UNITED STATES
SECURITIES AND EXCHANGE COMMISSION

Washington, DC 20549

FORM 10-Q

(Mark One)

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

For the quarterly period ended June 30, 2022

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: 001-35966

bluebird bio, Inc.

(Exact Name of Registrant as Specified in Its Charter)

Delaware	**13-3680878**
(State or Other Jurisdiction of Incorporation or Organization)	**(IRS Employer Identification No.)**
455 Grand Union Boulevard Somerville , Massachusetts	**02145**
(Address of Principal Executive Offices)	**(Zip Code)**

(339) 499-9300
(Registrant's Telephone Number, Including Area Code)

N/A
(Former Name, Former Address and Former Fiscal Year, if Changed Since Last Report)

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	BLUE	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 ☒ No ☐

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

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

Large accelerated filer	☒	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 ☒

As of August 3, 2022, there were 77,121,751 shares of the registrant's Common Stock, par value $0.01 per share, outstanding.

FORWARD LOOKING STATEMENTS

This Quarterly Report on Form 10-Q contains forward-looking statements that involve risks and uncertainties, as well as assumptions that, if they never materialize or prove incorrect, could cause our results to differ materially from those expressed or implied by such forward-looking statements. We make such forward-looking statements pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995 and other federal securities laws. 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 words such as “anticipate,” “believe,” “contemplate,” “continue,” “could,” “estimate,” “expect,” “intend,” “may,” “plan,” “potential,” “predict,” “project,” “seek,” “should,” “target,” “would,” or the negative of these words or other comparable terminology. These forward-looking statements include, but are not limited to, statements about:

- the initiation, timing, progress and results of our preclinical and clinical studies, and our research and development programs;
- our ability to advance product candidates into, and successfully complete, clinical studies;
- our ability to obtain adequate financing to fund our operations and to execute on our strategy;
- our ability to implement and realize expected cost savings from our comprehensive restructuring plans;
- our ability to establish and scale commercial viral vector and drug product manufacturing capabilities, and to ensure adequate supply of our viral vectors and drug products;
- the timing or likelihood of regulatory filings and marketing approvals for our product candidates;
- the timing or success of commercialization of any approved products;
- our ability to obtain adequate pricing and reimbursement of any approved products;
- the implementation of our business model, strategic plans for our business, product candidates and technology;
- estimates of our expenses, future revenues, capital requirements and our needs for additional financing;
- developments relating to our competitors and our industry;
- the impact of the COVID-19 pandemic;
- the effects, costs, and benefits of the separation of our portfolio of products and programs into two independent, publicly-traded companies; and
- other risks and uncertainties, including those listed under Part II, Item 1A. Risk Factors.

Any forward-looking statements in this Quarterly Report on Form 10-Q reflect our current views with respect to future events or to our 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 listed 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.

This Quarterly Report on Form 10-Q also contains estimates, projections and other information concerning our industry, our business, and the markets for certain diseases, including data regarding the estimated size of those markets, and the incidence and prevalence of certain medical conditions. Information that is based on estimates, forecasts, projections, market research or similar methodologies is inherently subject to uncertainties and actual events or circumstances may differ materially from events and circumstances reflected in this information. Unless otherwise expressly stated, we obtained this industry, business, market and other data from reports, research surveys, studies and similar data prepared by market research firms and other third parties, industry, medical and general publications, government data and similar sources.

Summary of the Material and Other Risks Associated with Our Business

Below is a summary of the material risks to our business, operations and the investment in our common stock. This summary does not address all of the risks that we face. Risks and uncertainties not presently known to us or that we presently deem less significant may also impair our business operations. Additional discussion of the risks summarized in this risk factor summary, and other risks that we face, can be found below under the heading "Risk Factors" and should be carefully considered, together with other information in this Quarterly Report on Form 10-Q in its entirety before making investment decisions regarding our common stock.

- The FDA has placed our clinical studies of lovo-cel on partial clinical hold, and we have no assurance as to what the FDA may require, or the timing, if ever, of when the partial clinical hold may be lifted, or when we may resume enrolling pediatric patients in our clinical studies of lovo-cel.
- The FDA has placed our clinical studies of eli-cel on clinical hold, and we have no assurances as to what the FDA may require, or the timing, if ever, of when this clinical hold may be lifted, or the effect this clinical hold may have on FDA's ongoing review of the Biologics License Application ("BLA") for eli-cel.
- We cannot predict when or if we will obtain marketing approval to commercialize our product candidates, and the marketing approval of our product and any future products may ultimately be for more narrow indications than we expect.
- We have incurred significant losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future.
- There is substantial doubt regarding our ability to continue as a going concern. We will need to raise additional financing in upcoming periods, which may not be available on acceptable terms, or at all. Failure to obtain necessary capital when needed may force us to delay, limit or terminate our commercial readiness efforts, activities to support a potential commercial launch following any approval of our product candidates, or other operations.
- Insertional oncogenesis is a risk of gene therapies using viral vectors that can integrate into the genome, and several patients with CALD treated with eli-cel in our clinical studies have been diagnosed with myelodysplastic syndrome likely mediated by Lenti-D lentiviral vector ("LVV") insertion. These events may require us to halt or delay further clinical development of our product candidates, such as eli-cel, or to suspend or cease commercialization following marketing approval, if any, and the commercial potential of our product candidates may be materially and negatively impacted.
- We have limited experience as a commercial company and the marketing and sale of future products may be unsuccessful or less successful than anticipated.
- The commercial success of our future products will depend upon the degree of market acceptance by physicians, patients, third-party payers and others in the medical community. If we fail to obtain sufficient pricing or reimbursement approval for any future products, our revenues may be adversely affected and our business may suffer.
- If the market opportunities for our product or any future products are smaller than we believe they are, and if we are not able to successfully identify patients and achieve significant market share, our revenues may be adversely affected and our business may suffer.
- We rely on a complex supply chain for our product candidates. The manufacture and delivery of our LVV and drug products present significant challenges for us, and we may not be able to produce our vector and drug products at the quality, quantities, locations or timing needed to support our clinical programs or potential commercialization. In addition, we may encounter challenges with engaging or coordinating with qualified treatment centers needed to support potential commercialization.
- We face intense competition and rapid technological change and the possibility that our competitors may develop therapies that are more advanced or effective than ours, which may adversely affect our financial condition and our ability to successfully commercialize our product and any future products.
- Our future success depends on our ability to retain key employees, consultants and advisors and to attract, retain and motivate qualified personnel.

