to the spread of COVID-19, we have taken temporary precautionary measures intended to help minimize the risk of the virus to our employees and their families, including implementing a global work from home policy for all employees who are able to perform their duties remotely, and have generally restricted on-site staff to only those personnel and contractors who perform essential activities that need to be completed on-site and limited the number of staff in any given laboratory, manufacturing facility or other facility. We also suspended non-essential travel worldwide for our employees and may take further measures as the pandemic continues. In addition, our customer-facing employees in most markets have moved to virtual interactions with healthcare providers, administrators, patients, payers, regulators and other government employees. The effects of government-imposed quarantines and our work-from-home policies may negatively impact productivity , or disrupt, delay, or otherwise adversely impact our business. In addition, this could increase our cyber security risk, create data accessibility concerns, and make us more susceptible to communication disruptions, any of which could adversely impact our business operations.

As a result of the COVID-19 outbreak, we may experience disruptions that could severely impact our business and operations, including our ability to successfully commercialize our approved products, ONPATTRO and GIVLAARI, and due to the current pandemic, we may not be able to meet expectations with respect to commercial sales. For example, due to the impact of the COVID-19 pandemic, product revenues for ONPATTRO could potentially decrease by about 10% in the second quarter of 2020, and our ONPATTRO product revenues could be less than originally forecast for 2020. In addition, business interruptions from the current or future pandemics, including staffing shortages, production slowdowns and disruptions in delivery systems, may also adversely impact the third parties we or our partners rely on in the U.S. and abroad to sufficiently manufacture our approved products and to produce product candidates in quantities we require, which may impair our commercialization efforts, our research and development activities and the potential commercialization of our product candidates.

Additionally, timely completion of preclinical activities and initiation of planned clinical trials is dependent upon the availability of, for example, preclinical and clinical trial sites, researchers and investigators, patients or healthy volunteer subjects available for recruitment and enrollment, and regulatory agency personnel, which may be adversely affected by global health matters, such as the COVID-19 pandemic. We are conducting and plan to continue to conduct preclinical activities and clinical trials for our drug product candidates in geographies which have been and continue to be affected by COVID-19, and believe that the COVID-19 pandemic will have an impact on various aspects of our ongoing clinical trials and on the clinical and preclinical trials we expected to initiate in 2020. For example, certain trial sites in some of our ongoing clinical trials have been restricted temporarily by the institutions where they are located from scheduling patient visits or permitting onsite monitoring and in some of our ongoing trials, delayed or missed doses of study drug have been reported. In addition, in May 2020, we announced that due to the impact of the COVID-19 pandemic, enrollment delays in our APOLLO-B Phase 3 study of patisiran for the treatment of ATTR amyloidosis with cardiomyopathy will result in a shift in the enrollment completion date from late 2020 into 2021. We also announced that we plan to shift the filing of our IND for ALN-LEC into 2021 in order to focus on our COVID-19 investigational RNAi therapeutic program.

Health regulatory agencies globally may also experience disruptions in their operations as a result of the COVID-19 pandemic. The FDA and comparable foreign regulatory agencies may have slower response times or be under-resourced, which could significantly delay the FDA or EMA's ability to timely review and process any submissions we or our partners have filed or may file. For example, any delay by the FDA or EMA could impact the regulatory review of our NDA and MAA submissions for lumasiran or the NDA and MAA submissions for inclisiran, which is being advanced by our partner, MDCO, which could materially and adversely affect our business.

Some factors from the COVID-19 outbreak that may delay or otherwise adversely affect enrollment in and the conduct of the clinical trials of our product candidates, as well as adversely impact our business generally, include:

- the ongoing diversion of healthcare resources away from the conduct of clinical trials to focus on pandemic concerns, including the availability of necessary materials and the attention of physicians serving as our clinical trial investigators, hospitals serving as our clinical trial sites and hospital staff supporting the conduct of our clinical trials;
- limitations on travel that could interrupt key trial activities, such as clinical trial site initiations and monitoring, domestic and international travel by employees, contractors or patients to clinical trial sites, including any government-imposed travel restrictions or quarantines that will impact the ability or willingness of patients, employees or contractors to travel to our research, manufacturing and clinical trial sites or secure visas or entry permissions, any of which could delay or adversely impact the conduct or progress of our clinical trials;
- interruption or delays in the operations of the FDA and comparable foreign regulatory agencies, which may impact review, inspection and approval timelines;
- interruption of, or delays in receiving, supplies of our product candidates from our contract manufacturing organizations due to staffing shortages, production slowdowns or stoppages and disruptions in delivery systems; and
- business disruptions caused by potential workplace, laboratory and office closures and an increased reliance on employees working from home, disruptions to or delays in ongoing laboratory experiments and operations, staffing shortages, travel limitations, cyber security and data accessibility, or communication or mass transit disruptions, any of which could adversely impact our business operations or delay necessary interactions with local regulators, ethics committees, manufacturing sites, research or clinical trial sites and other important agencies and contractors.

These and other factors arising from the COVID-19 pandemic could worsen in countries that are already afflicted with COVID-19, could continue to spread to additional countries, or could return to countries where the pandemic has been partially contained, each of which could further adversely impact our ability to conduct clinical trials and our business generally, and could have a material adverse impact on our operations and financial condition and results. In addition, the trading prices for our common stock and the common stock of other biopharmaceutical companies have been highly volatile as a result of the COVID-19 pandemic. A recession, depression or other sustained adverse market event resulting from the COVID-19 pandemic could materially and adversely affect our business and the value of our common stock.

The global pandemic of COVID-19 continues to rapidly evolve. The ultimate impact of the recent COVID-19 pandemic is highly uncertain and subject to change. We do not yet know the full extent of potential delays or impacts on our business, our commercial results, clinical trials, healthcare systems or the global economy as a whole. These effects could have a material impact on our operations, and we will continue to monitor the COVID-19 situation closely.

We have limited experience as a commercial company and the marketing and sale of ONPATTRO, GIVLAARI or any future products may be unsuccessful or less successful than anticipated.

In 2018, our first commercial product, ONPATTRO, was approved by the FDA and EMA, and we have since received approval in several additional territories. To date, we have launched ONPATTRO in the U.S., Japan, Canada, Brazil and in several countries in Europe. In addition, in November 2019, the FDA approved our second product, GIVLAARI, which was also approved by the EMA in March 2020. While we have commercially launched ONPATTRO and GIVLAARI, we have limited experience as a commercial company and there is limited information about our ability to successfully overcome many of the risks and uncertainties encountered by companies commercializing products in the biopharmaceutical industry. We also have several product candidates in late-stage clinical development, including lumasiran, which is under review by the FDA and EMA for marketing approval. To execute our business plan of building a multi-product, commercial-stage biopharmaceutical company and achieving a self-sustainable financial profile in the future, in addition to successfully marketing and selling ONPATTRO and GIVLAARI, we will need to successfully:

- execute product development activities using new technologies related to both RNAi and to the delivery of siRNAs to the relevant tissues and cells;
- build and maintain a strong intellectual property portfolio;
- gain regulatory acceptance for the development and commercialization of our product candidates and market success for ONPATTRO and GIVLAARI, as well as any other products we commercialize;
- attract and retain customers for our products;

- develop and maintain successful strategic alliances; and
- manage our spending as costs and expenses increase due to clinical trials, regulatory approvals and commercialization.

If we are unsuccessful in accomplishing these objectives, we may not be able to develop product candidates, successfully commercialize ONPATTRO, GIVLAARI or any future products, including lumasiran, raise capital, if needed, repay the debt we plan to incur in 2020 and 2021, expand our business, achieve financial self-sustainability or continue our operations.

We have a history of losses and may never become and remain consistently profitable.

We have experienced significant operating losses since our inception. As of March 31, 2020, we had an accumulated deficit of $3.91 billion. Although to date we have launched ONPATTRO in the U.S. and several other countries globally, launched GIVLAARI in the U.S. and Germany, and expect to launch our commercially approved products in additional countries during 2020, we may never attain profitability or positive cash flow from operations. For the quarter ended March 31, 2020, we recognized $71.9 million in net product revenues from sales of ONPATTRO and GIVLAARI. While we believe 2019 was our peak net loss year, we expect to continue to incur annual net operating losses for the foreseeable future and will require substantial resources over the next several years as we expand our efforts to discover, develop and commercialize RNAi therapeutics, and aim to achieve a self-sustainable financial profile. While we believe the funding provided by Blackstone should enable us to achieve a self-sustainable profile without the need for future equity financing, we will depend on our ability to generate revenues to achieve this goal. In addition to revenues derived from sales of our current and future, if any, commercially approved products, we anticipate that a portion of any revenues we generate over the next several years will continue to be from alliances with pharmaceutical and biotechnology companies. We cannot be certain that we will be able to maintain our existing alliances or secure and maintain new alliances, or meet the obligations or achieve any milestones that we may be required to meet or achieve to receive payments under our existing or new alliances.

We believe that to become and remain consistently profitable, we must succeed in discovering, developing and commercializing novel drugs with significant market potential. This will require us to become and/or continue to be successful in a range of challenging activities, including pre-clinical testing and clinical trial stages of development, obtaining regulatory approval and reimbursement for these novel drugs and manufacturing, marketing and selling them. We may never succeed as a commercial company, and may never generate revenues that are significant enough to achieve profitability. Even if we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis. If we cannot become and remain consistently profitable, the market price of our common stock could decline. In addition, we may be unable to raise capital, expand our business, develop additional product candidates or continue our operations.

We will require substantial funds to continue our research, development and commercialization activities and if the funds we require are greater than what we have estimated, we may need to critically limit or significantly scale back or cease our operations.

We have used substantial funds to develop our RNAi technologies and will require substantial funds to conduct further research and development, including pre-clinical testing and clinical trials of our product candidates, and to manufacture, market and sell ONPATTRO, GIVLAARI and any other products that are approved for commercial sale, including lumasiran. Because the length of time or activities associated with successful development of our product candidates, including vutrisiran, may be greater than we anticipate, we are unable to estimate the actual funds we will require to develop and commercialize them.

We believe 2019 was our peak net loss year, and believe that our strategic financing collaboration with Blackstone will enable us to achieve a self-sustainable financial profile without need for future equity financing. However, our future capital requirements and the period for which we expect our existing resources to support our operations may vary from what we expect. We have based our expectations on a number of factors, many of which are difficult to predict or are outside of our control, including:

- our continued progress in demonstrating that siRNAs can be active as drugs and achieve desired clinical effects;
- progress in our research and development programs, as well as what may be required by regulatory bodies to advance these programs;
- the timing, receipt and amount of milestone and other payments, if any, from present and future collaborators, if any, including milestone payments related to inclisiran, which is being advanced by our partner, MDCO;
- our ability to maintain and establish additional collaborative arrangements and/or new business initiatives;
- the resources, time and costs required to successfully initiate and complete our pre-clinical and clinical studies, obtain regulatory approvals, prepare for global commercialization of our product candidates and obtain and maintain licenses to third-party intellectual property;
- our ability to establish, maintain and operate our own manufacturing facilities in a timely and cost-effective manner;

- our ability to manufacture, or contract with third parties for the manufacture of, our product candidates for clinical testing and commercial sale;
- the impact of COVID-19 on the initiation or completion of preclinical studies or clinical trials and the supply of our products or product candidates;
- the resources, time and cost required for the preparation, filing, prosecution, maintenance and enforcement of patent claims;
- the costs associated with legal activities, including litigation, arising in the course of our business activities and our ability to prevail in any such legal disputes;
- the timing, receipt and amount of sales and royalties, if any, from ONPATTRO and GIVLAARI and our other potential products, including lumasiran; and
- the outcome of the regulatory review process and commercial success of drug products for which we are entitled to receive royalties, including inclisiran.

If our estimates, predictions and financial guidance relating to these factors are incorrect, we may need to modify our operating plan and may be required to seek additional funding in the future. We may do so through either collaborative arrangements, public or private equity offerings or debt financings, royalty or other monetization transactions or a combination of one or more of these funding sources. Additional funds may not be available to us on acceptable terms or at all.

In April 2020, we entered into a credit agreement, or Credit Agreement, for up to $750.0 million among us, certain of our subsidiaries (together with us, the Loan Parties), funds or accounts managed or advised by GSO Capital Partners LP and certain other affiliates of Blackstone, and the other lenders from time to time party thereto, or Lenders, and Wilmington Trust, National Association, as the administrative agent for the lenders. The Credit Agreement provides for a senior secured delayed draw term loan facility to be funded in three tranches, or Term Loans, each tranche to be requested by certain dates specified in the Credit Agreement, and subject to customary terms and conditions in the case of each tranche. In the event certain borrowing conditions are not satisfied as of December 31, 2022, the Lenders are not required to fund the second and third tranches of the term loan facility. If we are unable to secure the borrowings under the second and third tranches of the term loan facility, we may not be able to replace the financing commitment on favorable terms, or at all. The Term Loans mature seven years from the date of the first draw, and bear interest at a variable rate. All obligations under the Credit Agreement will be secured, subject to certain exceptions, by security interests in certain assets, including the intellectual property owned by us relating to ONPATTRO, GIVLAARI and vutrisiran, the equity interests held by the Loan Parties in their subsidiaries, all of the our ownership of the inclisiran royalty remaining after the royalty purchase and material real property, and certain personal property, including, without limitation, cash held in certain deposit accounts of the Loan Parties and equipment. The Credit Agreement contains negative covenants that, among other things and subject to certain exceptions, could restrict our ability to, incur additional liens, incur additional indebtedness, make investments, including acquisitions, engage in fundamental changes, sell or dispose of assets that constitute collateral, including certain intellectual property, pay dividends or make any distribution or payment on or redeem, retire or purchase any equity interests, amend, modify or waive certain material agreements or organizational documents and make payments of certain subordinated indebtedness. The Credit Agreement also requires us to have consolidated liquidity of at least $100.0 million as of the last day of each fiscal quarter. Additionally, the Credit Agreement contains certain customary representations and warranties, affirmative covenants and provisions relating to events of default, including nonpayment of principal, interest and other amounts; failure to comply with covenants; the rendering of judgments or orders or default by us in respect of other material indebtedness; and certain insolvency and ERISA events. Our ability to satisfy our obligations under this agreement and meet our debt service obligations will depend upon our future performance, which will be subject to financial, business and other factors affecting our operations, many of which are beyond our control.

The terms of any financing we may be required to pursue in the future notwithstanding the funds due or available to us from Blackstone may adversely affect the holdings or the rights of our stockholders. If we raise additional funds by issuing equity securities, further dilution to our existing stockholders will result. In addition, as a condition to providing additional funding to us, future investors may demand, and may be granted, rights superior to those of existing stockholders. For example, pursuant to our stock purchase agreement with Blackstone, we agreed to register the resale of the shares purchased on a registration statement to be filed with the Securities and Exchange Commission within 60 days of April 10, 2020. In addition, subject to certain conditions, Blackstone will be entitled to participate in registered underwritten public offerings by us if other selling stockholders are included in the registration.

If we are unable to obtain additional funding on a timely basis, we may be required to significantly delay or curtail one or more of our research or development programs, or delay or curtail the continued build out of our global commercial infrastructure, and our ability to achieve our long-term strategic goals may be delayed or diminished. We also could be required to seek funds through arrangements with collaborators or others that may require us to relinquish rights to some of our technologies, product candidates or products that we would otherwise pursue on our own.

We expect our operating results to fluctuate in future periods, which may adversely affect our stock price.

Our quarterly operating results have fluctuated in the past, and we believe they will continue to do so in the future. Our operating results may fluctuate due to the level of success of our commercial efforts and resulting revenues, as well as the variable nature of our operating expenses as a result of the timing and magnitude of expenditures. In one or more future periods, our results of operations may fall below the expectations of securities analysts and investors. In that event, the market price of our common stock could substantially decline.

If the estimates we make, or the assumptions on which we rely, in preparing our condensed consolidated financial statements and/or our projected guidance prove inaccurate, our actual results may vary from those reflected in our projections and accruals.

Our condensed consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States of America, or GAAP. The preparation of these condensed consolidated financial statements requires us to make estimates and judgments that affect the reported amounts of our assets, liabilities, revenues and expenses, the amounts of charges accrued by us and related disclosure of contingent assets and liabilities. We base our estimates on historical experience and on various other assumptions that we believe to be reasonable under the circumstances. We cannot assure you, however, that our estimates, or the assumptions underlying them, will be correct.

Further, from time to time we issue financial guidance relating to our expectations regarding our non-GAAP research and development and selling, general and administrative expenses, and expectations for our cash, cash equivalents and marketable debt securities available for operations, which guidance is based on estimates and the judgment of management. If, for any reason, our expenses differ materially from our guidance or we utilize our cash more quickly than anticipated, we may have to adjust our publicly announced financial guidance. If we fail to meet, or if we are required to change or update any element of, our publicly disclosed financial guidance or other expectations about our business, our stock price could decline.

The investment of our cash, cash equivalents and marketable debt securities is subject to risks which may cause losses and affect the liquidity of these investments.

As of March 31, 2020, we had $1.34 billion in cash, cash equivalents and marketable debt and equity securities, excluding the $24.7 million of restricted investments related to the security deposit for the lease of our corporate headquarters in Cambridge, Massachusetts and collateral to support letters of credit. We historically have invested these amounts in high–grade corporate notes, commercial paper, securities issued or sponsored by the U.S. government, certificates of deposit and money market funds meeting the criteria of our investment policy, which is focused on the preservation of our capital. Corporate notes may also include foreign bonds denominated in U.S. dollars. These investments are subject to general credit, liquidity, market and interest rate risks. We may realize losses in the fair value of these investments or a complete loss of these investments, which would have a negative effect on our condensed consolidated financial statements. In addition, should our investments cease paying or reduce the amount of interest paid to us, our interest income would suffer. The market risks associated with our investment portfolio may have an adverse effect on our results of operations, liquidity and financial condition.