bluebird bio, Inc.

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PART I. FINANCIAL INFORMATION

Item 1. Financial Statements

bluebird bio, Inc.

Condensed Consolidated Balance Sheets
(unaudited)
(in thousands, except par value amounts)

	As of June 30, 2022	As of December 31, 2021
Assets		
Current assets:		
Cash and cash equivalents	$ 81,499	$ 161,160
Marketable securities	51,010	138,343
Prepaid expenses	24,473	25,628
Receivables and other current assets	10,476	11,389
Total current assets	167,458	336,520
Marketable securities	40,641	97,114
Property, plant and equipment, net	14,566	9,706
Goodwill	5,646	5,646
Operating lease right-of-use assets	292,731	91,532
Restricted cash and other non-current assets	52,550	53,277
Total assets	$ 573,592	$ 593,795
Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable	$ 24,865	$ 25,883
Accrued expenses and other current liabilities	75,550	103,958
Operating lease liability, current portion	48,446	23,152
Total current liabilities	148,861	152,993
Operating lease liability, net of current portion	244,522	66,432
Other non-current liabilities	93	93
Total liabilities	393,476	219,518
Commitments and contingencies *(Note 9)*		
Stockholders' equity:		
Preferred stock, $0.01 par value, 5,000 shares authorized; 0 shares issued and outstanding at June 30, 2022 and December 31, 2021	—	—
Common stock, $0.01 par value, 125,000 shares authorized; 73,551 and 71,115 shares issued and outstanding at June 30, 2022 and December 31, 2021, respectively	735	711
Additional paid-in capital	4,126,012	4,096,402
Accumulated other comprehensive loss	(4,416)	(2,911)
Accumulated deficit	(3,942,215)	(3,719,925)
Total stockholders' equity	180,116	374,277
Total liabilities and stockholders' equity	$ 573,592	$ 593,795

See accompanying notes to unaudited condensed consolidated financial statements.

bluebird bio, Inc.

Condensed Consolidated Statements of Operations and Comprehensive Loss
(unaudited)
(in thousands, except per share data)

	For the three months ended June 30,		For the six months ended June 30,	
	2022	2021	2022	2021
Revenue:				
Product revenue	$ 1,331	$ —	$ 2,739	$ 724
Other revenue	188	143	725	313
Total revenues	1,519	143	3,464	1,037
Operating expenses:				
Research and development	63,841	84,645	141,716	167,488
Selling, general and administrative	36,694	54,984	72,800	118,553
Cost of product revenue	1,745	15,215	10,055	15,791
Restructuring expenses	6,639	—	6,639	—
Total operating expenses	108,919	154,844	231,210	301,832
Loss from operations	(107,400)	(154,701)	(227,746)	(300,795)
Interest income, net	174	218	280	573
Other (expense) income, net	7,088	(1,274)	5,176	23,027
Loss before income taxes	(100,138)	(155,757)	(222,290)	(277,195)
Income tax (expense) benefit	—	(216)	—	(282)
Net loss from continuing operations	(100,138)	(155,973)	(222,290)	(277,477)
Net loss from discontinued operations	—	(85,729)	—	(170,033)
Net loss	$ (100,138)	$ (241,702)	$ (222,290)	$ (447,510)
Net loss per share from continuing operations - basic and diluted	$ (1.36)	$ (2.31)	$ (3.02)	$ (4.13)
Net loss per share from discontinued operations - basic and diluted	$ —	$ (1.27)	$ —	$ (2.53)
Net loss per share - basic and diluted	$ (1.36)	$ (3.58)	$ (3.02)	$ (6.66)
Weighted-average number of common shares used in computing net loss per share - basic and diluted:	73,767	67,487	73,727	67,233
Other comprehensive (loss) income:				
Other comprehensive (loss) income, net of tax benefit (expense) of $0.0 million for the three and six months ended June 30, 2022 and 2021	43	(328)	(1,505)	(272)
Total other comprehensive (loss) income	43	(328)	(1,505)	(272)
Comprehensive loss	$ (100,095)	$ (242,030)	$ (223,795)	$ (447,782)

See accompanying notes to unaudited condensed consolidated financial statements.

bluebird bio, Inc.

Condensed Consolidated Statements of Stockholders' Equity
(unaudited)
(in thousands)

	Common stock		Additional paid-in capital	Accumulated other comprehensive loss	Accumulated deficit	Total stockholders' equity
	Shares	Amount				
Balances at December 31, 2021	71,115	$ 711	$ 4,096,402	$ (2,911)	$ (3,719,925)	$ 374,277
Vesting of restricted stock units	310	3	(3)	—	—	—
Exercise of stock options	1	—	1	—	—	1
Stock-based compensation	—	—	12,681	—	—	12,681
Issuance of unrestricted stock awards to settle accrued employee compensation	12	—	—	—	—	—
Other comprehensive income	—	—	—	(1,548)	—	(1,548)
Net loss	—	—	—	—	(122,152)	(122,152)
Balances at March 31, 2022	71,438	$ 714	$ 4,109,081	$ (4,459)	$ (3,842,077)	$ 263,259
Vesting of restricted stock units	60	$ 1	$ (1)			$ —
Exercise of stock options	1	$ —	$ 1			$ 1
Issuance of common stock	2,052	$ 20	$ 8,023			$ 8,043
Stock-based compensation	—	$ —	$ 8,908			$ 8,908
Other comprehensive income				$ 43		$ 43
Net loss					$ (100,138)	$ (100,138)
Balances at June 30, 2022	73,551	$ 735	$ 4,126,012	$ (4,416)	$ (3,942,215)	$ 180,116

	Common stock		Additional paid-in capital	Accumulated other comprehensive loss	Accumulated deficit	Total stockholders' equity
	Shares	Amount				
Balances at December 31, 2020	66,432	$ 665	$ 4,260,443	$ (5,505)	$ (2,900,547)	$ 1,355,056
Vesting of restricted stock units	294	3	(3)	—	—	—
Exercise of stock options	207	2	1,217	—	—	1,219
Purchase of common stock under ESPP	67	1	1,706	—	—	1,707
Stock-based compensation	—	—	36,090	—	—	36,090
Issuance of unrestricted stock awards to settle accrued employee compensation	422	4	12,009	—	—	12,013
Other comprehensive income	—	—	—	56	—	56
Net loss	—	—	—	—	(205,808)	(205,808)
Balances at March 31, 2021	67,422	$ 675	$ 4,311,462	$ (5,449)	$ (3,106,355)	$ 1,200,333
Vesting of restricted stock units	127	$ 1	$ (1)	$ —	$ —	$ —
Exercise of stock options	2	$ —	$ 36	$ —	$ —	$ 36
Stock-based compensation	—	$ —	$ 26,222	$ —	$ —	$ 26,222
Other comprehensive loss	—	$ —	$ —	$ (328)	$ —	$ (328)
Net loss	—	$ —	$ —	$ —	$ (241,702)	$ (241,702)
Balances at June 30, 2021	67,551	$ 676	$ 4,337,719	$ (5,777)	$ (3,348,057)	$ 984,561

bluebird bio, Inc.

Condensed Consolidated Statements of Cash Flows
(unaudited)
(in thousands)

	For the six months ended June 30,	
	2022	**2021**
Cash flows from operating activities:		
Net loss	$ (222,290)	$ (447,510)
Adjustments to reconcile net loss to net cash used in operating activities:		
Change in fair value of contingent consideration	—	416
Depreciation and amortization	2,358	11,353
Stock-based compensation expense	21,298	73,687
Loss (gain) on equity securities	3,135	(28,286)
Excess inventory reserve	7,519	15,084
Other non-cash items	661	6,228
Changes in operating assets and liabilities:		
Prepaid expenses and other assets	(9,629)	(3,481)
Operating lease right-of-use assets	17,636	15,074
Accounts payable	(1,175)	7,475
Accrued expenses and other liabilities	(28,565)	17,453
Operating lease liabilities	(10,602)	(16,468)
Net cash used in operating activities	(219,654)	(348,975)
Cash flows from investing activities:		
Purchase of property, plant and equipment	(6,836)	(9,204)
Purchases of marketable securities	—	(196,145)
Proceeds from maturities of marketable securities	108,225	557,751
Proceeds from sales of marketable securities	30,213	31,318
Purchase of intangible assets	—	(2,000)
Net cash provided by investing activities	131,602	381,720
Cash flows from financing activities:		
Proceeds from exercise of stock options and ESPP contributions	—	4,192
Proceeds from the secondary public offering, net of issuance costs	$ 8,043	—
Net cash provided by financing activities	8,043	4,192
(Decrease) increase in cash, cash equivalents and restricted cash	(80,009)	36,937
Cash, cash equivalents and restricted cash at beginning of period	206,693	373,728
Cash, cash equivalents and restricted cash at end of period	$ 126,684	$ 410,665
Reconciliation of cash, cash equivalents and restricted cash:		
Cash and cash equivalents	$ 81,499	$ 353,468
Restricted cash included in receivables and other current assets	$ 1,635	$ 2,687
Restricted cash included in restricted cash and other non-current assets	$ 43,550	$ 54,510
Total cash, cash equivalents and restricted cash	$ 126,684	$ 410,665
Supplemental cash flow disclosures from investing and financing activities:		
Purchases of property, plant and equipment included in accounts payable and accrued expenses	$ 842	$ 1,508
Right-of-use assets obtained in exchange for operating lease liabilities	$ 218,836	$ 22,049
Issuance of unrestricted stock awards to settle accrued employee compensation	$ —	$ 12,013
Purchases of intangible assets included in accounts payable and accrued expenses, net of reimbursement receivable from collaboration partner	$ —	$ 6,500

See accompanying notes to unaudited condensed consolidated financial statements.

bluebird bio, Inc.