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

Our business is subject to numerous international, federal, state, and other governmental laws, rules, and regulations that may adversely affect our operating results, including, taxation and tax policy changes, tax rate changes, new tax laws, or revised tax law interpretations, which individually or in combination may cause our effective tax rate to increase. In the U.S., the rules dealing with federal, state, and local income taxation are constantly under review by persons involved in the legislative process and by the Internal Revenue Service and the U.S. Treasury Department. Changes to tax laws (which changes may have retroactive application) could adversely affect us or holders of our common stock. In recent years, many such changes have been made and changes are likely to continue to occur in the future. For example, on March 27, 2020, President Trump signed into law the Coronavirus Aid, Relief, and Economic Security Act, or CARES Act, which included certain changes in tax law intended to stimulate the U.S. economy in light of the COVID-19 outbreak, including temporary beneficial changes to the treatment of net operating losses, interest deductibility limitations and payroll tax matters. Future changes in tax laws could have a material adverse effect on our business, cash flow, financial condition or results of operations.

Additionally, the Organization for Economic Co-operation and Development, or OECD, the EC, and individual taxing jurisdictions where we and our affiliates do business have recently focused on issues related to the taxation of multinational corporations. The OECD has released its comprehensive plan to create an agreed set of international rules for fighting base erosion and profit shifting. In addition, the OECD, the EC and individual counties are examining changes to how taxing rights should be allocated among countries considering the digital economy. As a result, the tax laws in the U.S. and other countries in which we and our affiliates do business could change on a prospective or retroactive basis and any such changes could materially adversely affect our business.

Risks Related to Our Dependence on Third Parties

We may not be able to execute our business strategy if we are unable to maintain existing or enter into new alliances with other companies that can provide business and scientific capabilities and funds for the development and commercialization

of our product candidates. If we are unsuccessful in forming or maintaining these alliances on terms favorable to us, our business may not succeed.

We are continuing to advance our commercial capabilities, including in marketing, sales, market access and distribution, to support our wholly-owned products. We also continue to advance our growing pipeline of RNAi therapeutic opportunities. However, we may not have adequate capacity or capabilities to advance all of our therapeutic opportunities. Accordingly, we have entered into alliances with other companies and collaborators that we believe can provide such capabilities in certain territories and/or for certain product candidates, and we intend to enter into additional such alliances in the future. Our collaboration strategy is to form alliances that create significant value for us and our collaborators in the advancement of RNAi therapeutics as a new class of innovative medicines. Specifically, with respect to our Genetic Medicine pipeline, as a result of our broad strategic alliance with Sanofi Genzyme formed in 2014, Sanofi Genzyme is now developing and commercializing fitusiran globally. In addition, we formed a collaboration with MDCO (which was acquired by Novartis AG in January 2020) to advance inclisiran. In March 2018, we entered into a discovery collaboration with Regeneron to identify RNAi therapeutics for NASH and potentially other related diseases, and in November 2018, we and Regeneron entered into a separate, fifty-fifty collaboration to further research, co-develop and commercialize any therapeutic product candidates that emerge from these discovery efforts. In October 2017, we announced an exclusive licensing agreement with Vir for the development and commercialization of RNAi therapeutics for infectious diseases, including chronic HBV infection, and in early 2020, we expanded our exclusive licensing agreement to include the development and commercialization of RNAi therapeutics targeting SARS-CoV-2, the virus that causes the disease COVID-19, as well as up to three human host factor targets relating to susceptibility to coronaviruses, for use in connection with the treatment, palliation, diagnosis or prevention of SARS-CoV-2 and other diseases caused by coronaviruses. In April 2020, we entered into a development and commercialization collaboration with Dicerna to advance investigational RNAi therapeutics for the treatment of alpha-1 liver disease. With respect to our CNS/Ocular Disease pipeline, in April 2019, we announced a global, strategic collaboration with Regeneron to discover, develop and commercialize RNAi therapeutics for a broad range of diseases by addressing therapeutic targets expressed in the eye and CNS, in addition to a select number of targets expressed in the liver.

In such alliances, we expect our current, and may expect our future, collaborators to provide substantial capabilities in clinical development, regulatory affairs, and/or marketing, sales and distribution. Under certain of our alliances, we also may expect our collaborators to develop, market and/or sell certain of our product candidates. We may have limited or no control over the development, sales, marketing and distribution activities of these third parties. Our future revenues may depend heavily on the success of the efforts of these third parties. For example, we will rely entirely on (i) Regeneron for the development and commercialization of all programs targeting eye diseases (subject to limited exceptions), and potentially other CNS and liver programs, (ii) MDCO for all future development and commercialization of inclisiran worldwide, and (iii) Sanofi Genzyme for the development and commercialization of fitusiran worldwide. In the case of each such collaboration referenced in clauses (i)-(iii) above, we are entitled to royalties on the sales of each of these products. If our collaborators are not successful in their development and/or commercialization efforts, our future revenues from RNAi therapeutics for these indications may be adversely affected. Moreover, if the revenues generated by the royalties received from us by Blackstone with respect to inclisiran sales do not reach a certain level by the end of 2029, Blackstone will be entitled to a higher royalty percentage beginning in 2030, which would have an adverse impact on our revenues beginning in 2030.

We may not be successful in entering into future alliances on terms favorable to us due to various factors, including our ability to successfully demonstrate POC for our technology in humans, including our alternative conjugate approach for delivering CNS or ocular product candidates, our ability to demonstrate the safety and efficacy of our specific drug candidates, our ability to manufacture or have third parties manufacture RNAi therapeutics, the strength of our intellectual property and/or concerns around challenges to our intellectual property. For example, our decision in October 2016 to discontinue development of revusiran could give rise to concerns around the safety and/or efficacy of our technology platform or product candidates. In addition, the occurrence of a fatal thrombotic SAE in our fitusiran study in 2017 could contribute to further concerns about the safety of our therapeutic candidates. Even when we succeed in securing such alliances, we may not be able to maintain them if, for example, development or approval of a product candidate is delayed, challenges are raised as to the validity or scope of our intellectual property, we are unable to secure adequate reimbursement from payors or sales of an approved drug are lower than we expected.

Furthermore, any delay in entering into collaboration agreements would likely either delay the development and commercialization of certain of our product candidates and reduce their competitiveness even if they reach the market, or prevent the development of certain product candidates. Any such delay related to our collaborations could adversely affect our business.

For certain product candidates, we have formed collaborations to fund all or part of the costs of drug development and commercialization, such as our collaborations with Regeneron, MDCO, Vir, Dicerna and Sanofi Genzyme. We may not, however, be able to enter into additional collaborations for certain other programs, and the terms of any collaboration agreement we do secure may not be favorable to us. If we are not successful in our efforts to enter into future collaboration arrangements with respect to one or more of our product candidates, we may not have sufficient funds to develop these product candidates or other product candidates internally, or to bring our product candidates to market. If we do not have sufficient funds to develop and bring our product candidates to market, we will not be able to generate revenues from these product candidates, and this will substantially harm our business.

If any collaborator materially amends, terminates or fails to perform its obligations under agreements with us, the development and commercialization of our product candidates could be delayed or terminated.

Our dependence on collaborators for capabilities and funding means that our business could be adversely affected if any collaborator materially amends or terminates its collaboration agreement with us or fails to perform its obligations under that agreement. Our current or future collaborations, if any, may not be scientifically or commercially successful. Disputes may arise in the future with respect to the ownership of rights to technology or products developed with collaborators, which could have an adverse effect on our ability to develop and commercialize any affected product candidate. Our current collaborations allow, and we expect that any future collaborations will allow, either party to terminate the collaboration for a material breach by the other party. In addition, our collaborators may have additional termination rights for convenience with respect to the collaboration or a particular program under the collaboration, under certain circumstances. For example, our agreement with MDCO, which was acquired by Novartis AG in January 2020, relating to the development and commercialization of inclisiran worldwide may be terminated by MDCO at any time upon four months' prior written notice, provided if the agreement is terminated by MDCO for convenience, MDCO has agreed to grant a license to us under certain of our technology developed in the course of MDCO's activities under the agreement, subject to a royalty to be negotiated between the parties. Moreover, any adverse actions by MDCO or Novartis with respect to the MDCO agreement could adversely impact our ability to comply with our obligations under our agreements with Blackstone. If we were to lose a commercialization collaborator, we would have to attract a new collaborator or develop expanded sales, distribution and marketing capabilities internally, which would require us to invest significant amounts of financial and management resources.

In addition, if we have a dispute with a collaborator over the ownership of technology or other matters, or if a collaborator terminates its collaboration with us, for breach or otherwise, or determines not to pursue the research, development and/or commercialization of RNAi therapeutics, it could delay our development of product candidates, result in the need for additional company resources to develop product candidates, require us to expend time and resources to develop expanded sales and marketing capabilities on a more expedited timeline, make it more difficult for us to attract new collaborators and could adversely affect how we are perceived in the business and financial communities.

Moreover, a collaborator, or in the event of a change in control of a collaborator or the assignment of a collaboration agreement to a third party, the successor entity or assignee, as in the case of MDCO and Novartis AG, could determine that it is in its interests to:

- pursue alternative technologies or develop alternative products, either on its own or jointly with others, that may be competitive with the products on which it is collaborating with us or which could affect its commitment to the collaboration with us;
- pursue higher-priority programs or change the focus of its development programs, which could affect the collaborator's commitment to us; or
- if it has marketing rights, choose to devote fewer resources to the marketing of our product candidates, if any are approved for marketing, than it does for product candidates developed without us.

If any of these occur, the development and commercialization of one or more product candidates could be delayed, curtailed or terminated because we may not have sufficient financial resources or capabilities to continue such development and commercialization on our own.

Although we sold a portion of the expected royalty stream and commercial milestones from the global sales of inclisiran by our collaborator, MDCO, we are entitled to retain the remaining portion of future royalties from the global sales of inclisiran and, if certain specified thresholds are met, to the remaining portion of commercial milestone payments, and any negative developments related to inclisiran could have a material adverse effect on our receipt of those payments.

In April 2020, we sold to Blackstone 50% of the royalties payable to us with respect to net sales by MDCO, its affiliates or sublicensees of inclisiran and 75% of the commercial milestone payments payable to us under the MDCO license and collaboration agreement. If Blackstone does not receive royalty payments in respect of global sales of inclisiran equaling at least $1.0 billion by December 31, 2029, Blackstone's royalty interest will increase to 55% effective January 1, 2030. Our receipt of future royalty payments and a portion of commercial milestone payments may be negatively impacted if the inclisiran royalty stream and commercial milestones payments are insufficient to meet the specified thresholds. Additional factors that may have an adverse effect on the potential inclisiran royalty stream and commercial milestones include:

- companies working to develop new therapies or alternative formulations of products for ASCVD;
- foreign currency movement, which could have a negative impact on MDCO's future sales of inclisiran, assuming approval, thereby reducing the royalties;

- any negative developments relating to inclisiran, such as safety, efficacy, or reimbursement issues, could reduce demand for inclisiran;
- any disputes concerning patents, proprietary rights, or license and collaboration agreements could negatively impact our receipt of commercial milestone payments or royalties; and
- adverse regulatory or legislative developments could limit or prohibit the sale of inclisiran, if approved, such as restrictions on the use of inclisiran or safety-related label changes, including enhanced risk management programs, which may significantly reduce expected royalty revenue and commercial milestone payments and could require significant expense to address the associated legal and regulatory issues.

If the revenues generated by sales of inclisiran are lower than expected, our business could be materially adversely affected.

We have limited manufacturing experience and resources and we must incur significant costs to develop this expertise and/or rely on third parties to manufacture our products.

We have limited manufacturing experience. In order to continue to commercialize ONPATTRO and GIVLAARI, continue to develop our current product candidates, including vutrisiran, apply for regulatory approvals and, if approved, commercialize future products, including lumasiran, we will need to develop, contract for, or otherwise arrange for the necessary manufacturing capabilities. Historically, our internal manufacturing capabilities were limited to small-scale production of material for use in in vitro and in vivo experiments that is not required to be produced under cGMP standards. During 2012, we developed cGMP capabilities and processes for the manufacture of patisiran formulated bulk drug product for late stage clinical trial use and commercial supply. In addition, in April 2016, we completed our purchase of a parcel of land in Norton, Massachusetts, where we are completing construction and qualification of a cGMP manufacturing facility for drug substance for clinical and, eventually, commercial use.

We may manufacture limited quantities of clinical trial materials ourselves, but otherwise we currently rely on third parties to manufacture the drug substance and finished product we will require for any clinical trials that we initiate and to support the commercial supply of ONPATTRO, GIVLAARI and any of our other product candidates, including lumasiran. There are a limited number of manufacturers that supply synthetic siRNAs. We currently rely on a limited number of CMOs for our supply of synthetic siRNAs. For example, in July 2015, we amended our manufacturing services agreement with Agilent, to provide for Agilent to supply, subject to any conflicting obligations under our third-party agreements, a specified percentage of the active pharmaceutical ingredients required for certain of our product candidates in clinical development, as well as other products the parties may agree upon in the future. We currently rely on Agilent to supply the active pharmaceutical ingredient to support the commercial supply of ONPATTRO and GIVLAARI, and we have entered into a manufacturing services agreement with Agilent for such supply of ONPATTRO and are finalizing an agreement for the commercial supply of GIVLAARI. There are risks inherent in pharmaceutical manufacturing that could affect the ability of our CMOs, including Agilent, to meet our delivery time requirements or provide adequate amounts of material to meet our needs. Included in these risks are potential synthesis and purification failures and/or contamination during the manufacturing process, as well as other issues with the CMO's facility and ability to comply with the applicable manufacturing requirements, which could result in unusable product and cause delays in our manufacturing timelines and ultimately delay our clinical trials and potentially put at risk commercial supply, as well as result in additional expense to us. To fulfill our siRNA requirements, we will likely need to secure alternative suppliers of synthetic siRNAs and such alternative suppliers are limited and may not be readily available, or we may be unable to enter into agreements with them on reasonable terms and in a timely manner. As noted above, in order to ensure long-term supply capabilities for our RNAi therapeutics, we are developing our own capabilities to manufacture drug substance for clinical and commercial use.

In addition to the manufacture of the synthetic siRNAs, we may have additional manufacturing requirements related to the technology required to deliver the siRNA to the relevant cell or tissue type, such as LNPs or conjugates. In some cases, the delivery technology we utilize is highly specialized or proprietary, and for technical and/or legal reasons, we may have access to only one or a limited number of potential manufacturers for such delivery technology. In addition, the scale-up of our delivery technologies could be very difficult and/or take significant time. We also have very limited experience in such scale-up and manufacturing, requiring us to depend on a limited number of third parties, who might not be able to deliver in a timely manner, or at all. Failure by manufacturers to properly manufacture our delivery technology and/or formulate our siRNAs for delivery could result in unusable product, supply delays and shortages. Furthermore, competition for supply from our manufacturers from other companies, a breach by such manufacturers of their contractual obligations or a dispute with such manufacturers would cause delays in our discovery and development efforts, as well as additional expense to us.

Given the limited number of suppliers for our delivery technology and drug substance, we developed cGMP capabilities and processes for the manufacture of patisiran formulated bulk drug product for late-stage clinical use and commercial supply. During 2015, we scaled our cGMP manufacturing capacity for ONPATTRO and believe we have adequate resources to supply our drug product commercial needs. In addition, as noted above, we are developing our own capabilities to manufacture drug substance for clinical and commercial use. In developing these manufacturing capabilities by building our own manufacturing facilities, we have incurred substantial expenditures, and expect to incur significant additional expenditures in the future. In addition, the construction and qualification of our drug substance facility is a lengthy process to complete and there are many risks inherent in the construction of a new facility that could result in delays and additional costs, including the need to obtain access to necessary equipment and third-party technology, if any. Also, we have had to, and will likely need to continue to, hire and train qualified employees to staff our facilities. We do not currently have a second source of supply for patisiran formulated bulk drug product. If we are unable to manufacture sufficient quantities of material or if we encounter problems with our facilities in the future, we may also need to secure alternative suppliers of patisiran formulated bulk drug product and drug substance, and such alternative suppliers may not be available, or we may be unable to enter into agreements with them on reasonable terms and in a timely manner. Given our dependence on a limited number of CMOs to supply drug substance for our commercial products and clinical candidates, and our dependence on our own facility to produce patisiran formulated bulk drug product, any delay in supply caused by the COVID-19 pandemic, in particular at Agilent or at our own facilities, could impact our ability to procure sufficient supplies for ONPATTRO and GIVLAARI, and the development of our product candidates could also be delayed. Any delay or setback in the manufacture of ONPATTRO or GIVLAARI could impede ongoing commercial supply, which could significantly impact our revenues and operating results. In addition, to the extent we or our partners rely on CMOs outside of the U.S. to supply drug substance for our product candidates, any delays or disruptions in supply caused by the COVID-19 pandemic could have a material adverse impact on the research and development activities and potential commercialization of our or our partners' product candidates.

The manufacturing process for ONPATTRO, GIVLAARI and any other products that we may develop, including lumasiran, is subject to the FDA and foreign regulatory authority approval process and we will need to meet, and will need to contract with CMOs who can meet, all applicable FDA and foreign regulatory authority requirements on an ongoing basis. In addition, if we receive the necessary regulatory approval for any product candidate, we also expect to rely on third parties, including potentially our commercial collaborators, to produce materials required for commercial supply. We may experience difficulty in obtaining adequate manufacturing capacity for our needs and the needs of our collaborators, who we have, in some instances, the obligation to supply. If we are unable to obtain or maintain CMOs for our product candidates and/or our marketed products, or to do so on commercially reasonable terms, we may not be able to successfully develop and commercialize our products.

To the extent that we have existing, or enter into future, manufacturing arrangements with third parties, we depend, and will depend in the future, on these third parties, including Agilent, to perform their obligations in a timely manner and consistent with contractual and regulatory requirements, including those related to quality control and quality assurance. The failure of Agilent or any other CMO to perform its obligations as expected, or, to the extent we manufacture all or a portion of our product candidates ourselves, our failure to execute on our manufacturing requirements, could adversely affect our business in a number of ways, including:

- we or our current or future collaborators may not be able to initiate or continue clinical trials of product candidates that are under development;
- we or our current or future collaborators may be delayed in submitting regulatory applications, or receiving regulatory approvals, for our product candidates;
- we may lose the cooperation of our collaborators;
- our facilities and those of our CMOs, and our products could be the subject of inspections by regulatory authorities that could have a negative outcome and result in delays in supply;
- we may be required to cease distribution or recall some or all batches of our products or take action to recover clinical trial material from clinical trial sites; and
- ultimately, we may not be able to meet commercial demands for our products.