Notes to Condensed Consolidated Financial Statements
(unaudited)

1. Description of the business

bluebird bio, Inc. (the “Company” or “bluebird”) was incorporated in Delaware on April 16, 1992, and is headquartered in Cambridge, Massachusetts. The Company is a biotechnology company committed to researching, developing and commercializing potentially transformative gene therapies for severe genetic diseases. Since its inception, the Company has devoted substantially all of its resources to its research and development efforts relating to its product candidates, including activities to manufacture product candidates, conduct clinical studies of its product candidates, perform preclinical research to identify new product candidates and provide selling, general and administrative support for these operations, including commercial-readiness activities.

The Company’s programs in severe genetic diseases include betibeglogene autotemcel ("beti-cel", formerly "LentiGlobin for β-thalassemia gene therapy") being developed as a treatment for β-thalassemia; lovotibeglogene autotemcel ("lovo-cel", formerly "LentiGlobin for SCD") being developed as a treatment for sickle cell disease ("SCD"); and elivaldogene autotemcel ("eli-cel", formerly "Lenti-D gene therapy") being developed as a treatment for cerebral adrenoleukodystrophy ("CALD").

In August 2021, the Company announced its intent to focus its severe genetic disease business on the U.S. market and further invest in research and development for its core programs in β-thalassemia, SCD, and CALD. As part of the strategy to focus on the U.S. market, it began executing an orderly wind down of its European operations, which will result in a reduction of selling, general and administrative costs and had an impact on the Company's excess inventory analysis, which is based on sales forecasts and projected inventory consumption levels.

In November 2021, the Company completed the separation of its severe genetic disease and oncology programs into two separate, independent publicly traded companies, bluebird bio, Inc. and 2seventy bio, Inc. (“2seventy bio”), a Delaware corporation and wholly-owned subsidiary of the Company prior to the separation. bluebird retained its severe genetic disease programs, including programs for β-thalassemia, SCD, and CALD, with a focus on the U.S. market.

In April 2022, the Board of Directors approved a comprehensive restructuring plan intended to reduce operating expenses and enhance the Company’s focus on achieving U.S. Food and Drug Administration ("FDA") approval for its programs in the U.S. The Company intends to maintain targeted research efforts focused on in-vivo lentiviral vector ("LVV") gene therapy and to deprioritize direct investments in reduced toxicity conditioning and cryopreserved apheresis. As part of the restructuring, bluebird plans to reduce its workforce by approximately 30% across the second and third quarters of 2022. Refer to Note 14, *Reduction in workforce*, for more information on this restructuring.

On June 22, 2022, the Company entered into an Equity Distribution Agreement (the “Equity Distribution Agreement”) with Goldman Sachs & Co. LLC (“Goldman”) to sell shares of the Company’s common stock up to $75.0 million, from time to time, through an “at the market” equity offering program under which Goldman will act as manager. The Equity Distribution Agreement also provides for the sale of shares to Goldman directly as principal, in which case the Company and Goldman will enter into a separate terms agreement. The Company will pay Goldman a commission equal to up to 3.0% of the gross proceeds of any Common Stock sold through Goldman under the Equity Distribution Agreement. In the three months ended June 30, 2022, the Company sold 2.1 million shares of common stock at-the-market under the Equity Distribution Agreement, resulting in gross proceeds of approximately $8.3 million ($8.0 million net of offering costs). Refer to Note 10, *Equity*, for more information.

As of June 30, 2022, the Company had cash, cash equivalents and marketable securities of approximately $173.2 million. The Company has incurred losses since inception and to date has financed its operations primarily through the sale of equity securities and, to a lesser extent, through collaboration agreements and grants from charitable foundations. As of June 30, 2022, the Company had an accumulated deficit of $3.94 billion. During the six months ended June 30, 2022, the Company incurred a loss of $222.3 million and used $219.7 million of cash in operations. The Company expects to continue to generate operating losses and negative operating cash flows for the next few years and will need additional funding to support its planned operating activities through profitability. The transition to profitability is dependent upon the successful development, approval, and commercialization of beti-cel, eli-cel, and lovo-cel, and the achievement of a level of revenues adequate to support its cost structure.