If any CMO with whom we contract, including Agilent, fails to perform its obligations, we may be forced to manufacture the materials ourselves, for which we may not have the capabilities or resources, or enter into an agreement with a different CMO, which we may not be able to do on reasonable terms, if at all. In either scenario, our clinical trials or commercial distribution could be delayed significantly as we establish alternative supply sources. In some cases, the technical skills required to manufacture our products or product candidates may be unique or proprietary to the original CMO and we may have difficulty, or there may be contractual restrictions prohibiting us from, transferring such skills to a back-up or alternate supplier, or we may be unable to transfer such skills at all. In addition, if we are required to change CMOs for any reason, we will be required to verify that the new CMO maintains facilities and procedures that comply with quality standards and with all applicable regulations and guidelines. We will also need to verify, such as through a manufacturing comparability study, that any new manufacturing process will produce our product according to the specifications previously submitted to or approved by the FDA or another regulatory authority. The delays associated with the verification of a new CMO could negatively affect our ability to develop product candidates or commercialize our products in a timely manner or within budget. Furthermore, a CMO may possess technology related to the manufacture of our product candidate that such CMO owns independently. This would increase our reliance on such CMO or require us to obtain a license from such CMO in order to have another CMO manufacture our products or product candidates.

We have limited commercial experience and newly established capabilities for marketing, sales, market access and distribution, and expect to continue to invest significant financial and management resources to continue to build these capabilities and to establish a global commercial infrastructure. Even if we build and scale our commercial capabilities, the market may not be receptive to our commercial products.

We have limited commercial experience and newly established capabilities for marketing, sales, market access and distribution. We currently expect to rely heavily on third parties to launch and market certain of our product candidates in certain geographies, if approved. However, we intend to commercialize ONPATTRO and GIVLAARI, as well as several of our late-stage product candidates if approved, including lumasiran and vutrisiran, on our own globally. Accordingly, we have developed internal marketing, sales, market access and distribution capabilities as part of our core product strategy initially in the U.S. and the EU, with expansion ongoing globally, which has, and will continue to, require significant financial and management resources. For those products for which we will perform marketing, sales, market access and distribution functions ourselves, including ONPATTRO, GIVLAARI and, if approved, lumasiran and vutrisiran, and for future products we successfully develop where we may retain certain product development and commercialization rights, we could face a number of additional risks, including:

- developing and retaining our global sales, marketing and administrative infrastructure and capabilities;
- hiring, training, managing and supervising our personnel worldwide;
- the cost of establishing, or leveraging an established, marketing or sales force, which may not be justifiable in light of the revenues generated by any particular product and/or in any specific geographic region; and
- our direct sales and marketing efforts may not be successful.

If we are unable to continue to develop and scale our own global marketing, sales, market access and distribution capabilities for ONPATTRO, GIVLAARI and any future products, including lumasiran, if approved, we will not be able to successfully commercialize our products without reliance on third parties.

We rely on third parties to conduct our clinical trials, and if they fail to fulfill their obligations, our development plans may be adversely affected.

We rely on independent clinical investigators, contract research organizations, or CROs, and other third-party service providers to assist us in managing, monitoring and otherwise carrying out our clinical trials. We have contracted, and we plan to continue to contract with, certain third parties to provide certain services, including site selection, enrollment, monitoring, auditing and data management services. These investigators and CROs are not our employees and we have limited control over the amount of time and resources they dedicate to our programs. These third parties may have contractual relationships with other entities, some of which may be our competitors, which may draw their time and resources away from our programs. Although we depend heavily on these parties, we control only certain aspects of their activity and therefore, we cannot be assured that these third parties will adequately perform all of their contractual obligations to us in compliance with regulatory and other legal requirements and our internal policies and procedures. Nevertheless, we are responsible for ensuring that each of our studies is conducted in accordance with the applicable protocol, legal, regulatory and scientific standards, and our reliance on third parties does not relieve us of our regulatory responsibilities. We and our CROs are required to comply with applicable GCP requirements, which are regulations and guidelines enforced by the FDA and comparable foreign regulatory authorities for all of our product candidates in clinical development, and to implement timely corrective action to any non-compliance. Regulatory authorities enforce these GCP requirements through periodic inspections of trial sponsors, principal investigators and trial sites, including in connection with the review of marketing applications. If we or any of our CROs fail to comply with applicable GCP requirements, or fail to take any such corrective action, the clinical data generated in our clinical trials may be deemed unreliable and the FDA, the EMA, the Pharmaceuticals and Medical Devices Agency in Japan or comparable foreign regulatory authorities may require us to take additional action or perform additional clinical trials before approving our marketing applications. We cannot assure you that upon inspection by a given regulatory authority in the future, such regulatory authority will determine that any of our clinical trials comply with GCP regulations.

If our third-party service providers cannot adequately and timely fulfill their obligations to us for any reason, including due to disruptions caused by the COVID-19 pandemic on their operations or at the sites they are overseeing, or if the quality and accuracy of our clinical trial data is compromised due to failure by such third party to adhere to our protocols or regulatory requirements or if such third parties otherwise fail to meet deadlines, our development plans and/or regulatory reviews for marketing approvals may be delayed or terminated. As a result, our stock price would likely be negatively impacted, and our results of operations and the commercial prospects for our product candidates would be harmed, our costs could increase and our ability to generate revenues could be delayed.

Risks Related to Managing Our Operations

If we are unable to attract and retain qualified key management and scientists, development, medical and commercial staff, consultants and advisors, our ability to implement our business plan may be adversely affected.

We are highly dependent upon our senior management and our scientific, clinical, sales and medical staff. The loss of the service of any of the members of our senior management, including Dr. John Maraganore, our Chief Executive Officer, may significantly delay or prevent the achievement of product development and commercialization, and other business objectives. Our employment arrangements with our key personnel are terminable without notice. We do not carry key person life insurance on any of our employees.

We have grown our workforce significantly over the past several years and anticipate continuing to add additional employees as we focus on achieving our long-term strategic goals. We face intense competition for qualified individuals from numerous pharmaceutical and biotechnology companies, universities, governmental entities and other research institutions, many of which have substantially greater resources with which to attract and reward qualified individuals than we do. In addition, due to the risks associated with developing a new class of medicine, we may experience disappointing results in a clinical program and our stock price may decline as a result, as was the case following our decision in October 2016 to discontinue our revusiran program, and, to a lesser extent, following our temporary suspension of dosing in our fitusiran program in September 2017. As a result, we may face additional challenges in attracting and retaining employees. In addition, we may not be successful commercializing our approved products and as a result, we may be unable to attract and retain highly qualified sales and marketing professionals to support ONPATTRO, GIVLAARI and our future products, if approved, including lumasiran. Accordingly, we may be unable to attract and retain suitably qualified individuals in order to support our growing research, development and global commercialization efforts and initiatives, and our failure to do so could have an adverse effect on our ability to implement our future business plan.

Moreover, in response to the spread of COVID-19, we have taken temporary precautionary measures intended to help minimize the risk of the virus to our employees and their families, including implementing a global work from home policy for all employees who are able to perform their duties remotely, and have restricted on-site staff to only those personnel and contractors who must perform essential activities that must be completed on-site and limited the number of staff in any given laboratory, manufacturing facility or other facility. These actions may impair our ability to recruit and/or onboard new employees.

We may have difficulty expanding our operations successfully as we continue to evolve from a U.S.- and EU-based company primarily involved in discovery, pre-clinical testing and clinical development into a global company that develops and commercializes multiple drugs.

As we continue the commercial launches of approved products, and increase the number of product candidates we are developing, we will also need to expand our operations in the U.S. and continue to build operations in the EU and other geographies, including Asia and Latin America. To date, we have received regulatory approval for ONPATTRO in the U.S. and EU and other countries globally, and as a result of the January 2018 amendment to our Sanofi Genzyme collaboration, we now have global development and commercialization rights for ONPATTRO. In addition, we have received regulatory approval for our second RNAi therapeutic, GIVLAARI in the U.S. and EU, and have also filed for marketing approval in Brazil. We plan to file for additional regulatory approvals for both ONPATTRO and GIVLAARI in additional countries during 2020 and beyond.

As noted above, we grew our workforce significantly from 2016 through 2019, and anticipate continuing to hire additional employees globally during 2020 as we focus on the commercialization of ONPATTRO and GIVLAARI and achieving our long-term strategic goals. This growth has placed a strain on our administrative and operational infrastructure and, as a result, we will need to continue to develop additional and/or new infrastructure and capabilities to support our growth and obtain additional space to conduct our global operations in the U.S., the EU, Japan, Latin America and other geographies. If we are unable to develop such additional infrastructure or obtain sufficient space to accommodate our growth in a timely manner and on commercially reasonable terms, our business could be negatively impacted. As we continue the commercialization of ONPATTRO and GIVLAARI, and as the product candidates we develop enter and advance through clinical trials, we will need to continue to expand our global development, regulatory, manufacturing, quality, compliance, and marketing and sales capabilities, or contract with other organizations to provide these capabilities for us. In addition, as our operations expand due to our development progress, we will need to continue to manage additional relationships with various collaborators, suppliers and other organizations. Our ability to manage our operations and future growth will require us to continue to enhance our operational, financial and management controls and systems, reporting systems and infrastructure, and policies and procedures. We may not be able to implement enhancements to our management information and control systems in an efficient or timely manner and may discover deficiencies in existing systems and controls.

The increasing use of social media platforms presents new risks and challenges.

Social media is increasingly being used to communicate about our clinical development programs and the diseases our investigational RNAi therapeutics are being developed to treat, and we are utilizing what we believe is appropriate social media in connection with our commercialization efforts for ONPATTRO and GIVLAARI, and we intend to do the same for our future products, if approved, including lumasiran. Social media practices in the biopharmaceutical industry continue to evolve and regulations and regulatory guidance relating to such use are evolving and not always clear. This evolution creates uncertainty and risk of noncompliance with regulations applicable to our business, resulting in potential regulatory actions against us, along with the potential for litigation related to off-label marketing or other prohibited activities. For example, for our clinical-stage candidates, patients may use social media channels to comment on their experience in an ongoing blinded clinical study or to report an alleged AE. When such disclosures occur, there is a risk that study enrollment may be adversely impacted, we fail to monitor and comply with applicable adverse event reporting obligations or that we may not be able to defend our business or the public's legitimate interests in the face of the political and market pressures generated by social media due to restrictions on what we may say about our investigational products. There is also a risk of inappropriate disclosure of sensitive information or negative or inaccurate posts or comments about us on any online platform, including a blog on the internet, or a post on a website, that can be distributed rapidly and could negatively harm our reputation. If any of these events were to occur or we otherwise fail to comply with applicable regulations, we could incur liability, face regulatory actions or incur other harm to our business.

Our business and operations could suffer in the event of system failures or unauthorized or inappropriate use of or access to our systems.

We are increasingly dependent on our information technology systems and infrastructure for our business. We collect, store and transmit sensitive information including intellectual property, proprietary business information and personal information in connection with business operations. The secure maintenance of this information is critical to our operations and business strategy. Some of this information could be an attractive target of criminal attack or unauthorized access and use by third parties with a wide range of motives and expertise, including organized criminal groups, "hacktivists," patient groups, disgruntled current or former employees and others. Cyber-attacks are of ever-increasing levels of sophistication, and despite our security measures, our information technology and infrastructure may be vulnerable to such attacks or may be breached, including due to employee error or malfeasance.

Despite the implementation of security measures, our internal computer systems and those of our contractors and consultants are vulnerable to damage or interruption from computer viruses, unauthorized or inappropriate access or use, natural disasters, pandemics (including COVID-19), terrorism, war, and telecommunication and electrical failures. Such events could cause interruption of our operations. For example, the loss of pre-clinical trial data or data from completed or ongoing clinical trials for our product candidates could result in delays in our regulatory filings and development efforts, as well as delays in the commercialization of our products, and significantly increase our costs. To the extent that any disruption, security breach or unauthorized or inappropriate use or access to our systems were to result in a loss of or damage to our data, or inappropriate disclosure of confidential or proprietary information, including but not limited to patient, employee or vendor information, we could incur notification obligations to affected individuals and government agencies, liability, including potential lawsuits from patients, collaborators, employees, stockholders or other third parties and liability under foreign, federal and state laws that protect the privacy and security of personal information, and the development and potential commercialization of our product candidates could be delayed.

The results of the United Kingdom's referendum on withdrawal from the EU may have a negative effect on global economic conditions, financial markets and our business.

In June 2016, the United Kingdom, or UK, held a referendum in which voters approved an exit from the EU, commonly referred to as "Brexit." This referendum has created political and economic uncertainty, particularly in the UK and the EU, and this uncertainty may persist for years. The UK officially withdrew from the EU on January 31, 2020, however the effects of the departure on both the EU and the UK are still highly uncertain, as many details of the divorce have yet to be addressed. The withdrawal could, among other outcomes, disrupt the free movement of goods, services and people between the UK and the EU, and result in increased legal and regulatory complexities, as well as potential higher costs of conducting business in Europe. Given the lack of comparable precedent, it is unclear what financial, trade and legal implications the withdrawal of the UK from the EU would have and how such withdrawal would affect us.

For example, Brexit could result in the UK or the EU significantly altering its regulations affecting the clearance or approval of our product candidates that are developed in the UK. Any new regulations could add time and expense to the conduct of our business, as well as the process by which our products receive regulatory approval in the UK, the EU and elsewhere. In addition, the announcement of Brexit and the withdrawal of the UK from the EU have had and may continue to have a material adverse effect on global economic conditions and the stability of global financial markets, and may significantly reduce global market liquidity and restrict the ability of key market participants to operate in certain financial markets. Any of these effects of Brexit, among others, could adversely affect our business, our results of operations, liquidity and financial condition.

Risks Related to Our Industry

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

Any product candidates we or our partners develop may fail in development or be delayed to a point where they do not become commercially viable.

Before obtaining regulatory approval for the commercial distribution of our product candidates, we must conduct, at our own expense, extensive nonclinical tests and clinical trials to demonstrate the safety and/or efficacy in humans of our product candidates. Nonclinical and clinical testing is expensive, difficult to design and implement, can take many years to complete and is uncertain as to outcome, and the historical failure rate for product candidates is high. For example, in October 2016, we discontinued development of one of our product candidates, which included a Phase 3 clinical trial. We currently have multiple other programs in clinical development, including internal and partnered programs in Phase 3 development, as well as several earlier-stage clinical programs. In December 2019, we reported positive topline results from our ILLUMINATE-A Phase 3 clinical trial for lumasiran, an investigational RNAi therapeutic targeting GO in development for the treatment of PH1, and in April 2020, we submitted an NDA, which was accepted by the FDA, and submitted an MAA, which was granted an accelerated assessment. However, we may not be able to further advance this or any other product candidate through clinical trials and regulatory approval.

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

If we enter into clinical trials, the results from nonclinical testing or early clinical trials of a product candidate may not predict the results that will be obtained in subsequent subjects or in subsequent human clinical trials of that product candidate or any other product candidate. There is a high failure rate for drugs proceeding through clinical studies. A number of companies in the pharmaceutical and biotechnology industries have suffered significant setbacks in clinical development even after achieving promising results in earlier studies, and any such setbacks in our clinical development could have a material adverse effect on our business and operating results. Moreover, ONPATTRO, GIVLAARI and our current product candidates, including lumasiran, vutrisiran, fitusiran and inclisiran, each employ novel delivery technologies that, with the exception of inclisiran, have yet to be extensively evaluated in human clinical trials and proven safe and effective.

In addition, we, the FDA or other applicable regulatory authorities, or an institutional review board, or IRB, or similar foreign review board or committee, may delay initiation of or suspend clinical trials of a product candidate at any time for various reasons, including if we or they believe the healthy volunteer subjects or patients participating in such trials are being exposed to unacceptable health risks. Among other reasons, adverse side effects of a product candidate or related product on healthy volunteer subjects or patients in a clinical trial could result in our decision, or a decision by the FDA or foreign regulatory authorities, to suspend or terminate the trial, or, in the case of regulatory agencies, a refusal to approve a particular product candidate for any or all indications of use. For example, in October 2016, we announced our decision to discontinue development of revusiran, an investigational RNAi therapeutic that was being developed for the treatment of patients with cardiomyopathy due to hATTR amyloidosis. Our decision followed the recommendation of the revusiran ENDEAVOUR Phase 3 study Data Monitoring Committee, or DMC, to suspend dosing and the observation of an imbalance in mortality in revusiran-treated patients as compared to those on placebo. We conducted a comprehensive evaluation of the revusiran data and reported the results of our evaluation in August 2017. Following our evaluation, we continue to believe that the decision to discontinue development of revusiran does not affect ONPATTRO or any of our other investigational RNAi therapeutic programs in development. In September 2017, we announced that we had temporarily suspended dosing in all ongoing fitusiran studies pending further review of a fatal thrombotic SAE and agreement with regulatory authorities on a risk mitigation strategy. In December 2017, we reached alignment with study investigators and the FDA on safety measures and a risk mitigation strategy to enable resumption of dosing in clinical studies with fitusiran, including our Phase 2 or OLE, study, and the ATLAS Phase 3 program, including protocol-specified guidelines and additional investigator and patient education concerning reduced doses of replacement factor or bypassing agent to treat any breakthrough bleeds in fitusiran studies.

Clinical trials of a new product candidate require the enrollment of a sufficient number of patients, including patients who are suffering from the disease the product candidate is intended to treat and who meet other eligibility criteria. Rates of patient enrollment are affected by many factors, including the size of the patient population, the age and condition of the patients, the stage and severity of disease, the availability of clinical trials for other investigational drugs for the same disease or condition, the nature of the protocol, the proximity of patients to clinical sites, the availability of effective treatments for the relevant disease, and the eligibility criteria for the clinical trial. For example, we or our partners may experience difficulty enrolling our clinical trials, including, but not limited to, the ongoing clinical trials for fitusiran, due to the availability of existing approved treatments, as well as other investigational treatments in development. Moreover, given the temporary suspension of dosing in our fitusiran studies in September 2017 due to a fatal thrombotic SAE, people with hemophilia may be more reluctant to enroll in the ATLAS Phase 3 program of fitusiran. In addition, in November 2018 we announced that due to recruitment challenges, we had discontinued a Phase 2 study of cemdisiran in atypical hemolytic uremic syndrome and are focusing our cemdisiran clinical development efforts in a different indication. Delays or difficulties in patient enrollment or difficulties retaining trial participants, including as a result of the availability of existing or other investigational treatments or safety concerns, including the impact of public health emergencies such as the COVID-19 pandemic, can result in increased costs, longer development times or termination of a clinical trial.