In accordance with Accounting Standards Codification 205-40, *Going Concern* ("ASC 205-40"), the Company evaluated whether there are conditions and events, considered in the aggregate, that raise substantial doubt about its ability to continue as a going concern within one year after the date that these condensed consolidated financial statements are issued. This evaluation initially does not take into consideration the potential mitigating effect of management's plans that have not been fully implemented as of the date the financial statements are issued. When substantial doubt exists under this methodology, management evaluates whether the mitigating effect of its plans sufficiently alleviates substantial doubt about the Company's ability to continue as a going concern. The mitigating effect of management's plans, however, is only considered if both (1) it is probable that the plans will be effectively implemented within one year after the date that the financial statements are issued, and (2) it is probable that the plans, when implemented, will mitigate the relevant conditions or events that raise substantial doubt about the entity's ability to continue as a going concern within one year after the date that these condensed consolidated financial statements are issued. In performing its analysis, management excluded certain elements of its operating plan that cannot be considered probable. Under ASC 205-40, the future receipt of potential funding from future equity or debt issuances, the release of restricted cash related to the Company's 50 Binney Street lease, and the potential sale of priority review vouchers cannot be considered probable at this time because these plans are not entirely within the Company's control nor have been approved by the Board of Directors as of the date of these condensed consolidated financial statements. The restructuring plan described above was approved by the Board of Directors in April 2022 and therefore was incorporated into the Company's assessment of its ability to continue as a going concern within one year after the date that these condensed consolidated financial statements are issued.

The Company's expectation to generate operating losses and negative operating cash flows in the future and the need for additional funding to support its planned operations raise substantial doubt regarding the Company's ability to continue as a going concern for a period of one year after the date that these condensed consolidated financial statements are issued. Management's plans to alleviate the conditions that raise substantial doubt include implementing reduced 2022 spending, including projected savings through the move of the Company's headquarters to Assembly Row in Somerville, Massachusetts, the completion of its orderly wind down of European operations, the completion of its April 2022 restructuring plans, the potential sale of priority review vouchers that would be issued with the potential U.S. regulatory approvals of BLAs for beti-cel and/or eli-cel, and the pursuit of additional cash resources through public or private equity or debt financings. Management has concluded the likelihood that its plan to successfully obtain sufficient funding from one or more of these sources, or adequately reduce expenditures, while reasonably possible, is less than probable. In accordance with ASC 205-40, the Company has concluded that substantial doubt exists about the Company's ability to continue as a going concern for a period of at least 12 months from the date of issuance of these condensed consolidated financial statements.

The accompanying financial statements have been prepared on a going concern basis, which contemplates the realization of assets and satisfaction of liabilities in the ordinary course of business. The financial statements do not include any adjustments relating to the recoverability and classification of recorded asset amounts or the amounts and classification of liabilities that might result from the outcome of the uncertainties described above.

2. Basis of presentation, principles of consolidation and significant accounting policies

Basis of presentation

The accompanying condensed consolidated financial statements are unaudited and have been prepared by the Company in accordance with accounting principles generally accepted in the United States ("GAAP"). Any reference in these notes to applicable guidance is meant to refer to the authoritative United States GAAP as included in the ASC and Accounting Standards Updates ("ASUs") of the Financial Accounting Standards Board ("FASB"). Certain information and footnote disclosures normally included in the Company's annual financial statements have been condensed or omitted. These condensed consolidated financial statements, in the opinion of management, reflect all normal recurring adjustments necessary for a fair presentation of the Company's financial position and results of operations for the interim periods ended June 30, 2022 and 2021.

The results of operations for the interim periods are not necessarily indicative of the results of operations to be expected for the full year. These condensed consolidated financial statements should be read in conjunction with the audited consolidated financial statements as of and for the year ended December 31, 2021, and the notes thereto, which are included in the Company's Annual Report on Form 10-K for the fiscal year ended December 31, 2021, filed with the Securities and Exchange Commission (the "SEC") on March 4, 2022 (the "2021 Annual Report on Form 10-K").

Certain items in the prior year's condensed consolidated financial statements have been reclassified to conform to the current presentation. The Company has presented its oncology business together with its manufacturing facility in Durham,

North Carolina as discontinued operations in its consolidated financial statements for the three and six months ended June 30, 2021 (see Note 3, *Discontinued operations*). The historical financial statements and footnotes have been recast accordingly.

Amounts reported are computed based on thousands, except percentages, per share amounts or as otherwise noted. As a result, certain totals may not sum due to rounding.

The accompanying condensed consolidated financial statements include the accounts of the Company and its wholly-owned subsidiaries. 2seventy bio was a wholly-owned subsidiary until it became an independent publicly-traded company on November 4, 2021. All intercompany balances and transactions have been eliminated in consolidation. The Company views its operations and manages its business in one operating segment.

Discontinued operations

The Company determined that the separation of its oncology business in November 2021 and the sale of its manufacturing facility in Durham, North Carolina in September 2021 represented multiple components of a single disposal plan that met the criteria for classification as a discontinued operation in accordance with ASC Subtopic 205-20, *Discontinued Operations* ("ASC 205-20"). Accordingly, the accompanying condensed consolidated financial statements for the three and six months ended June 30, 2021 have been updated to present the results of all discontinued operations reported as a separate component of loss in the consolidated statements of operations and comprehensive loss (see Note 3, *Discontinued operations*).

Significant accounting policies

The significant accounting policies used in preparation of these condensed consolidated financial statements for the three and six months ended June 30, 2022 are consistent with those discussed in Note 2 to the consolidated financial statements included in the Company's 2021 Annual Report on Form 10-K, except as noted in the *"Recent accounting pronouncements - Not yet adopted"* section below.

Use of estimates

The preparation of financial statements in conformity with GAAP requires management to make estimates and assumptions that affect the reported amounts in the financial statements and accompanying notes. Actual results could materially differ from those estimates. Management considers many factors in selecting appropriate financial accounting policies and controls, and in developing the estimates and assumptions that are used in the preparation of these financial statements. Management must apply significant judgment in this process. In addition, other factors may affect estimates, including: expected business and operational changes, sensitivity and volatility associated with the assumptions used in developing estimates, and whether historical trends are expected to be representative of future trends. The estimation process often may yield a range of potentially reasonable estimates of the ultimate future outcomes and management must select an amount that falls within that range of reasonable estimates. This process may result in actual results differing materially from those estimated amounts used in the preparation of the financial statements.

Estimates and judgments are used in the following areas, among others: future undiscounted cash flows and subsequent fair value estimates used to assess potential and measure any impairment of long-lived assets, including goodwill and intangible assets, and the measurement of right-of-use assets and lease liabilities, stock-based compensation expense, accrued expenses, income taxes, the assets and liabilities and losses related to discontinued operations and the assessment of the Company's ability to fund its operations for at least the next twelve months from the date of issuance of these financial statements.

Recent accounting pronouncements

Not yet adopted

ASU No. 2022-02, Financial Instruments – Credit Losses (Topic 326): Troubled Debt Restructurings and Vintage Disclosures

In March 2022, the FASB issued ASU 2022-02, *Financial Instruments – Credit Losses (Topic 326): Troubled Debt Restructurings and Vintage Disclosures* ("ASU 2022-02"), which eliminates the recognition and measurement guidance on troubled debt restructurings for creditors that have adopted ASC 326 and requires enhanced disclosure of loan modifications for borrowers experiencing financial difficulty. ASU 2022-02 amends the guidance on vintage disclosures to require disclosure of current-period gross write-offs by year of origination. The new standard will be effective beginning January 1, 2023. The adoption of ASU 2022-02 is not expected to have a material impact on the Company's financial position or results of operations.

3. Discontinued operations

Sale of bluebird Research Triangle manufacturing facility

In November 2017, the Company acquired a manufacturing facility in Durham, North Carolina ("bRT") for the future manufacture of LVV for the Company's therapies related to its oncology programs. In July 2021, the Company and Resilience US, Inc., an affiliate of National Resilience, Inc. ("Resilience"), signed an Asset Purchase Agreement (the "Agreement"). As part of the Agreement, and upon the closing of the transaction in September 2021, Resilience acquired the Company's LVV manufacturing facility located in Durham, North Carolina and retained staff currently employed at the site. As a result of the transaction, the Company disposed of $111.2 million of net assets, primarily consisting of the building and laboratory equipment associated with the Company's oncology programs. The Company recognized a loss on disposal of assets of $2.0 million during the year ended December 31, 2021. As the sale of the bRT manufacturing facility and the separation of 2seventy bio (as described below) were deemed to represent multiple components of a single disposal plan, the results of operations related to bRT have been included as a component of discontinued operations.

2seventy bio Separation

On November 4, 2021, the Company completed the previously announced separation of its oncology programs and portfolio, and the certain related assets and liabilities, into a separate, independent publicly traded company (the "Separation"). The Separation was effected by means of a distribution of all of the outstanding shares of common stock of 2seventy bio in which each bluebird stockholder received one share of common stock, par value $0.0001 per share, of 2seventy bio for every three shares of common stock, par value $0.01 per share, of bluebird held as of the close of business on October 19, 2021 (the "Distribution").

In connection with the Separation, bluebird entered into a separation agreement (the "Separation Agreement") with 2seventy bio, dated as of November 3, 2021, that, among other things, set forth bluebird's agreements with 2seventy bio regarding the principal actions to be taken in connection with the Separation, including the Distribution. The effective time of the Distribution was 12:01 a.m. on November 4, 2021. The Separation Agreement identified assets transferred to, liabilities assumed by and contracts assigned to 2seventy bio as part of the Separation, and it provided for when and how these transfers, assumptions and assignments occurred. The purpose of the Separation Agreement was to provide 2seventy bio and bluebird with assets to operate their respective businesses and retain or assume liabilities related to those assets. Each of 2seventy bio and bluebird agreed to releases, with respect to pre-Separation claims, and cross indemnities, with respect to post-Separation claims, that were principally designed to place financial responsibility for the obligations and liabilities allocated to 2seventy bio under the Separation Agreement with 2seventy bio and financial responsibility for the obligations and liabilities allocated to bluebird under the Separation Agreement with bluebird. bluebird and 2seventy bio are also each subject to mutual 12-month employee non-solicit and non-hire restrictions, subject to certain customary exceptions.

bluebird and 2seventy bio also entered into a tax matters agreement, an employee matters agreement and an intellectual property agreement. Additionally, bluebird entered into two transition services agreements with 2seventy bio, whose President is a member of the Company's Board of Directors. Pursuant to the transition service agreements, bluebird is obligated to provide and is entitled to receive certain transition services related to corporate functions, such as finance, human resources, internal audit, research and development, financial reporting, and information technology. Services provided by bluebird to 2seventy bio will continue for an initial term of up to two years, unless earlier terminated or extended according to the terms of the transition services agreement. Services received and performed are paid at a mutually agreed upon rate. Amounts received for services provided to 2seventy bio are recorded as other income and amounts paid for services provided by 2seventy bio are recorded as selling, general and administrative expense and research and development expense, as applicable. In addition, the Company entered into a sublease agreement with 2seventy bio for office, laboratory and storage space located at 60 Binney Street (the "60 Binney Street Sublease") while it constructs and outfits its new office and laboratory space.