Although our investigational RNAi therapeutics have been generally well-tolerated in our clinical trials to date, new safety findings may emerge. For example, as noted above, in September 2017, we announced that we had temporarily suspended dosing in all ongoing fitusiran studies pending further review of a fatal thrombotic SAE that occurred in a patient with hemophilia A without inhibitors who was receiving fitusiran in our Phase 2 open-label extension, or OLE, study. In addition, in October 2016, we made the decision to discontinue our revusiran program. Following reports in the revusiran Phase 2 OLE study of new onset or worsening peripheral neuropathy, the revusiran ENDEAVOUR Phase 3 study DMC assembled in early October 2016 at our request to review these reports and ENDEAVOUR safety data on an unblinded basis. The DMC did not find conclusive evidence for a drug-related neuropathy signal in the ENDEAVOUR trial, but informed us that the benefit-risk profile for revusiran no longer supported continued dosing. We subsequently reviewed unblinded ENDEAVOUR data which revealed an imbalance of mortality in the revusiran arm as compared to placebo. Further, a review by us in 2017 of the ENDEAVOUR results subsequent to the completion of follow-up of the patients post-dosing discontinuation revealed an imbalance in new onset or worsening peripheral neuropathy in the revusiran arm as compared to placebo. We had previously reported, in July 2016, preliminary data from our revusiran Phase 2 OLE study for 12 patients who had reached the 12-month endpoint as of the data transfer date of May 26, 2016. SAEs were observed in 14 patients, one of which, a case of lactic acidosis, was deemed possibly related to the study drug and the patient discontinued treatment. There were a total of seven deaths reported at that time in the revusiran OLE study, all of which were unrelated to the study drug. The majority of the AEs were mild or moderate in severity; injection site reactions, or ISRs, were reported in 12 patients. In August 2015, we reported that three patients had discontinued from the revusiran Phase 2 OLE study due to recurrent localized reactions at the injection site or a diffuse rash; no further discontinuations due to ISRs had occurred as of May 26, 2016.

In our ENVISION Phase 3 study of givosiran in patients with AHP, AEs were reported in 89.6% of givosiran patients and 80.4% of placebo patients; SAEs were reported in 20.8% of givosiran patients and 8.7% of placebo patients. Of the SAEs reported in givosiran patients, there were two cases of chronic kidney disease, or CKD, and one case each of asthma, device-related infection, gastroenteritis, hypoglycemia, abnormal liver function test, major depression, pain management and pyrexia. Three SAEs in givosiran patients were reported as related to study drug: pyrexia, abnormal liver function test and CKD. The two SAEs of CKD noted above were considered serious due to elective hospitalization for diagnostic evaluation. There were no deaths in the study. One patient in the givosiran arm discontinued treatment due to an increase in alanine aminotransferase, or ALT, level greater than eight times the upper limit of normal, a protocol-defined stopping rule. The increase in ALT levels subsequently resolved. AEs reported in greater than 10% of givosiran patients and seen more frequently compared to placebo were nausea, ISRs, CKD, and fatigue. Four of five of the patients with AEs reported as CKD had a prior history of CKD or a baseline estimated glomerular filtration rate less than 60 mL/min/1.73 m^2. No patients had clinically significant proteinuria and there were no treatment discontinuations due to renal AEs.

In our ALN-VSP clinical trial, one patient with advanced pancreatic neuroendocrine cancer with extensive involvement of the liver developed hepatic failure five days following the second dose of ALN-VSP and subsequently died; this was deemed possibly related to the study drug. As demonstrated by the discontinuation of our revusiran program in October 2016 and the temporary suspension of dosing in September 2017 in our fitusiran studies, the occurrence of SAEs and/or AEs can result in the suspension or termination of clinical trials of a product candidate by us or the FDA or a foreign regulatory authority. The occurrence of SAEs and/or AEs could also result in refusal by the FDA or a foreign regulatory authority to approve a particular product candidate for any or all indications of use.

Clinical trials also require the review, oversight and approval of IRBs or, outside of the U.S., an independent ethics committee, which continually review clinical investigations and protect the rights and welfare of human subjects. Inability to obtain or delay in obtaining IRB or ethics committee approval can prevent or delay the initiation and completion of clinical trials, and the FDA or foreign regulatory authorities may decide not to consider any data or information derived from a clinical investigation not subject to initial and continuing IRB or ethics committee review and approval, as the case may be, in support of a marketing application.

Our product candidates that we develop may encounter problems during clinical trials that will cause us, an IRB, ethics committee or regulatory authorities to delay, suspend or terminate these trials, or that will delay or confound the analysis of data from these trials. If we experience any such problems, we may not have the financial resources to continue development of the product candidate that is affected, or development of any of our other product candidates. We may also lose, or be unable to enter into, collaborative arrangements for the affected product candidate and for other product candidates we are developing.

A failure of one or more of our clinical trials can occur at any stage of testing. We may experience numerous unforeseen events during, or as a result of, nonclinical testing and the clinical trial process that could delay or prevent regulatory approval or our ability to commercialize our product candidates, including:

- our nonclinical tests or clinical trials may produce negative or inconclusive results, and we may decide, or regulators may require us, to conduct additional nonclinical testing or clinical trials, or we may abandon projects that we expect to be promising;

- delays in filing IND applications or comparable foreign applications or delays or failure in obtaining the necessary approvals from regulators or IRBs/ethics committees in order to commence a clinical trial at a prospective trial site, or their suspension or termination of a clinical trial once commenced;
- conditions imposed on us by an IRB or ethics committee, or the FDA or comparable foreign authorities regarding the scope or design of our clinical trials;
- problems in engaging IRBs or ethics committees to oversee clinical trials or problems in obtaining or maintaining IRB or ethics committee approval of trials;
- delays in enrolling patients and volunteers into clinical trials, and variability in the number and types of patients and volunteers available for clinical trials, including as a result of the COVID-19 pandemic;
- disruptions caused by man-made or natural disasters or public health pandemics or epidemics or other business interruptions, including the recent outbreak of COVID-19;
- high drop-out rates for patients and volunteers in clinical trials;
- negative or inconclusive results from our clinical trials or the clinical trials of others for product candidates similar to ours;
- inadequate supply or quality of product candidate materials or other materials necessary for the conduct of our clinical trials or disruption or delays in the clinical supply due to COVID-19;
- greater than anticipated clinical trial costs;
- serious and unexpected drug-related side effects experienced by participants in our clinical trials or by individuals using drugs similar to our product candidates;
- poor or disappointing effectiveness of our product candidates during clinical trials;
- unfavorable FDA or other regulatory agency inspection and review of a clinical trial site or records of any clinical or nonclinical investigation;
- failure of our third-party contractors or investigators to comply with regulatory requirements, including GCP and cGMP, or otherwise meet their contractual obligations in a timely manner, or at all;
- governmental or regulatory delays and changes in regulatory requirements, policy and guidelines, including the imposition of additional regulatory oversight around clinical testing generally or with respect to our technology in particular; or
- interpretations of data by the FDA and similar foreign regulatory agencies that differ from ours.

Even if we successfully complete clinical trials of our product candidates, any given product candidate may not prove to be a safe and effective treatment for the disease for which it was being tested.

We may be unable to obtain U.S. or foreign regulatory approval for our product candidates and, as a result, we may be unable to commercialize such product candidates.

Our product candidates are subject to extensive governmental regulations relating to, among other things, research, testing, development, manufacturing, safety, efficacy, approval, recordkeeping, reporting, labeling, storage, pricing, marketing and distribution of drugs. Rigorous nonclinical testing and clinical trials and an extensive regulatory approval process are required to be successfully completed in the U.S. and in many foreign jurisdictions before a new drug can be marketed. Satisfaction of these and other regulatory requirements is costly, time consuming, uncertain and subject to unanticipated delays. It is possible that the product candidates we are developing will not obtain the regulatory approvals necessary for us or our collaborators to begin selling them.

The time required to obtain FDA and other regulatory approvals is unpredictable but typically takes many years following the commencement of clinical trials, depending upon the type, complexity and novelty of the product candidate. The standards that the FDA and its foreign counterparts use when regulating us are not always applied predictably or uniformly and can change. Any analysis we perform of data from nonclinical and clinical activities is subject to confirmation and interpretation by regulatory authorities, which could delay, limit or prevent regulatory approval. We may also encounter unexpected delays or increased costs due to new government regulations, for example, from future legislation or administrative action, or from changes in FDA policy during the period of product development, clinical trials and FDA regulatory review. It is impossible to predict whether legislative changes will be enacted, or whether FDA or foreign regulations, guidance or interpretations will be changed, or what the impact of such changes, if any, may be.

Because the drugs we are developing represent a new class of drug, the FDA and its foreign counterparts have not yet established any definitive policies, practices or guidelines in relation to these drugs. The lack of policies, practices or guidelines may hinder or slow review by the FDA of any regulatory filings that we may submit. Moreover, the FDA may respond to these submissions by defining requirements we may not have anticipated. Such responses could lead to significant delays in the development of our product candidates. In addition, because there may be approved treatments for some of the diseases for which we may seek approval, or treatments in development which are approved by the time we apply for approval, in order to receive regulatory approval, we may need to demonstrate through clinical trials that the product candidates we develop to treat these diseases, if any, are not only safe and effective, but safer or more effective than existing products. In April 2020, we announced that we submitted an NDA and an MAA for lumasiran. The EMA has granted an accelerated assessment for lumasiran. Interruption or delays in the operations of the FDA, EMA and comparable foreign regulatory agencies due to the COVID-19 pandemic, may impact the review, inspection and approval timelines for our product candidates, including lumasiran. Any such interruption or delay by the FDA, EMA or comparable foreign regulatory agency in light of COVID-19 pandemic could have a material adverse effect on our efforts to obtain regulatory approval for lumasiran, or our collaborator MDCO's efforts to obtain regulatory approval for inclisiran, which could have a material adverse effect on our financial results.

Any delay or failure in obtaining required approvals for our product candidates could have a material adverse effect on our ability to generate revenues from any product candidate for which we may seek approval in the future. Furthermore, any regulatory approval to market any product may be subject to limitations on the approved uses for which we may market the product or the labeling or other restrictions, which could limit each such product’s market opportunity and have a negative impact on our results of operations and our stock price. In addition, the FDA has the authority to require a Risk Evaluation and Mitigations Strategy, or REMS, plan as part of an NDA, or after approval, which may impose further requirements or restrictions on the distribution or use of an approved drug, such as limiting prescribing to certain physicians or medical centers that have undergone specialized training, limiting treatment to patients who meet certain safe-use criteria and requiring treated patients to enroll in a registry. In the EU, we could be required to adopt a similar plan, known as a risk management plan, and our products could be subject to specific risk minimization measures, such as restrictions on prescription and supply, the conduct of post-marketing safety or efficacy studies, or the distribution of patient and/or prescriber educational materials. In either instance, these limitations and restrictions may limit the size of the market for the product and affect reimbursement by third-party payors.

We are also subject to numerous foreign regulatory requirements governing, among other things, the conduct of clinical trials, manufacturing and marketing authorization, pricing and third-party reimbursement. The foreign regulatory approval process varies among countries and includes all of the risks associated with FDA approval described above as well as risks attributable to the satisfaction of local regulations in foreign jurisdictions. Approval by the FDA does not ensure approval by regulatory authorities outside the U.S. and vice versa.

Even if we or our partners obtain regulatory approvals, our marketed drugs will be subject to ongoing regulatory oversight. If we or our partners fail to comply with continuing U.S. and foreign requirements, our approvals could be limited or withdrawn, we could be subject to other penalties, and our business would be seriously harmed.

Following any initial regulatory approval of drugs we or our partners may develop, including ONPATTRO, which was approved in the U.S. and EU in August 2018, and in several other geographies during 2019, and GIVLAARI, which was approved in the U.S. in November 2019 and in the EU in March 2020, we will also be subject to continuing regulatory oversight, including the review of adverse drug experiences and clinical results that are reported after our drug products are made commercially available. This would include results from any post-marketing tests or surveillance to monitor the safety and efficacy of ONPATTRO, GIVLAARI or other drug products required as a condition of approval or agreed to by us. The regulatory approvals that we receive for ONPATTRO and GIVLAARI, as well as any regulatory approvals we receive for any other product candidates, including lumasiran, may also be subject to limitations on the approved uses for which the product may be marketed. Other ongoing regulatory requirements include, among other things, submissions of safety and other post-marketing information and reports, registration and listing, as well as continued compliance with good practice quality guidelines and regulations, including cGMP requirements and GCP requirements for any clinical trials that we conduct post-approval. In addition, we are conducting, and intend to continue to conduct, clinical trials for our product candidates, and we intend to seek approval to market our product candidates, in jurisdictions outside of the U.S., and therefore will be subject to, and must comply with, regulatory requirements in those jurisdictions.

The FDA has significant post-market authority, including, for example, the authority to require labeling changes based on new safety information and to require post-market studies or clinical trials to evaluate serious safety risks related to the use of a drug and to require withdrawal of the product from the market. The FDA also has the authority to require a REMS plan after approval, which may impose further requirements or restrictions on the distribution or use of an approved drug. As ONPATTRO and GIVLAARI are used commercially, we or others could identify previously unknown side effects or known side effects could be observed as being more frequent or severe than in clinical studies or earlier post-marketing periods, in which case:

- sales of ONPATTRO or GIVLAARI may be more modest than originally anticipated;
- regulatory approvals for ONPATTRO or GIVLAARI may be restricted or withdrawn;
- we may decide, or be required, to send product warning letters or field alerts to physicians, pharmacists and hospitals;

- additional nonclinical or clinical studies, changes in labeling, adoption of a REMS plan, or changes to manufacturing processes, specifications and/or facilities may be required; and
- government investigations or lawsuits, including class action suits, may be brought against us.

Any of the above occurrences could reduce or prevent sales of ONPATTRO or GIVLAARI, increase our expenses and impair our ability to successfully commercialize either ONPATTRO or GIVLAARI.

The CMO and manufacturing facilities we use to make ONPATTRO, GIVLAARI and certain of our current product candidates, including our Cambridge facility, our future Norton facility, and Agilent and other CMOs, will also be subject to periodic review and inspection by the FDA and other regulatory agencies. For example, Agilent and our Cambridge-based facility were subject to regulatory inspection by the FDA and the EMA in connection with the review of our applications for regulatory approval for ONPATTRO and GIVLAARI, and may be subject to similar inspection in connection with any subsequent applications for regulatory approval of ONPATTRO or GIVLAARI filed in other territories or in connection with the pending FDA regulatory application for lumasiran. The discovery of any new or previously unknown problems with our facilities or our CMOs, or our or their manufacturing processes or facilities, may result in restrictions on the drug or CMO or facility, including delay in approval or, in the future, withdrawal of the drug from the market. We have developed cGMP capabilities and processes for the manufacture of patisiran formulated bulk drug product for commercial use. In addition, in April 2016, we completed our purchase of a parcel of land in Norton, Massachusetts, where we are completing construction of a cGMP manufacturing facility for drug substance for clinical and, eventually, commercial use. We may not have the ability or capacity to manufacture material at a broader commercial scale in the future. We may manufacture clinical trial materials or we may contract a third party to manufacture these materials for us. Reliance on CMOs entails risks to which we would not be subject if we manufactured products ourselves, including reliance on the CMO for regulatory compliance.

If we or our collaborators, CMOs or service providers fail to comply with applicable continuing regulatory requirements in the U.S. or foreign jurisdictions in which we may seek to market our products, we or they may be subject to, among other things, fines, warning letters, holds on clinical trials, refusal by the FDA or foreign regulatory authorities to approve pending applications or supplements to approved applications, suspension or withdrawal of regulatory approval, product recalls and seizures, refusal to permit the import or export of products, operating restrictions, injunction, civil penalties and criminal prosecution.

Even if we receive regulatory approval to market our product candidates, the market may not be receptive to our product candidates upon their commercial introduction, which will prevent us from becoming profitable.

The product candidates that we are developing are based upon new technologies or therapeutic approaches. Key participants in pharmaceutical marketplaces, such as physicians, third-party payors and consumers, may not accept a product intended to improve therapeutic results based on RNAi technology. As a result, it may be more difficult for us to convince the medical community and third-party payors to accept and use our product, or to provide favorable reimbursement.

Other factors that we believe will materially affect market acceptance of our product candidates include:

- the timing of our receipt of any marketing approvals, the terms of any approvals and the countries in which approvals are obtained;
- the safety and efficacy of our product candidates, as demonstrated in clinical trials and as compared with alternative treatments, if any;
- relative convenience and ease of administration of our product candidates;
- the willingness of patients to accept potentially new routes of administration or new or different therapeutic approaches and mechanisms of action;
- the success of our physician education programs;
- the availability of adequate government and third-party payor reimbursement;
- the pricing of our products, particularly as compared to alternative treatments, and the market perception of such prices and any price increase that we may implement in the future; and
- availability of alternative effective treatments for the diseases that product candidates we develop are intended to treat and the relative risks, benefits and costs of those treatments.

For example, ONPATTRO utilizes an intravenous mode of administration with pre-medication that physicians and/or patients may not readily adopt, or which may not compete favorably with other available options, including inotersen, marketed by Akcea Therapeutics, Inc., or Akcea, which is administered subcutaneously, or tafamidis, marketed by Pfizer, which is in pill form. In addition, fitusiran represents a new approach to treating hemophilia which may not be readily accepted by patients and their caregivers.

The patient populations suffering from hATTR amyloidosis, AHP and PH1 are small and have not been established with precision. If the actual number of patients is smaller than we estimate, or if we cannot raise awareness of these diseases and diagnosis is not improved, our revenue and ability to achieve profitability from ONPATTRO, GIVLAARI and, if approved, lumasiran, may be adversely affected.

Our estimates regarding the potential market size for ONPATTRO, GIVLAARI or any future products, including lumasiran, at the time we commence commercialization, may be materially different from the actual market size, including as a result of the indication approved by regulatory authorities, which could result in significant changes in our business plan and may have a material adverse effect on our results of operations and financial condition. For example, the indication approved by the FDA for ONPATTRO is for the treatment of the polyneuropathy of hATTR amyloidosis and not for the treatment of cardiomyopathy or other manifestations of the disease. In addition, the U.S. label does not include data from the exploratory cardiac endpoints included in our APOLLO Phase 3 study. This could have an adverse impact on the market opportunity for ONPATTRO in the U.S. In addition, our efforts to raise disease awareness and improve diagnosis of hATTR amyloidosis have also been impacted by the COVID-19 pandemic. For example, Alnylam Act®, our third-party genetic screening initiative in the U.S., Canada and Brazil, has experienced a decrease in submitted samples since the pandemic began. As is the case with most orphan diseases, if we cannot successfully raise awareness of these diseases and improve diagnosis, it will be more difficult or impossible to achieve profitability.

We may incur significant liability if enforcement authorities allege or determine that we are engaging in commercial activities or promoting our commercially approved products in a way that violates applicable regulations.

Physicians have the discretion to prescribe approved drug products for uses that are not described in the product's labeling and that differ from those approved by the FDA or other applicable regulatory agencies. Off-label uses are common across medical specialties. Although the FDA and other regulatory agencies that approve drug products do not regulate a physician's practice of medicine or choice of treatments, the FDA and other regulatory agencies regulate a manufacturer's communications regarding off-label use and prohibit off-label promotion, as well as the dissemination of false or misleading labeling or promotional materials, including by their agents. Manufacturers and their agents may not promote drugs for off-label uses or provide off-label information in the promotion of drug products that is not consistent with the approved labeling for those products. For example, we may not promote ONPATTRO in the U.S. for use in any indications other than the treatment of the polyneuropathy of hATTR amyloidosis in adults. The FDA and other regulatory and enforcement authorities actively enforce laws and regulations prohibiting promotion of off-label uses and the promotion of products for which marketing approval has not been obtained. A company that is found to have improperly promoted off-label uses may be subject to corrective advertising in addition to significant liability, which may include civil and administrative remedies as well as criminal sanctions.

Notwithstanding regulations related to product promotion, the FDA and other regulatory authorities allow companies to engage in truthful, non-misleading and non-promotional scientific exchange concerning their products, and we intend to engage in medical education activities and communicate with healthcare providers in compliance with all applicable laws and regulatory guidance. Nonetheless, the FDA, other applicable regulatory authorities, competitors, and other third parties may take the position that we are not in compliance with such regulations, and if such non-compliance is proven, it could harm our reputation, financial condition or divert financial and management resources from our core business, and would have a material adverse effect on our business, financial condition and results of operations. Moreover, any threatened or actual government enforcement actions or lawsuits by third parties could also generate adverse publicity, which could decrease demand for our products and require that we devote substantial resources that could be used productively on other aspects of our business.

In addition to our medical education efforts, we also offer patient support services to assist patients receiving treatment with our commercially approved products. Manufacturers have increasingly become the focus of government investigation of patient support programs based on allegations that through such services illegal inducements are provided to physicians and/or patients, leading to improper utilization of government resources through Medicare, Medicaid and other government programs. Companies that are found to have violated laws such as the federal Anti-Kickback Statute and/or False Claims Act, or FCA, face significant liability, including civil and administrative penalties, criminal sanctions, and potential exclusion from participation in government programs. We have designed our programs in a manner that we believe complies with all applicable laws and regulations and have implemented a robust compliance program to support a compliant corporate culture and compliance with such laws.

Any drugs we develop may become subject to unfavorable pricing regulations, third-party reimbursement practices or healthcare reform initiatives, thereby harming our business.

The regulations that govern marketing approvals, pricing and reimbursement for new drugs vary widely from country to country. Some countries require approval of the sale price of a drug before it can be marketed. In many countries, the pricing review period begins after marketing or product licensing approval is granted. In some foreign markets, prescription pharmaceutical pricing remains subject to continuing governmental control even after initial approval is granted. We are actively monitoring these regulations as we market and sell ONPATTRO and GIVLAARI and as several of our other programs move through late stages of development. However, a number of our programs are currently in the earlier stages of development and we will not be able to assess the impact of price regulations for such programs for a number of years. We might obtain regulatory approval for a product, including ONPATTRO and GIVLAARI, in a particular country, but then be subject to price regulations that delay our commercial launch of the product and negatively impact the revenues we are able to generate from the sale of the product in that country and potentially in other countries due to reference pricing.

Our ability to commercialize ONPATTRO, GIVLAARI or any future products, including lumasiran, successfully also will depend in part on the extent to which reimbursement for these products and related treatments will be available from government health administration authorities, private health insurers and other organizations. ONPATTRO, GIVLAARI and other products for which we are able to obtain marketing approval, including lumasiran, may not be considered cost-effective, and the amount reimbursed may be insufficient to allow us to sell ONPATTRO, GIVLAARI or any future products, including lumasiran on a competitive basis. Increasingly, the third-party payors who pay for or reimburse patients or healthcare providers, such as government and private insurance plans, are requiring that drug companies provide them with predetermined discounts from list prices, and are seeking to reduce the prices charged or the amounts reimbursed for drug products. In the U.S., we have entered into more than ten VBAs and are negotiating additional VBAs for ONPATTRO with certain private health insurers. In addition, we have made significant progress toward establishing VBAs for GIVLAARI. The goal of these agreements is to ensure that we are paid based on the ability of our commercially approved products to deliver results in the real world setting comparable to those demonstrated in clinical trials. Partnering with payers on these agreements is intended to provide more certainty to them for their investment, and help accelerate coverage decisions for patients. The agreements are structured to link our commercially approved products' performance in real-world use to financial terms. If the price we are able to charge for ONPATTRO, GIVLAARI or any other products we develop, including lumasiran, or the reimbursement provided for such products, is inadequate in light of our development and other costs, or if reimbursement is denied, our return on investment could be adversely affected. In addition, we have stated publicly that we intend to grow through continued scientific innovation rather than arbitrary price increases. Specifically, we have stated that we will not raise the price of any product for which we receive marketing approval over the rate of inflation, as determined by the consumer price index for urban consumers (approximately 2.2% currently) absent a significant value driver. Our patient access philosophy could also negatively impact the revenues we are able to generate from the sale of one or more of our products in the future.

Some of the drugs we market need to be administered under the supervision of a physician or other healthcare professional on an outpatient basis, including ONPATTRO and GIVLAARI. Under currently applicable U.S. law, certain drugs that are not usually self-administered (including injectable drugs) may be eligible for coverage under the Medicare Part B program if:

- they are incident to a physician's services;
- they are reasonable and necessary for the diagnosis or treatment of the illness or injury for which they are administered according to accepted standards of medical practice; and
- they have been approved by the FDA and meet other requirements of the statute.

There may be significant delays in obtaining coverage for newly-approved drugs, and coverage may be more limited than the purposes for which the drug is approved by the FDA or foreign regulatory authorities. Moreover, eligibility for coverage does not imply that any drug will be reimbursed in all cases or at a rate that covers our costs, including research, development, manufacture, sale and distribution or that covers a particular provider's cost of acquiring the drug. Interim payments for new drugs, if applicable, may also not be sufficient to cover our costs and may not be made permanent. Reimbursement may be based on payments allowed for lower-cost drugs that are already reimbursed, may be incorporated into existing payments for other services and may reflect budgetary constraints or imperfections in Medicare data. Net prices for drugs may be reduced by mandatory discounts or rebates required by government healthcare programs or private payors and by any future relaxation of laws that presently restrict imports of drugs from countries where they may be sold at lower prices than in the U.S. For example, on December 18, 2019, President Trump, the U.S. Department of Health and Human Services, and the FDA issued a notice of proposed rulemaking that, if finalized, would allow for the importation of certain prescription drugs from Canada. FDA also issued a Draft Guidance document outlining a potential pathway for manufacturers to obtain an additional National Drug Code for an FDA-approved drug that was originally intended to be marketed in a foreign country and that was authorized for sale in that foreign country. The regulatory and market implications of the notice of proposed rulemaking and Draft Guidance are unknown at this time, but legislation, regulations or policies allowing the reimportation of drugs, if enacted and implemented, could decrease the price we receive for our products and adversely affect our future revenues and prospects for profitability. Third-party payors often rely upon Medicare coverage policy and payment limitations in setting their own reimbursement rates. Our inability to promptly obtain coverage or adequate reimbursement rates from both government-funded and private payors for ONPATTRO, GIVLAARI or other new drugs that we develop, including lumasiran, and for which we obtain regulatory approval could have a material adverse effect on our operating results, our ability to raise capital needed to commercialize products, and our overall financial condition.

We believe that the efforts of governments and third-party payors to contain or reduce the cost of healthcare and legislative and regulatory proposals to broaden the availability of healthcare will continue to affect the business and financial condition of pharmaceutical and biopharmaceutical companies. Specifically, there have been several recent U.S. Congressional inquiries and proposed federal and state legislation designed to, among other things, bring more transparency to drug pricing, reduce the cost of prescription drugs under Medicare, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for drugs.

A number of other legislative and regulatory changes in the healthcare system in the U.S. and other major healthcare markets have been proposed or enacted in recent months and years, and such efforts have expanded substantially in recent years. These developments have included prescription drug benefit legislation that was enacted in 2003 and took effect in January 2006, healthcare reform legislation enacted by certain states, and major healthcare reform legislation that was passed by Congress and enacted into law in the U.S. in 2010. These developments could, directly or indirectly, affect our ability to sell ONPATTRO, GIVLAARI or future products, if approved, including lumasiran, at a favorable price.

In particular, in March 2010, the Patient Protection and Affordable Care Act, also referred to as the Affordable Care Act, or the ACA, was signed into law. This legislation changed the system of healthcare insurance and benefits intended to broaden coverage and control costs. The law also contains provisions that affect companies in the pharmaceutical industry and other healthcare related industries by imposing additional costs and changes to business practices. Among the provisions affecting pharmaceutical companies are the following:

- Mandatory rebates for drugs sold into the Medicaid program were increased, and the rebate requirement was extended to drugs used in risk-based Medicaid managed care plans.
- The 340B Drug Pricing Program under the Public Health Service Act was extended to require mandatory discounts for drug products sold to certain critical access hospitals, cancer hospitals and other covered entities.
- Pharmaceutical companies are required to offer discounts on brand-name drugs to patients who fall within the Medicare Part D coverage gap, commonly referred to as the “donut hole.”
- Pharmaceutical companies are required to pay an annual non-tax deductible fee to the federal government based on each company’s market share of prior year total sales of branded products to certain federal healthcare programs, such as Medicare, Medicaid, Department of Veterans Affairs and Department of Defense. Since we expect our branded pharmaceutical sales to constitute a small portion of the total federal healthcare program pharmaceutical market, we do not expect this annual assessment to have a material impact on our financial condition.
- The law provides that approval of an application for a follow-on biologic product may not become effective until 12 years after the date on which the reference innovator biologic product was first licensed by the FDA, with a possible six-month extension for pediatric products. After this exclusivity ends, it will be easier for generic manufacturers to enter the market, which is likely to reduce the pricing for such products and could affect our profitability.
- The law creates a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for drugs that are inhaled, infused, instilled, implanted or injected.
- The law expands eligibility criteria for Medicaid programs by, among other things, allowing states to offer Medicaid coverage to certain individuals with income at or below 133% of the federal poverty level, thereby potentially increasing a manufacturer’s Medicaid rebate liability.
- The law expands the entities eligible for discounts under the Public Health Service Act pharmaceutical pricing program.
- The law expands healthcare fraud and abuse laws, including the civil FCA and the federal Anti-Kickback Statute, new government investigative powers, and enhanced penalties for noncompliance.
- The law establishes new requirements to report financial arrangements with physicians and teaching hospitals and to annually report drug samples that manufacturers and distributors provide to physicians.
- The law establishes a new Patient-Centered Outcomes Research Institute to oversee, identify priorities in, and conduct comparative clinical effectiveness research, along with funding for such research.
- The law established the Center for Medicare and Medicaid Innovation within the Centers for Medicare and Medicaid Services, or CMS, to test innovative payment and service delivery methods.

In addition, other legislative changes have been proposed and adopted since the ACA was enacted. In August 2011, the Budget Control Act of 2011, among other things, created measures for spending reductions by Congress. A Joint Select Committee on Deficit Reduction, tasked with recommending a targeted deficit reduction of at least $1.2 trillion for the years 2013 through 2021, was unable to reach required goals, thereby triggering the legislation’s automatic reduction to several government programs. These changes included aggregate reductions to Medicare payments to providers of 2% per fiscal year, which went into effect in April 2013 and will remain in effect through 2029; however, these Medicare sequester reductions will be suspended from May 1, 2020 through December 31, 2020 due to the COVID-19 pandemic. The American Taxpayer Relief Act of 2012, among other things, reduced Medicare payments to several providers and increased the statute of limitations period for the government to recover overpayments to providers from three to five years. These new laws may result in additional reductions in Medicare and other healthcare funding and otherwise affect the prices we may obtain for ONPATTRO, GIVLAARI or any of our product candidates for which we may obtain regulatory approval, including lumasiran, or the frequency with which ONPATTRO, GIVLAARI or any future product, including lumasiran, is prescribed or used.

The full effects of the U.S. healthcare reform legislation cannot be known until the law is fully implemented through regulations or guidance issued by the CMS and other federal and state healthcare agencies. The financial impact of the U.S. healthcare reform legislation over the next few years will depend on a number of factors, including, but not limited, to the policies reflected in implementing regulations and guidance, and changes in sales volumes for products affected by the new system of rebates, discounts and fees. This legislation may also have a positive impact on our future net sales, if any, by increasing the aggregate number of persons with healthcare coverage in the U.S.

Since its enactment, there have been numerous judicial, administrative, executive, and legislative challenges to certain aspects of the ACA, and we expect there will be additional challenges and amendments to the ACA in the future. Various portions of the ACA are currently undergoing legal and constitutional challenges in the Fifth Circuit Court and the United States Supreme Court; the Trump Administration has issued various Executive Orders which eliminated cost sharing subsidies and various provisions that would impose a fiscal burden on states or a cost, fee, tax, penalty or regulatory burden on individuals, healthcare providers, health insurers, or manufacturers of pharmaceuticals or medical devices; and Congress has introduced several pieces of legislation aimed at significantly revising or repealing the ACA. It is unclear whether the ACA will be overturned, repealed, replaced, or further amended. We cannot predict what affect further changes to the ACA would have on our business. The costs of prescription pharmaceuticals in the U.S. have also been the subject of considerable discussion in the U.S., and members of Congress and the Trump administration have stated that they will address such costs through new legislative and administrative measures. To date, there have been several U.S. Congressional inquiries and proposed and enacted federal and state legislation designed to, among other things, bring more transparency to drug pricing, review the relationship between pricing and manufacturer patient programs, reduce the costs of drugs under Medicare and reform government program reimbursement methodologies for drug products. At the federal level, Congress and the Trump administration have each indicated that it will continue to pursue new legislative and/or administrative measures to control drug costs. The Trump administration released a “Blueprint,” or plan, to reduce the cost of drugs, increase drug manufacturer competition, increase the negotiating power of certain federal healthcare programs, incentivize manufacturers to lower the list price of their products, and reduce the out of pocket costs of drug products paid by consumers. The Trump administration’s Blueprint contains certain measures that the U.S. Department of Health and Human Services is already working to implement. For example, on October 25, 2018, CMS issued an Advanced Notice of Proposed Rulemaking, or ANPRM, indicating it was considering issuing a proposed rule in 2019 on a model called the International Pricing Index, with a potential start in the spring of 2020. To date, a proposed rule has not yet been released. This model would utilize a basket of other countries’ prices as a reference for the Medicare program to use in reimbursing for drugs covered under Part B. The ANPRM also included an updated version of the Competitive Acquisition Program, as an alternative to current “buy and bill” payment methods for Part B drugs. Such a proposed rule could limit our product pricing and have material adverse effects on our business. Although some of these, and other, proposals related to the administration’s Blueprint may require additional authorization to become effective, may ultimately be withdrawn, or may face challenges in the courts, the Congress and the Trump administration have indicated that they will continue to seek new legislative and administrative measures to control drug costs. For example, on September 25, 2019, the Senate Finance Committee introduced the Prescription Drug Pricing Reduction Act of 2019, a bill intended to reduce Medicare and Medicaid prescription drug prices. The proposed legislation would restructure the Part D benefit, modify payment methodologies for certain drugs, and impose an inflation cap on drug price increases. Another bill, the Lower Drug Costs Now Act of 2019, which passed out of the House of Representatives on December 12, 2019, and would require the U.S. Department of Health and Human Services to directly negotiate drug prices with manufacturers. It is unclear whether either of these bills will make it through both chambers of Congress and be signed into law, and if either is enacted, what effect it would have on our business; however enactment of either of these bills could have a material adverse effect on our business and prospects.

At the state level, legislatures have become increasingly aggressive in passing legislation and implementing regulations designed to control pharmaceutical and biological product pricing. Some of these measures include price or patient reimbursement constraints, discounts, restrictions on certain product access, marketing cost disclosure and transparency measures, and, in some cases, measures designed to encourage importation from other countries and bulk purchasing. In addition, regional health care authorities and individual hospitals are increasingly using bidding procedures to determine what pharmaceutical products and which suppliers will be included in their prescription drug and other health care programs. These measures could reduce the ultimate demand for our products, once approved, or put pressure on our product pricing.

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

We are subject to U.S. and certain foreign export and import controls, sanctions, embargoes, anti-corruption laws, and anti-money laundering laws and regulations. Compliance with these legal standards could impair our ability to compete in

domestic and international markets. We can face criminal liability and other serious consequences for violations, which can harm our business.