During the three and six months ended June 30, 2022, the Company incurred $2.5 million and $5.5 million, respectively of net expense for transactions with 2seventy bio within research and development and selling, general and administrative expense in the condensed consolidated statements of operations and comprehensive loss, including $1.1 million and $2.3 million, respectively of net expense related to the 60 Binney Street Sublease. As of June 30, 2022, the Company had $0.4 million of accounts receivable due from and $2.9 million of accounts payable due to 2seventy bio. As of December 31, 2021, the Company had an immaterial amount of accounts receivable and accounts payable due from and due to 2seventy bio.

Discontinued operations

In connection with the Separation, the Company determined its oncology business, together with the bRT manufacturing facility, qualified for discontinued operations accounting treatment in accordance with ASC 205-20. The following table summarizes revenue and expenses of the discontinued operations for the three and six months ended June 30, 2021 (in thousands):

	Three months ended June 30, 2021	Six months ende June 30, 2021
Revenue:		
Service revenue	$ 5,314	$ 11,2
Collaborative arrangement revenue	1,670	3,1
Royalty and other revenue	345	4,8
Total revenues	7,329	19,2
Operating expenses:		
Research and development	59,670	131,3
Selling, general and administrative	23,592	46,8
Share of collaboration loss	10,071	10,0
Cost of royalty and other revenue	86	1,7
Change in fair value of contingent consideration	47	4
Total operating expenses	93,466	190,4
Loss from operations	(86,137)	(171,2
Interest income, net	220	5
Other income, net	188	6
Loss before income taxes	(85,729)	(170,0
Income tax benefit (expense)	—	-
Net loss	$ (85,729)	$ (170,0

There were no revenue and expenses of the discontinued operations for the three and six months ended June 30, 2022, as all operations were transferred to 2seventy bio upon the Separation. There were no assets and liabilities related to discontinued operations as of June 30, 2022 or December 31, 2021, as all balances were transferred to 2seventy bio upon the Separation.

The following table summarizes the significant non-cash items and capital expenditures of the discontinued operations that are included in the condensed consolidated statements of cash flows for the six months ended June 30, 2021 (in thousands):

	Six months ended June 30, 2021
Operating activities:	
Change in fair value of contingent consideration	$ 416
Depreciation and amortization	8,300
Stock-based compensation expense	19,104
Loss on fixed asset disposal	254
Investing activities:	
Purchase of property, plant and equipment	$ (7,675)
Purchase of intangible assets	(2,000)
Supplemental cash flow disclosures:	
Purchases of property, plant and equipment included in accounts payable and accrued expenses	$ 1,345
Purchases of intangible assets included in accounts payable and accrued expenses, net of reimbursement receivable from collaboration partner	6,500

4. Marketable securities

The following table summarizes the marketable securities held at June 30, 2022 and December 31, 2021 (in thousands):

Description	Amortized cost / Cost	Unrealized gains	Unrealized losses	Fair value
June 30, 2022				
U.S. government agency securities and treasuries	$ 77,943	$ —	$ (1,980)	$ 75,963
Corporate bonds	13,294		(105)	13,189
Commercial paper	2,499	—	—	2,499
Equity securities	—	—	—	—
Total	$ 93,736	$ —	$ (2,085)	$ 91,651
December 31, 2021				
U.S. government agency securities and treasuries	$ 128,902	$ —	$ (509)	$ 128,393
Corporate bonds	49,366	—	(59)	49,307
Commercial paper	54,065	—	—	54,065
Equity securities	4,305	—	(614)	3,691
Total	$ 236,638	$ —	$ (1,182)	$ 235,456

No available-for-sale debt securities held as of June 30, 2022 or December 31, 2021 had remaining maturities greater than five years.

5. Fair value measurements

The following table sets forth the Company's assets and liabilities that are measured at fair value on a recurring basis as of June 30, 2022 and December 31, 2021 (in thousands):

Description	Total	Quoted prices in active markets (Level 1)	Significant other observable inputs (Level 2)	Significant unobservable inputs (Level 3)
June 30, 2022				
Assets:				
Cash and cash equivalents	$ 81,499	$ 81,499	$ —	$ –
Marketable securities:				
U.S. government agency securities and treasuries	75,963	—	75,963	–
Corporate bonds	13,189	—	13,189	–
Commercial paper	2,499	—	2,499	–
Equity securities	—	—	—	–
Total	$ 173,150	$ 81,499	$ 91,651	$ –
December 31, 2021				
Assets:				
Cash and cash equivalents	$ 161,160	$ 161,146	$ 14	$ –
Marketable securities:				
U.S. government agency securities and treasuries	128,393	—	128,393	–
Corporate bonds	49,308	—	49,308	–
Commercial paper	54,065	—	54,065	–
Equity securities	3,691	3,691	—	–
Total	$ 396,617	$ 164,837	$ 231,780	$ –

Cash and cash equivalents

The Company considers all highly liquid securities with original final maturities of 90 days or less from the date of purchase to be cash equivalents. As of June 30, 2022 and December 31, 2021, cash and cash equivalents comprise funds in cash and money market accounts.