We are subject to export control and import laws and regulations, including the U.S. Export Administration Regulations, U.S. Customs regulations, various economic and trade sanctions regulations administered by the U.S. Treasury Department's Office of Foreign Assets Controls, the FCPA, the U.S. domestic bribery statute contained in 18 U.S.C. § 201, the U.S. Travel Act, the USA PATRIOT Act, and other state and national anti-bribery and anti-money laundering laws in the countries in which we conduct activities. Anti-corruption laws are interpreted broadly and prohibit companies and their employees, agents, contractors, and other collaborators from authorizing, promising, offering, or providing, directly or indirectly, improper payments or anything else of value to recipients in the public or private sector. From time to time, we may engage third parties for clinical trials outside of the United States, to sell our products abroad, and/or to obtain necessary permits, licenses, patent registrations, and other regulatory approvals. We have direct or indirect interactions with officials and employees of government agencies or government-affiliated hospitals, universities, and other organizations. We can be held liable for the corrupt or other illegal activities of our employees, agents, contractors, and other collaborators, even if we do not explicitly authorize or have actual knowledge of such activities. Any violations of the laws and regulations described above may result in substantial civil and criminal fines and penalties, imprisonment, the loss of export or import privileges, debarment, tax reassessments, breach of contract and fraud litigation, reputational harm, and other consequences.

Governments outside the U.S. may impose strict price controls, which may adversely affect our revenues, if any.

The pricing of prescription pharmaceuticals is also subject to governmental control outside the U.S. In these countries, pricing negotiations with governmental authorities can take considerable time after the receipt of regulatory 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 revenues and become profitable could be impaired.

In some countries, including Member States of the EU, or Japan, the pricing of prescription drugs is subject to governmental control. Additional countries may adopt similar approaches to the pricing of prescription drugs. In such countries, pricing negotiations with governmental authorities can take considerable time after receipt of regulatory approval for a product. In addition, there can be considerable pressure by governments and other stakeholders on prices and reimbursement levels, including as part of cost containment measures. Moreover, political, economic and regulatory developments may further complicate pricing negotiations, and pricing negotiations may continue after coverage and reimbursement have been obtained. Reference pricing used by various countries and parallel distribution, or arbitrage between low-priced and high-priced countries, can further reduce prices. In some countries, we may be required to conduct a clinical study or other studies that compare the cost-effectiveness of a product candidate to other available therapies in order to obtain or maintain reimbursement or pricing approval, which is time-consuming and costly. We cannot be sure that such prices and reimbursement will be acceptable to us or our strategic partners. Publication of discounts by third-party payors or authorities may lead to further pressure on the prices or reimbursement levels within the country of publication and other countries. If pricing is set at unsatisfactory levels or if reimbursement of our products is unavailable or limited in scope or amount, our revenues from sales by us or our strategic partners and the potential profitability of ONPATTRO, GIVLAARI or any future products, including lumasiran, in those countries would be negatively affected. Another impact from the tightening pricing control could be felt from greater competition from less expensive generic or biosimilar products once the exclusivity expires; the governments have adopted policies to switch prescribed products to generic versions in order to cut the medical cost.

If we or our collaborators, CMOs or service providers fail to comply with healthcare laws and regulations, or legal obligations related to privacy, data protection and information security, we or they could be subject to enforcement actions, which could affect our ability to develop, market and sell our products and may harm our reputation.

As a manufacturer of pharmaceuticals, we are subject to federal, state, and comparable foreign healthcare laws and regulations pertaining to fraud and abuse and patients' rights, in addition to legal obligations related to privacy, data protection and information security. These laws and regulations include:

- The U.S. federal Anti-Kickback Statute, which prohibits, among other things, persons from knowingly and willfully soliciting, receiving, offering or paying remuneration, directly or indirectly, to induce either the referral of an individual for a healthcare item or service, or the purchasing or ordering of an item or service, for which payment may be made under a federal healthcare program such as Medicare or Medicaid.
- The U.S. federal false claims laws, including the FCA, which prohibit, among other things, individuals or entities from knowingly presenting or causing to be presented, claims for payment by government-funded programs such as Medicare or Medicaid that are false or fraudulent, making, using or causing to be made or used a false record or statement material to a false or fraudulent claim to the federal government, or making a false statement to avoid, decrease or conceal an obligation to pay money to the federal government. Manufacturers can be held liable under the FCA even when they do not submit claims directly to government payors if they are deemed to "cause" the submission

of false or fraudulent claims. The FCA also permits a private individual acting as a "whistleblower" to bring actions on behalf of the federal government alleging violations of the FCA and to share in any monetary recovery.

- The federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, which created federal criminal statutes that prohibit knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program or obtain, by means of false or fraudulent pretenses, representations, or promises, any of the money or property owned by, or under the custody or control of, any healthcare benefit program, regardless of the payor (e.g., public or private) and knowingly and willfully falsifying, concealing or covering up by any trick or device a material fact or making any materially false statements in connection with the delivery of, or payment for, healthcare benefits, items or services relating to healthcare matters. Similar to the federal Anti-Kickback Statute, a person or entity can be found guilty of violating HIPAA without actual knowledge of the statute or specific intent to violate it.
- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act, which imposes requirements relating to the privacy, security, and transmission of individually identifiable health information; and requires notification to affected individuals and regulatory authorities of certain breaches of security of individually identifiable health information.
- The U.S. federal Open Payments requirements, which were implemented by the CMS pursuant to the Physician Payments Sunshine Act as part of the ACA. Under the Open Payments Program, manufacturers of medical devices, medical supplies, biological products and drugs covered by Medicare, Medicaid and the Children's Health Insurance Programs must report all transfers of value, including consulting fees, travel reimbursements, research grants, and other payments made to physicians (currently defined to include doctors, dentists, optometrists, podiatrists and chiropractors) and teaching hospitals as well as ownership and investment interests held by physicians and their immediate family members. Legislation passed in 2018 expands the scope of covered recipients to non-physician provider such as physician assistants and advanced practice nurses, effective in 2022.
- Federal statutory and regulatory requirements applicable to pricing and sales of product to Federal Government Agencies.
- Federal consumer protection and unfair competition laws, which broadly regulate marketplace activities and activities that potentially harm consumers.
- State and foreign laws comparable to each of the above federal laws, including in the EU laws prohibiting giving healthcare professionals any gift or benefit in kind as an inducement to prescribe our products, national transparency laws requiring the public disclosure of payments made to healthcare professionals and institutions, and data privacy laws, in addition to anti-kickback and false claims laws applicable to commercial insurers and other non-federal payors, requirements for mandatory corporate regulatory compliance programs, and laws relating to government reimbursement programs, patient data privacy and security.
- European Privacy Laws including Regulation 2016/679, known as the General Data Protection Regulation, or the GDPR, and the e-Privacy Directive (202/58/EC), and the national laws implementing each of them, as well as the privacy laws of Japan and other territories. Failure to comply with our obligations under the privacy regime could expose us to significant fines and/or adverse publicity, which could have material adverse effects on our reputation and business.
- The California Consumer Privacy Act of 2018, or CCPA, effective as of January 1, 2020, that gives California residents expanded rights to access and require deletion of their personal information, opt out of certain personal information sharing, and receive detailed information about how their personal information is used. The CCPA provides for civil penalties for violations, as well as a private right of action for data breaches that is expected to increase data breach litigation.

Some state laws also require pharmaceutical manufacturers to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government, in addition to requiring manufacturers to report information related to payments to physicians and other healthcare provides or marketing expenditures and pricing information. State and foreign laws also govern the privacy and security of health information, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts.

In the EU, the GDPR replaced the EU Data Protection Directive on May 25, 2018. The GDPR introduced new data protection requirements in the EU, as well as potential fines for noncompliance of up to the greater of €20,000,000 or 4% of total annual global revenue. The regulation imposes numerous new requirements for the collection, use and disclosure of personal information, including: more stringent requirements relating to data subject consent; what information must be shared with data subjects regarding how their personal information is used; the obligation to notify regulators and affected individuals of personal data breaches; extensive new internal privacy governance obligations; and obligations to honor expanded rights of individuals in relation to their personal information (e.g., the right to access, correct and delete their data). In addition, the GDPR maintains the EU Data Protection Directive's restrictions on cross-border data transfer. The GDPR increases the responsibility and liability of pharmaceutical companies in relation to processing personal data, and companies may be required to put in place additional mechanisms to ensure compliance with the new EU data protection rules. Further, Brexit has created uncertainty with regard to the status of the UK as an "adequate country" for the purposes of data transfers outside the EEA. In particular, it is unclear how data transfers to and from the UK will be regulated. These changes may require us to find alternative bases for the compliant transfer of personal data from the UK to the U.S., and we are monitoring developments in this area.

If our operations are found to be in violation of any of the aforementioned requirements, we may be subject to penalties, including civil or criminal penalties, criminal prosecution, monetary damages, the curtailment or restructuring of our operations, loss of eligibility to obtain approvals from the FDA, or exclusion from participation in government contracting, healthcare reimbursement or other government programs, including Medicare and Medicaid, or the imposition of a corporate integrity agreement with the Office of Inspector General of the Department of Health and Human Services, any of which could adversely affect our financial results. We are continuing to establish our global compliance infrastructure following the commercial launches of ONPATTRO in the third quarter of 2018, and GIVLAARI in December 2019, and as we prepare for the launch of our products in additional countries, assuming regulatory approvals. Although effective compliance programs can mitigate the risk of investigation and prosecution for violations of these laws, these risks cannot be entirely eliminated. Any action against us for an alleged or suspected violation could cause us to incur significant legal expenses and could divert our management's attention from the operation of our business, even if our defense is successful. In addition, achieving and sustaining compliance with applicable laws and regulations may be costly to us in terms of money, time and resources.

If we or our collaborators, CMOs or service providers fail to comply with applicable federal, state or foreign laws or regulations, we could be subject to enforcement actions, which could affect our ability to develop, market and sell ONPATTRO GIVLAARI, or any other future products, successfully and could harm our reputation and lead to reduced acceptance of our products by the market. These enforcement actions include, among others:

- adverse regulatory inspection findings;
- untitled letters or warning letters;
- voluntary or mandatory product recalls or public notification or medical product safety alerts to healthcare professionals;
- restrictions on, or prohibitions against, marketing our products;
- restrictions on, or prohibitions against, importation or exportation of our products;
- suspension of review or refusal to approve pending applications or supplements to approved applications;
- exclusion from participation in government-funded healthcare programs;
- exclusion from eligibility for the award of government contracts for our products;
- suspension or withdrawal of product approvals;
- product seizures;
- injunctions; and
- civil and criminal penalties, up to and including criminal prosecution resulting in fines, exclusion from healthcare reimbursement programs and imprisonment.

Moreover, federal, state or foreign laws or regulations are subject to change, and while we, our collaborators, CMOs and/or service providers currently may be compliant, that could change due to changes in interpretation, prevailing industry standards or the legal structure.

We are subject to governmental regulation and other legal obligations, particularly related to privacy, data protection and information security, and we are subject to consumer protection laws that regulate our marketing practices and prohibit unfair or deceptive acts or practices. Our actual or perceived failure to comply with such obligations could harm our business.

The GDPR imposes strict requirements on controllers and processors of personal data, including special protections for "special category data," which includes health, biometric and genetic information of data subjects located in the EU. Further, GDPR provides a broad right for EU Member States to create supplemental national laws, such as laws relating to the processing of health, genetic and biometric data, which could further limit our ability to use and share such data or could cause our costs to increase, and harm our business and financial condition. GDPR grants individuals the opportunity to object to the processing of their personal information, allows them to request deletion of personal information in certain circumstances, and provides the individual with an express right to seek legal remedy in the event the individual believes his or her rights have been violated. Further, the GDPR imposes strict rules on the transfer of personal data out of the EU to the U.S. or other regions that have not been deemed to offer "adequate" privacy protections.

Failure to comply with the requirements of the GDPR and the related national data protection laws of the EU Member States, which may deviate slightly from the GDPR, may result in fines of up to 4% of total global annual revenue, or €20,000,000, whichever is greater, and in addition to such fines, we may be the subject of litigation and/or adverse publicity, which could have material adverse effect on our reputation and business. As a result of the implementation of the GDPR, we are required to put in place additional mechanisms to ensure compliance with the new data protection rules. For example, the GDPR requires us to make more detailed disclosures to data subjects, requires disclosure of the legal basis on which we can process personal data, may make it harder for us to obtain valid consent for processing, will require the appointment of a data protection officer where sensitive personal data (i.e., health data) is processed on a large scale, introduces mandatory data breach notification requirements throughout the EU, imposes additional obligations on us when we are contracting with service providers and requires us to adopt appropriate privacy governance including policies, procedures, training and data audit.

We are subject to the supervision of local data protection authorities in those jurisdictions where we are monitoring the behavior of individuals in the EU (i.e., undertaking clinical trials). We depend on a number of third parties in relation to the provision of our services, a number of which process personal data of EU individuals on our behalf. With each such provider we enter or intend to enter into contractual arrangements under which they are contractually obligated to only process personal data according to our instructions, and conduct or intend to conduct diligence to ensure that they have sufficient technical and organizational security measures in place.

We are also subject to evolving European privacy laws on electronic marketing and cookies. The EU is in the process of replacing the e-Privacy Directive (2002/58/EC) with a new set of rules taking the form of a regulation, which will be directly implemented in the laws of each European member state, without the need for further enactment. While the e-Privacy Regulation was originally intended to be adopted on May 25, 2018 (alongside the GDPR), it is still going through the European legislative process. Draft regulations were rejected by the Permanent Representatives Committee of the Council of EU on November 22, 2019; it is not clear when new regulations will be adopted in 2020.

There is significant uncertainty related to the manner in which data protection authorities will seek to enforce compliance with GDPR. Further, Brexit has created uncertainty with regard to the status of the UK as an ‘adequate country’ for the purposes of data transfers outside the EEA. In particular, it is unclear how data transfers to and from the UK will be regulated. Enforcement uncertainty and the costs associated with ensuring GDPR and e-Privacy compliance may be onerous and may adversely affect our business, financial condition, results of operations and prospects.

Compliance with U.S. and international data protection laws and regulations could require us to take on more onerous obligations in our contracts, restrict our ability to collect, use and disclose data, or in some cases, impact our ability to operate in certain jurisdictions. Failure to comply with these laws and regulations could result in government enforcement actions (which could include civil, criminal and administrative penalties), private litigation, and/or adverse publicity and could negatively affect our operating results and business. Moreover, clinical trial subjects, employees and other individuals about whom we or our potential collaborators obtain personal information, as well as the providers who share this information with us, may limit our ability to collect, use and disclose the information. Claims that we have violated individuals’ privacy rights, failed to comply with data protection laws, or breached our contractual obligations, even if we are not found liable, could be expensive and time-consuming to defend and could result in adverse publicity that could harm our business.

Our ability to obtain services, reimbursement or funding from the federal government may be impacted by possible reductions in federal spending and services, and any inability on our part to effectively adapt to such changes could substantially affect our financial position, results of operations and cash flows.

Under the Budget Control Act of 2011, the failure of Congress to enact deficit reduction measures of at least $1.2 trillion for the years 2013 through 2021 triggered automatic cuts to most federal programs. These cuts included aggregate reductions to Medicare payments to providers of up to 2% per fiscal year, starting in 2013 (however, these Medicare sequester reductions will be suspended from May 1, 2020 through December 31, 2020 due to the COVID-19 pandemic). Certain of these automatic cuts have been implemented resulting in reductions in Medicare payments to physicians, hospitals, and other healthcare providers, among other things. Due to legislation amending the statute, including the Bipartisan Budget Act of 2018, these reductions will stay in effect through 2029 unless additional Congressional action is taken. The full impact on our business of these automatic cuts is uncertain.

If other federal spending is reduced, any budgetary shortfalls may also impact the ability of relevant agencies, such as the FDA or the National Institutes of Health to continue to function. Amounts allocated to federal grants and contracts may be reduced or eliminated. These reductions may also impact the ability of relevant agencies to timely review and approve drug research and development, manufacturing, and marketing activities, which may delay our ability to develop, market and sell ONPATTRO, GIVLAARI and any other products we may develop, including lumasiran.

Separately, in response to the COVID-19 pandemic, on March 10, 2020 the FDA announced its intention to postpone most inspections of foreign manufacturing facilities and products through April 2020. On March 18, 2020, the FDA announced its intention to temporarily postpone routine surveillance inspections of domestic manufacturing facilities and provided guidance regarding the conduct of clinical trials. Regulatory authorities outside the U.S. may adopt similar restrictions or other policy measures in response to the COVID-19 pandemic. If a prolonged government shutdown occurs, or if global health concerns related to COVID-19 continue to prevent the FDA or other regulatory authorities from conducting certain aspects of their regular review and approval processes within specified or customary time periods, it could significantly impact the ability of the FDA to timely review and process our regulatory submissions, which could have a material adverse effect on our business. Resolving such delays could force us or our collaborators to incur significant costs, could limit our allowed activities or the allowed activities of our collaborators, could diminish any competitive advantages that we or our collaborators may attain or could adversely affect our business, financial condition, results of operations and prospects, the value of our common stock and our ability to bring new products to market as forecasted. Even without such delay, there is no guarantee we will receive approval for our product candidates on a timely basis, or at all.

There is a substantial risk of product liability claims in our business. If we are unable to obtain sufficient insurance, a product liability claim against us could adversely affect our business.

Our business exposes us to significant potential product liability risks that are inherent in the development, testing, manufacturing and marketing of human therapeutic products. Product liability claims could delay or prevent completion of our clinical development programs. Following the decision to discontinue clinical development of revusiran, we conducted a comprehensive evaluation of available revusiran data. We reported the results of this evaluation in August 2017, however, our investigation did not result in a conclusive explanation regarding the cause of the mortality imbalance observed in the ENDEAVOUR Phase 3 study. In addition, in September 2017, we announced that we had temporarily suspended dosing in all ongoing fitusiran studies pending further review of a fatal thrombotic SAE and agreement with regulatory authorities on a risk mitigation strategy. Notwithstanding the risks undertaken by all persons who participate in clinical trials, and the information on risks provided to study investigators and patients participating in our clinical trials, including the revusiran and fitusiran studies, it is possible that product liability claims will be asserted against us relating to the worsening of a patient’s condition, injury or death alleged to have been caused by one of our product candidates, including revusiran or fitusiran. Such claims might not be fully covered by product liability insurance. If we succeed in marketing products, including ONPATTRO and GIVLAARI, product liability claims could result in an FDA investigation of the safety and effectiveness of our products, our manufacturing processes and facilities or our marketing programs, and potentially a recall of our products or more serious enforcement action, limitations on the approved indications for which they may be used, or suspension or withdrawal of approvals. Regardless of the merits or eventual outcome, liability claims may also result in decreased demand for our products, injury to our reputation, costs to defend the related litigation, a diversion of management’s time and our resources, substantial monetary awards to trial participants or patients and a decline in our stock price. We currently have product liability insurance that we believe is appropriate for our stage of development, including the marketing and sale of ONPATTRO and GIVLAARI. Any insurance we have or may obtain may not provide sufficient coverage against potential liabilities. Furthermore, clinical trial and product liability insurance is becoming increasingly expensive. As a result, we may be unable to obtain sufficient insurance at a reasonable cost to protect us against losses caused by product liability claims that could have a material adverse effect on our business.

Our employees may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements or insider trading violations, which could significantly harm our business.

We are exposed to the risk of employee fraud or other misconduct. Misconduct by employees could include intentional failures to comply with governmental regulations, comply with healthcare fraud and abuse and anti-kickback laws and regulations in the U.S. and abroad, or failure to report financial information or data accurately or disclose unauthorized activities to us. In particular, sales, marketing and business arrangements in the healthcare industry are subject to extensive laws and regulations intended to prevent fraud, misconduct, kickbacks, self-dealing and other abusive practices. These laws and regulations may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, customer incentive programs and other business arrangements. Employee misconduct could also involve the improper use of, including improper trading based upon, information obtained in the course of clinical studies, which could result in regulatory sanctions and serious harm to our reputation. We have adopted a code of business conduct and ethics and a robust compliance program, but it is not always possible to identify and deter employee misconduct, and the precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to comply with these laws or regulations. If any such actions are instituted against us, and we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business and results of operations, including the imposition of significant fines or other sanctions.

If we do not comply with laws regulating the protection of the environment and health and human safety, our business could be adversely affected.

Our research, development and manufacturing involve the use of hazardous materials, chemicals and various radioactive compounds. We maintain quantities of various flammable and toxic chemicals in our facilities in Cambridge and Norton that are required for our research, development and manufacturing activities. We are subject to federal, state and local laws and regulations governing the use, manufacture, storage, handling and disposal of these hazardous materials. We believe our procedures for storing, handling and disposing these materials in our Cambridge and Norton facilities comply with the relevant guidelines of the City of Cambridge, the town of Norton, the Commonwealth of Massachusetts and the Occupational Safety and Health Administration of the U.S. Department of Labor. Although we believe that our safety procedures for handling and disposing of these materials comply with the standards mandated by applicable regulations, the risk of accidental contamination or injury from these materials cannot be eliminated. If an accident occurs, we could be held liable for resulting damages, which could be substantial. We are also subject to numerous environmental, health and workplace safety laws and regulations, including those governing laboratory procedures, exposure to blood-borne pathogens and the handling of biohazardous materials.

Although we maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees resulting from the use of these materials, this insurance may not provide adequate coverage against potential liabilities. We do not maintain insurance for environmental liability or toxic tort claims that may be asserted against us in connection with our storage or disposal of biological, hazardous or radioactive materials. Additional federal, state and local laws and regulations affecting our operations may be adopted in the future. We may incur substantial costs to comply with, and substantial fines or penalties if we violate, any of these laws or regulations.

Risks Related to Patents, Licenses and Trade Secrets

If we are not able to obtain and enforce patent protection for our discoveries, our ability to develop and commercialize our product candidates will be harmed.

Our success depends, in part, on our ability to protect proprietary compositions, methods and technologies that we develop under the patent and other intellectual property laws of the U.S. and other countries, so that we can prevent others from unlawfully using our inventions and proprietary information. However, we may not hold proprietary rights to some patents required for us to manufacture and commercialize our proposed products. Because certain U.S. patent applications are confidential until the patents issue, such as applications filed prior to November 29, 2000, or applications filed after such date which will not be filed in foreign countries, third parties may have filed patent applications for subject matter covered by our pending patent applications without our being aware of those applications, and our patent applications may not have priority over those applications. For this and other reasons, we may be unable to secure desired patent rights, thereby losing desired exclusivity. Further, we or our licensees may be required to obtain licenses under third-party patents to market ONPATTRO or GIVLAARI or further develop and commercialize future products such as lumasiran and inclisiran, currently under review with the FDA, or continuing to develop candidates in our pipeline being developed by us or our licensees. If licenses are not available to us or not available on reasonable terms, we or our licensees may not be able to market the affected products or conduct the desired activities.

Our strategy depends on our ability to rapidly identify and seek patent protection for our discoveries. In addition, we may rely on third-party collaborators to file patent applications relating to proprietary technology that we develop jointly during certain collaborations. The process of obtaining patent protection is expensive and time-consuming. If our present or future collaborators fail to file and prosecute all necessary and desirable patent applications at a reasonable cost and in a timely manner, our business may be adversely affected. Despite our efforts and the efforts of our collaborators to protect our proprietary rights, unauthorized parties may be able to obtain and use information that we regard as proprietary. While issued patents are presumed valid, this does not guarantee that the patent will survive a validity challenge or be held enforceable. Any patents we have obtained, or obtain in the future, may be challenged, invalidated, adjudged unenforceable or circumvented by parties attempting to design around our intellectual property. Moreover, third parties or the United States Patent and Trademark Office, or USPTO, may commence interference proceedings involving our patents or patent applications. Any challenge to, finding of unenforceability or invalidation or circumvention of, our patents or patent applications, would be costly, would require significant time and attention of our management, could reduce or eliminate royalty payments to us from third party licensors and could have a material adverse effect on our business.

Our pending patent applications may not result in issued patents. The patent position of pharmaceutical or biotechnology companies, including ours, is generally uncertain and involves complex legal and factual considerations. The standards that the USPTO and its foreign counterparts use to grant patents are not always applied predictably or uniformly and can change. Similarly, the ultimate degree of protection that will be afforded to biotechnology inventions, including ours, in the U.S. and foreign countries, remains uncertain and is dependent upon the scope of the protection decided upon by patent offices, courts and lawmakers. Moreover, there are periodic discussions in the Congress of the United States and in international jurisdictions about modifying various aspects of patent law. For example, the America Invents Act, or AIA, included a number of changes to the patent laws of the U.S. If any of the enacted changes do not provide adequate protection for discoveries, including our ability to pursue infringers of our patents for substantial damages, our business could be adversely affected. One major provision of the AIA, which took effect in March 2013, changed U.S. patent practice from a first-to-invent to a first-to-file system. If we fail to file an invention before a competitor files on the same invention, we no longer have the ability to provide proof that we were in possession of the invention prior to the competitor's filing date, and thus would not be able to obtain patent protection for our invention. There is also no uniform, worldwide policy regarding the subject matter and scope of claims granted or allowable in pharmaceutical or biotechnology patents.

Accordingly, we do not know the degree of future protection for our proprietary rights or the breadth of claims that will be allowed in any patents issued to us or to others. We also rely to a certain extent on trade secrets, know-how and technology, which are not protected by patents, to maintain our competitive position. If any trade secret, know-how or other technology not protected by a patent were to be disclosed to or independently developed by a competitor, our business and financial condition could be materially adversely affected.

Failure to obtain and maintain all available regulatory exclusivities, broad patent scope and to maximize patent term restoration or extension on patents covering our products may lead to loss of exclusivity and early generic entry resulting in a loss of market share and/or revenue.

We license patent rights from third-party owners. If such owners do not properly or successfully obtain, maintain or enforce the patents underlying such licenses, our competitive position and business prospects may be harmed.

We are a party to a number of licenses that give us rights to third-party intellectual property that is necessary or useful for our business. In particular, we have obtained licenses from, among others, Cancer Research Technology Ltd., Ionis, the Massachusetts Institute of Technology, or MIT, Whitehead Institute for Biomedical Research, or Whitehead, Max Planck Innovation GmbH (formerly known as Garching Innovation GmbH), or Max Planck, and Arbutus. We also intend to enter into additional licenses to third-party intellectual property in the future.

Our success will depend in part on the ability of our licensors to obtain, maintain and enforce patent protection for our licensed intellectual property, in particular, those patents to which we have secured exclusive rights. Our licensors may not successfully prosecute the patent applications to which we are licensed. Even if patents issue in respect of these patent applications, our licensors may fail to maintain these patents, may determine not to pursue litigation against other companies that are infringing these patents, or may pursue such litigation less aggressively than we would. Without protection for the intellectual property we license, other companies might be able to offer substantially identical products for sale, which could adversely affect our competitive business position and harm our business prospects. In addition, we sublicense our rights under various third-party licenses to our collaborators. Any impairment of these sublicensed rights could result in reduced revenues under our collaboration agreements or result in termination of an agreement by one or more of our collaborators.

Other companies or organizations may challenge our patent rights or may assert patent rights that prevent us from developing and commercializing our products.

RNAi is a relatively new scientific field, the commercial exploitation of which has resulted in many different patents and patent applications from organizations and individuals seeking to obtain patent protection in the field. We have obtained grants and issuances of RNAi patents and have licensed many of these patents from third parties on an exclusive basis. The issued patents and pending patent applications in the U.S. and in key markets around the world that we own or license claim many different methods, compositions and processes relating to the discovery, development, manufacture and commercialization of RNAi therapeutics.

Specifically, we have a portfolio of patents, patent applications and other intellectual property covering: fundamental aspects of the structure and uses of siRNAs, including their use as therapeutics, and RNAi-related mechanisms; chemical modifications to siRNAs that improve their suitability for therapeutic and other uses; siRNAs directed to specific targets as treatments for particular diseases; delivery technologies, such as in the fields of carbohydrate conjugates and cationic liposomes; and all aspects of our specific development candidates.

As the field of RNAi therapeutics is maturing, patent applications are being fully processed by national patent offices around the world. There is uncertainty about which patents will issue, and, if they do, as to when, to whom, and with what claims. It is likely that there will be significant litigation and other proceedings, such as interference, re-examination and opposition proceedings, as well as *inter partes* and post-grant review proceedings introduced by provisions of the AIA, which became available to third party challengers on September 16, 2012, in various patent offices relating to patent rights in the RNAi field. In addition, third parties may challenge the validity of our patents. For example, a third party has filed an opposition in the EPO against our owned patent EP 2723758, with claims directed to compositions and methods of ANGPTL3, arguing that the granted claims are invalid. We expect that additional oppositions will be filed in the EPO and elsewhere, and other challenges will be raised relating to other patents and patent applications in our portfolio. In many cases, the possibility of appeal exists for either us or our opponents, and it may be years before final, unappealable rulings are made with respect to these patents in certain jurisdictions. The timing and outcome of these and other proceedings is uncertain and may adversely affect our business if we are not successful in defending the patentability and scope of our pending and issued patent claims. Even if our rights are not directly challenged, disputes could lead to the weakening of our intellectual property rights. Our defense against any attempt by third parties to circumvent or invalidate our intellectual property rights could be costly to us, could require significant time and attention of our management and could have a material adverse effect on our business and our ability to successfully compete in the field of RNAi.

There are many issued and pending patents that claim aspects of oligonucleotide chemistry and modifications that we may need for our siRNA marketed products ONPATTRO and GIVLAARI, our late-stage therapeutic candidates being developed by us or our licensees, including lumasiran, inclisiran and fitusiran, as well as our other pipeline products. There are also many issued patents that claim targeting genes or portions of genes that may be relevant for siRNA drugs we wish to develop. In addition, there may be issued and pending patent applications that may be asserted against us in a court proceeding or otherwise based upon the asserting party’s belief that we may need such patents for our siRNA therapeutic candidates or marketed products, including ONPATTRO and GIVLAARI, or further develop and commercialize future products such as lumasiran and inclisiran, currently under review with the FDA, or continuing to develop candidates in our pipeline being developed by us or our licensees. Thus, it is possible that one or more organizations will hold patent rights to which we may need a license, or hold patent rights which could be asserted against us. If those organizations refuse to grant us a license to such patent rights on reasonable terms and/or a court rules that we need such patent rights that have been asserted against us and we are not able to obtain a license on reasonable terms, we may be unable to market products, including ONPATTRO or GIVLAARI, or perform research and development or other activities covered by such patents. For example, during 2017 and 2018, Silence Therapeutics plc, or Silence, filed claims in several jurisdictions, including the High Court of England and Wales, and named us and our wholly owned subsidiary Alnylam UK Ltd. as co-defendants. Silence alleged various claims, including that ONPATTRO infringed one or more Silence patents. There were also a number of related actions brought by us or Silence in connection with this intellectual property dispute. In December 2018, we entered into a Settlement and License Agreement with Silence, resolving all ongoing claims, administrative proceedings, and regulatory proceedings worldwide between us regarding, among other issues, patent infringement, patent invalidity and breach of contract.

If we become involved in patent litigation or other proceedings related to a determination of rights, we could incur substantial costs and expenses, substantial liability for damages or be required to stop our product development and commercialization efforts.

Third parties may sue us for infringing their patent rights. For example, in October 2017 Silence sued us in the UK alleging that ONPATTRO and other investigational RNAi therapeutics we or MDCO are developing infringed one or more Silence patents. Likewise, we may need to resort to litigation to enforce a patent issued or licensed to us or to determine the scope and validity of proprietary rights of others or protect our proprietary information and trade secrets. For example, during the second quarter of 2015, we filed a trade secret misappropriation lawsuit against Dicerna to protect our rights in the RNAi assets we purchased from Merck Sharp & Dohme Corp., or Merck. We and Dicerna settled the ongoing litigation between us in April 2018 and in December 2018 we and Silence settled all ongoing litigation between us. A third party may also claim that we have improperly obtained or used its confidential or proprietary information. For example, in March 2011, Arbutus Biopharma Corp., or Arbutus, filed a civil complaint against us alleging, among other things, misappropriation of its confidential and proprietary information and trade secrets. In November 2012, we settled this litigation and restructured our contractual relationship with Arbutus. In connection with this restructuring, we incurred a $65.0 million charge to operating expenses during the fourth quarter of 2012.

In protecting our intellectual patent rights through litigation or other means, a third party may claim that we have improperly asserted our rights against them. For example, in August 2017, Dicerna successfully added counterclaims against us in the above-referenced trade secret lawsuit alleging that our lawsuit represented abuse of process and claiming tortious interference with its business. In addition, in August 2017, Dicerna filed a lawsuit against us in the United States District Court of Massachusetts alleging attempted monopolization by us under the Sherman Antitrust Act. As noted above, in April 2018, we and Dicerna settled the ongoing litigation between us.

Furthermore, third parties may challenge the inventorship of our patents or licensed patents. For example, in March 2011, The University of Utah, or Utah, filed a complaint against us, Max Planck Gesellschaft Zur Foerderung Der Wissenschaften e.V. and Max Planck Innovation, together, Max Planck, Whitehead, MIT and the University of Massachusetts, claiming that a professor of Utah was the sole inventor, or in the alternative, a joint inventor of certain of our in-licensed patents. Utah was seeking correction of inventorship of the Tuschl patents, unspecified damages and other relief. After several years of court proceedings and discovery, the court granted our motions for summary judgment, and dismissed Utah's state law damages claims as well. During the pendency of this litigation, as well as the Arbutus and Dicerna litigation described above, we incurred significant costs, and in each case, the litigation diverted the attention of our management and other resources that would otherwise have been engaged in other activities.

In addition, in connection with certain license and collaboration agreements, we have agreed to indemnify certain third parties for certain costs incurred in connection with litigation relating to intellectual property rights or the subject matter of the agreements. The cost to us of any litigation or other proceeding relating to intellectual property rights, even if resolved in our favor, could be substantial, and litigation would divert our management's efforts. Some of our competitors may be able to sustain the costs of complex patent litigation more effectively than we can because they have substantially greater resources. Uncertainties resulting from the initiation and continuation of any litigation could delay our research, development and commercialization efforts and limit our ability to continue our operations.

If any parties successfully claim that our creation or use of proprietary technologies infringes upon or otherwise violates their intellectual property rights, we might be forced to pay damages, potentially including treble damages, if we are found to have willfully infringed on such parties' patent rights. In addition to any damages we might have to pay, a court could issue an injunction requiring us to stop the infringing activity or obtain a license. Any license required under any patent may not be made available on commercially reasonable terms, if at all. In addition, such licenses are likely to be non-exclusive and, therefore, our competitors may have access to the same technology licensed to us. If we fail to obtain a required license and are unable to design around a patent, we may be unable to effectively market some of our technology and products, which could limit our ability to generate revenues or achieve profitability and possibly prevent us from generating revenue sufficient to sustain our operations. Moreover, we expect that a number of our collaborations will provide that royalties payable to us for licenses to our intellectual property may be offset by amounts paid by our collaborators to third parties who have competing or superior intellectual property positions in the relevant fields, which could result in significant reductions in our revenues from products developed through collaborations.

If we fail to comply with our obligations under any licenses or related agreements, we may be required to pay damages and could lose license or other rights that are necessary for developing, commercializing and protecting our RNAi technology, as well as ONPATTRO, GIVLAARI and any other product candidates that we develop, or we could lose certain rights to grant sublicenses.

Our current licenses impose, and any future licenses we enter into are likely to impose, various development, commercialization, funding, milestone, royalty, diligence, sublicensing, insurance, patent prosecution and enforcement, and other obligations on us. If we breach any of these obligations, or use the intellectual property licensed to us in an unauthorized manner, we may be required to pay damages and the licensor may have the right to terminate the license or render the license non-exclusive, which could result in us being unable to develop, manufacture, market and sell products that are covered by the licensed technology or enable a competitor to gain access to the licensed technology. Moreover, we could incur significant costs and/or disruption to our business and distraction of our management defending against any breach of such licenses alleged by the licensor. For example, in June 2018, Ionis sent us a notice claiming that it is owed payments under our second amended and restated strategic collaboration and license agreement as a result of the January 2018 amendment of our collaboration agreement with Sanofi Genzyme and the related Exclusive TTR License and AT3 License Terms. Ionis claims it is owed technology access fees based on rights granted and amounts paid to us in connection with the Sanofi Genzyme restructuring. In November 2018, we received notice that Ionis had filed a Demand for Arbitration with the Boston office of the American Arbitration Association against us, asserting, among other things, breach of contract. In December 2018, we filed our answer to Ionis's Demand for Arbitration, denying any liability to Ionis and the matter is currently in the expert discovery phase. The arbitration has been set for hearing in the first half of 2020. While we dispute that additional technology access fees are owed to Ionis, there can be no assurance that we will resolve this matter favorably or that it will not have a material adverse impact on our future results of operations.

Moreover, our licensors may own or control intellectual property that has not been licensed to us and, as a result, we may be subject to claims, regardless of their merit, that we are infringing or otherwise violating the licensor's rights. In addition, while we cannot currently determine the amount of the royalty obligations we will be required to pay on sales of ONPATTRO, GIVLAARI or future products, if any, the amounts may be significant. The amount of our future royalty obligations will depend on the technology and intellectual property we use in ONPATTRO, GIVLAARI or other products that we successfully develop and commercialize, if any. Therefore, even if we successfully develop and commercialize products, we may be unable to achieve or maintain profitability.

Confidentiality agreements with employees and others may not adequately prevent disclosure of trade secrets and other proprietary information.

In order to protect our proprietary technology and processes, we rely in part on confidentiality agreements with our collaborators, employees, consultants, outside scientific collaborators and sponsored researchers, and other advisors. These agreements may not effectively prevent disclosure of confidential information and may not provide an adequate remedy in the event of unauthorized disclosure of confidential information. In addition, others may independently discover trade secrets and proprietary information, and in such cases we could not assert any trade secret rights against such party. Costly and time-consuming litigation could be necessary to enforce and determine the scope of our proprietary rights, and failure to obtain or maintain trade secret protection could adversely affect our competitive business position.

Risks Related to Competition

The pharmaceutical market is intensely competitive. If we are unable to compete effectively with existing drugs, new treatment methods and new technologies, we may be unable to commercialize successfully any drugs that we develop.

The pharmaceutical market is intensely competitive and rapidly changing. Many large pharmaceutical and biotechnology companies, academic institutions, governmental agencies and other public and private research organizations are pursuing the development of novel drugs for the same diseases that we are targeting or expect to target. Many of our competitors have:

- much greater financial, technical and human resources than we have at every stage of the discovery, development, manufacture and commercialization of products;
- more extensive experience in pre-clinical testing, conducting clinical trials, obtaining regulatory approvals, and in manufacturing, marketing and selling drug products;
- product candidates that are based on previously tested or accepted technologies;
- products that have been approved or are in late stages of development; and
- collaborative arrangements in our target markets with leading companies and research institutions.

We will face intense competition from drugs that have already been approved and accepted by the medical community for the treatment of the conditions for which we may develop drugs. We also expect to face competition from new drugs that enter the market. There are a number of drugs currently under development, which may become commercially available in the future, for the treatment of conditions for which we may try to develop drugs. These drugs may be more effective, safer, less expensive, or marketed and sold more effectively, than any products we develop. For example, we developed ONPATTRO for the treatment of hATTR amyloidosis. In August 2018, the FDA approved ONPATTRO lipid complex injection for the treatment of the polyneuropathy of hATTR amyloidosis in adults, and the EC granted marketing authorisation for ONPATTRO for the treatment of hATTR amyloidosis in adults with stage 1 or stage 2 polyneuropathy. We are aware of other approved products used to treat this disease, including tafamidis, marketed by Pfizer, which is now approved in the U.S., the EU, Japan, Brazil, Argentina, Israel, Russia, South Korea and certain countries in Latin America, and inotersen, developed by Ionis and licensed to Akcea, which is now approved in the U.S., the EU, Canada and Brazil, as well as product candidates in various stages of clinical development, including an additional investigational drug being developed by Ionis. Finally, we are aware that Eidos Therapeutics, Inc., or Eidos, initiated a Phase 3 clinical trial of AG10, a TTR stabilizer, in ATTR-CM in February 2019. Eidos also plans to initiate a Phase 3 clinical trial of AG10 in ATTR-PN patients in the first half of 2020. While we believe that ONPATTRO has and will continue to have a competitive product profile, it is possible it will not compete favorably with these products and product candidates, or others, and, as a result, may not achieve commercial success. Moreover, positive data and/or the commercial success of competitive products could negatively impact our stock price.

If we continue to successfully develop product candidates, and obtain approval for them, we will face competition based on many different factors, including:

- the safety and effectiveness of our products relative to alternative therapies, if any;
- the ease with which our products can be administered and the extent to which patients accept relatively new routes of administration;
- the timing and scope of regulatory approvals for these products;
- the availability and cost of manufacturing, marketing and sales capabilities;
- the price of our products relative to alternative approved therapies;
- reimbursement coverage; and
- patent position.

We are aware of product candidates in various stages of clinical development for the treatment of PH1 which would compete with lumasiran, our investigational RNAi therapeutic now in registration for the treatment of this disease, including Oxabact®, a bacteria-based investigational therapy in Phase 3 development by OxThera AB, reloxaliase an investigational enzyme therapy in Phase 3 development for primary or severe secondary hyperoxaluria by Allena Pharmaceuticals, Inc., and nedosiran, an investigational RNAi therapeutic in development by Dicerna for the treatment of PH. In July 2019, the FDA granted a Breakthrough Therapy Designation to nedosiran for the treatment of patients with PH, and in November 2019, Dicerna announced that it initiated dosing in PHYOX2 pivotal clinical trial of nedosiran that is expected to enroll approximately 36 patients with PH1 and PH type 2. In April 2020, we and Dicerna granted each other a non-exclusive cross-license to our respective intellectual property related to our lumasiran product candidate, and Dicerna's nedosiran product candidate. Our competitors may develop or commercialize products with significant advantages over any products we develop based on any of the factors listed above or on other factors. In addition, our competitors may develop strategic alliances with or receive funding from larger pharmaceutical or biotechnology companies, providing them with an advantage over us. Our competitors may therefore be more successful in commercializing their products than we are, which could adversely affect our competitive position and business. Competitive products may make any products we develop obsolete or noncompetitive before we can recover the expenses of developing and commercializing our product candidates. Such competitors could also recruit our employees, which could negatively impact our level of expertise and the ability to execute on our business plan. Furthermore, we also face competition from existing and new treatment methods that reduce or eliminate the need for drugs, such as the use of advanced medical devices. The development of new medical devices or other treatment methods for the diseases we are targeting could make our product candidates noncompetitive, obsolete or uneconomical.

We face competition from other companies that are working to develop novel drugs and technology platforms using technology similar to ours. If these companies develop drugs more rapidly than we do or their technologies, including delivery technologies, are more effective, our ability to successfully commercialize drugs may be adversely affected.

In addition to the competition we face from competing drugs in general, we also face competition from other companies working to develop novel drugs using technology that competes more directly with our own. We are aware of several other companies that are working to develop RNAi therapeutic products. Some of these companies are seeking, as we are, to develop chemically synthesized siRNAs as drugs. Others are following a gene therapy approach, with the goal of treating patients not with synthetic siRNAs but with synthetic, exogenously-introduced genes designed to produce siRNA-like molecules within cells. Companies working on chemically synthesized siRNAs include, but are not limited to, Takeda Pharmaceutical Company

Ltd., or Takeda, Marina Biotech, Inc., Arrowhead Pharmaceuticals, Inc., or Arrowhead, and its subsidiary, Calando Pharmaceuticals, Inc., or Calando, Quark Pharmaceuticals, Inc., or Quark, Silence, Arbutus, Sylentis, S.A.U., or Sylentis, Dicerna and its collaborators, WAVE Life Sciences Ltd., Arcturus Therapeutics, Inc., and Genevant Sciences, launched by Arbutus and Roivant Sciences. In addition, we granted licenses or options for licenses to Ionis, Benitec Biopharma Ltd., Arrowhead, and its subsidiary, Calando, Arbutus, Quark, Sylentis and others under which these companies may independently develop RNAi therapeutics against a limited number of targets. Any one of these companies may develop its RNAi technology more rapidly and more effectively than us.

In addition, as a result of agreements that we have entered into, Takeda has obtained a non-exclusive license, and Arrowhead, as the assignee of Novartis AG, has obtained specific exclusive licenses for 30 gene targets, that include access to certain aspects of our technology. We also compete with companies working to develop antisense-based drugs. Like RNAi therapeutics, antisense drugs target mRNAs in order to suppress the activity of specific genes. Akcea has received marketing approval for an antisense drug, inotersen that was developed by Ionis, in the U.S., the EU, Canada and Brazil, for the treatment of stage 1 or stage 2 polyneuropathy in adult patients with hATTR amyloidosis. Several antisense drugs developed by Ionis have been approved and are currently marketed, and Ionis has multiple antisense product candidates in clinical trials. Ionis is also developing antisense drugs using ligand-conjugated GalNAc technology licensed from us, and these drugs have been shown to have increased potency at lower doses in clinical and pre-clinical studies, compared with antisense drugs that do not use such licensed GalNAc technology. The development of antisense drugs is more advanced than that of RNAi therapeutics, and antisense technology may become the preferred technology for drugs that target mRNAs to silence specific genes.

In addition to competition with respect to RNAi and with respect to specific products, we face substantial competition to discover and develop safe and effective means to deliver siRNAs to the relevant cell and tissue types. Safe and effective means to deliver siRNAs to the relevant cell and tissue types may be developed by our competitors, and our ability to successfully commercialize a competitive product would be adversely affected. In addition, substantial resources are being expended by third parties in the effort to discover and develop a safe and effective means of delivering siRNAs into the relevant cell and tissue types, both in academic laboratories and in the corporate sector. Some of our competitors have substantially greater resources than we do, and if our competitors are able to negotiate exclusive access to those delivery solutions developed by third parties, we may be unable to successfully commercialize our product candidates.

Risks Related to Our Common Stock

If our stock price fluctuates, purchasers of our common stock could incur substantial losses.

The market price of our common stock has fluctuated significantly and may continue to fluctuate significantly in response to factors that are beyond our control. The stock market in general has from time to time experienced extreme price and volume fluctuations, and the biotechnology sector in particular has experienced extreme price and volume fluctuations. The market prices of securities of pharmaceutical and biotechnology companies have been extremely volatile, and have experienced fluctuations that often have been unrelated or disproportionate to the clinical development progress or operating performance of these companies, including as a result of adverse development events. For example, the trading price for our common stock and the common stock of other biopharmaceutical companies has been highly volatile during the period of the COVID-19 pandemic. The COVID-19 outbreak continues to rapidly evolve, and the extent to which the outbreak may impact our business will depend on future developments, which are highly uncertain and cannot be predicted with confidence. These broad market and sector fluctuations have resulted and could in the future result in extreme fluctuations in the price of our common stock, which could cause purchasers of our common stock to incur substantial losses.

We may incur significant costs from class action litigation.

Our stock price may fluctuate for many reasons, including as a result of public announcements regarding the progress of our development and commercialization efforts or the development and commercialization efforts of our collaborators and/or competitors, the addition or departure of our key personnel, variations in our quarterly operating results and changes in market valuations of pharmaceutical and biotechnology companies. For example, in October 2016, we announced that we were discontinuing the development of revusiran and our stock price declined significantly as a result and in September 2017, following our temporary suspension of dosing in our fitusiran program, our stock also declined, although to a lesser extent. When the market price of a stock has been volatile as our stock price has been, holders of that stock have occasionally brought securities class action litigation against the company that issued the stock.

For example, a class action complaint was filed on September 26, 2018 in the United States District Court for the Southern District of New York. The complaint, as amended, or the Complaint, alleges that we and our Chief Executive Officer, former Chief Financial Officer and certain of our other executive officers violated certain federal securities laws, specifically under Sections 10(b) and 20(a) of the Exchange Act, and Rule 10b-5 promulgated thereunder. The plaintiff seeks unspecified damages on behalf of a purported class of purchasers of our common stock between September 20, 2017 and September 12, 2018. On March 23, 2020, the Court granted our motion and dismissed the Complaint without prejudice. On April 13, 2020, the plaintiff filed a motion seeking to amend the judgment to permit the plaintiff to file a further amended complaint. Defendants filed an opposition to that motion on April 17, 2020. We believe that the allegations contained in the now dismissed Complaint are without merit. However, whether or not the plaintiff's claims are successful, this type of litigation is often expensive and diverts management's attention and resources, which could adversely affect the operation of our business. If we are ultimately required to pay significant defense costs, damages or settlement amounts, in excess of our insurance coverage, such payments could adversely affect our operations.

We may be the target of similar litigation in the future. For example, on September 12, 2019, the Chester County Employees Retirement Fund, individually and on behalf of all others similarly situated, filed a purported securities class action complaint alleging violation of federal securities laws against us, certain of our current and former directors and officers, and the underwriters of our November 14, 2017 public stock offering, in the Supreme Court of the State of New York, New York County, or the New York State Securities Litigation. We believe the allegations in the New York State Securities Litigation, like those in the Complaint described above, are without merit and if our motion to dismiss the case is not successful, we intend to defend the case vigorously. This litigation and future litigation could result in substantial costs and divert our management's attention and resources, which could cause serious harm to our business, operating results and financial condition. We maintain liability insurance; however, if any costs or expenses associated with this or any other litigation exceed our insurance coverage, we may be forced to bear some or all of these costs and expenses directly, which could be substantial.

Future sales of shares of our common stock, including by our significant stockholders, us or our directors and officers, could cause the price of our common stock to decline.

A small number of our stockholders beneficially own a substantial amount of our common stock. As of March 31, 2020, our six largest stockholders beneficially owned in excess of 50% of our outstanding shares of common stock. If our significant stockholders, or we or our officers and directors, sell substantial amounts of our common stock in the public market, or there is a perception that such sales may occur, the market price of our common stock could be adversely affected. Sales of common stock by our significant stockholders might make it more difficult for us to raise funds by selling equity or equity-related securities in the future at a time and price that we deem appropriate.

Regeneron's ownership of our common stock could delay or prevent a change in corporate control.

As of May 21, 2019, the closing date of the stock purchase in connection with the 2019 Regeneron collaboration, Regeneron held approximately 4% of our outstanding common stock and has the right to increase its ownership up to 30%. This concentration of ownership could harm the market price of our common stock in the future by:

- delaying, deferring or preventing a change in control of our company;
- impeding a merger, consolidation, takeover or other business combination involving our company; or
- discouraging a potential acquirer from making a tender offer or otherwise attempting to obtain control of our company.

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

Provisions in our certificate of incorporation and our bylaws may delay or prevent an acquisition of us or a change in our management. In addition, 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. Because our board of directors is responsible for appointing the members of our management team, these provisions could in turn affect any attempt by our stockholders to replace current members of our management team. These provisions include:

- a classified board of directors;
- a prohibition on actions by our stockholders by written consent;
- limitations on the removal of directors; and
- advance notice requirements for election to our board of directors and for proposing matters that can be acted upon at stockholder meetings.

In addition, 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. These provisions would apply even if the proposed merger or acquisition could be considered beneficial by some stockholders.

ITEM 6. EXHIBITS.

31.1	Certification of principal executive officer pursuant to Rule 13a-14(a) promulgated under the Securities Exchange Act of 1934, as amended.
31.2	Certification of principal financial officer pursuant to Rule 13a-14(a) promulgated under the Securities Exchange Act of 1934, as amended.
32.1	Certification of principal executive officer pursuant to Rule 13a-14(b) promulgated under the Securities Exchange Act of 1934, as amended, and Section 1350 of Chapter 63 of Title 18 of the United States Code.
32.2	Certification of principal financial officer pursuant to Rule 13a-14(b) promulgated under the Securities Exchange Act of 1934, as amended, and Section 1350 of Chapter 63 of Title 18 of the United States Code.
101.SCH	Inline XBRL Taxonomy Extension Schema Document
101.CAL	Inline XBRL Taxonomy Extension Calculation Linkbase Document
101.LAB	Inline XBRL Taxonomy Extension Label Linkbase Document
101.PRE	Inline XBRL Taxonomy Extension Presentation Linkbase Document
101.DEF	Inline XBRL Taxonomy Extension Definition Linkbase Document
104	Cover Page Interactive Data File (formatted as inline XBRL with applicable taxonomy extension information contained in Exhibits 101.*)

SIGNATURES

Pursuant to the requirements of the Securities Exchange Act of 1934, the Registrant has duly caused this Report to be signed on its behalf by the undersigned, thereunto duly authorized.

ALNYLAM PHARMACEUTICALS, INC.

Date: May 6, 2020	/s/ John M. Maraganore
	John M. Maraganore, Ph.D. Chief Executive Officer (Principal Executive Officer)
Date: May 6, 2020	/s/ Jeffrey V. Poulton
	Jeffrey V. Poulton Executive Vice President, Chief Financial Officer (Principal Financial and Accounting Officer)

EXHIBIT 31.1

CERTIFICATION

I, John M. Maraganore, Ph.D., certify that:

1) I have reviewed this Quarterly Report on Form 10-Q of Alnylam Pharmaceuticals, 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 and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5) The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: May 6, 2020

/s/ John M. Maraganore

John M. Maraganore, Ph.D.
Chief Executive Officer

EXHIBIT 31.2

CERTIFICATION

I, Jeffrey V. Poulton, certify that:

1) I have reviewed this Quarterly Report on Form 10-Q of Alnylam Pharmaceuticals, 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 and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5) The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: May 6, 2020

/s/ Jeffrey V. Poulton

Jeffrey V. Poulton
Executive Vice President, Chief Financial Officer

EXHIBIT 32.1

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 Alnylam Pharmaceuticals, Inc. (the “Company”) for the quarter ended March 31, 2020 as filed with the Securities and Exchange Commission on the date hereof (the “Report”), the undersigned, John M. Maraganore, Ph.D., 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: May 6, 2020

/s/ John M. Maraganore

John M. Maraganore, Ph.D.
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.

EXHIBIT 32.2

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 Alnylam Pharmaceuticals, Inc. (the "Company") for the quarter ended March 31, 2020 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), the undersigned, Jeffrey V. Poulton, Executive Vice President, Chief Financial Officer, 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: May 6, 2020	/s/ Jeffrey V. Poulton
	Jeffrey V. Poulton Executive Vice President, 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.