Marketable securities

Marketable securities classified as Level 2 within the valuation hierarchy generally consist of U.S. government agency securities and treasuries, corporate bonds, and commercial paper. The Company estimates the fair values of these marketable securities by taking into consideration valuations obtained from third-party pricing sources. These pricing sources utilize industry standard valuation models, including both income and market-based approaches, for which all significant inputs are observable, either directly or indirectly, to estimate fair value. These inputs include market pricing based on real-time trade data for the same or similar securities, issuer credit spreads, benchmark yields, and other observable inputs. The Company validates the prices provided by its third-party pricing sources by understanding the models used, obtaining market values from other pricing sources and analyzing pricing data in certain instances.

The amortized cost of available-for-sale debt securities is adjusted for amortization of premiums and accretion of discounts to the earliest call date for premiums or to maturity for discounts. At June 30, 2022 and December 31, 2021, the balance in the Company's accumulated other comprehensive loss was composed primarily of activity related to the Company's available-for-sale debt securities. There were no material realized gains or losses recognized on the sale or maturity of available-for-sale debt securities during the three and six months ended June 30, 2022 or 2021.

Accrued interest receivable on the Company's available-for-sale debt securities totaled $0.1 million and $0.3 million as of June 30, 2022 and December 31, 2021, respectively. No accrued interest receivable was written off during the three and six months ended June 30, 2022 or 2021.

The following table summarizes available-for-sale debt securities in a continuous unrealized loss position for less than and greater than twelve months, and for which an allowance for credit losses has not been recorded at June 30, 2022 and December 31, 2021 (in thousands):

	Less than 12 months		12 months or greater		Total	
Description	Fair value	Unrealized losses	Fair value	Unrealized losses	Fair value	Unrealized losses
June 30, 2022						
U.S. government agency securities and treasuries	$ 68,129	$ (1,814)	$ 7,834	$ (166)	$ 75,963	$ (1,980)
Corporate bonds	6,672	(79)	6,517	(26)	13,189	(105)
Total	$ 74,801	$ (1,893)	$ 14,351	$ (192)	$ 89,152	$ (2,085)
December 31, 2021						
U.S. government agency securities and treasuries	$ 108,695	$ (505)	$ 2,496	$ (4)	$ 111,191	$ (509)
Corporate bonds	45,042	(56)	3,896	(2)	48,938	(58)
Total	$ 153,737	$ (561)	$ 6,392	$ (6)	$ 160,129	$ (567)

The Company determined that there was no material change in the credit risk of the above investments during the six months ended June 30, 2022. As such, an allowance for credit losses was not recognized. In April 2022, the Company sold securities with a carrying value of $29.7 million and realized net aggregate losses of $0.4 million. As of June 30, 2022, the Company does not intend to sell such securities before recovery of their amortized cost bases.

The Company held equity securities with an aggregate fair value of $0.0 million and $3.7 million as of June 30, 2022 and December 31, 2021, respectively, within current marketable securities on its condensed consolidated balance sheets. In January 2021, the Company sold a portion of its equity securities for proceeds of $31.3 million. In May 2022, the Company sold the remainder of the equity securities for proceeds of $0.6 million. During the three months ended June 30, 2022 and 2021, the Company recorded a loss of $0.6 million and $0.1 million, respectively, related to its equity securities. During the six months ended June 30, 2022 and 2021, the Company recorded a loss of $3.1 million and a gain of $28.3 million, respectively. Gains and losses related to equity securities are included in other (expense) income, net in the condensed consolidated statements of operations and comprehensive loss.

6. Property, plant and equipment, net

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

	As of June 30, 2022	As of December 31, 2021
Laboratory equipment	$ 28,838	$ 29,061
Computer equipment and software	1,733	421
Office equipment	5,679	117
Leasehold improvements	—	12
Construction-in-progress	817	501
Total property, plant and equipment	37,067	30,112
Less accumulated depreciation and amortization	(22,501)	(20,406)
Property, plant and equipment, net	$ 14,566	$ 9,706

7. Accrued expenses and other current liabilities

Accrued expenses and other current liabilities consist of the following (in thousands):

	As of June 30, 2022	As of December 31, 2021
Accrued manufacturing costs	$ 18,530	$ 15,722
Accrued goods and services	14,567	24,273
Accrued clinical and contract research organization costs	18,069	17,769
Accrued employee compensation	19,853	41,095
Accrued professional fees	1,226	1,665
Deferred revenue, current portion	1,635	2,282
Other	1,670	1,152
Total accrued expenses and other current liabilities	$ 75,550	$ 103,958

Accrued employee compensation as of December 31, 2021 includes severance costs associated with the Company's orderly wind down of its European operations. In April 2022, the Company announced a restructuring which included a reduction in force. As of June 30, 2022, the Company had $2.7 million of accrued employee compensation related to the April 2022 restructuring. Please refer to Note 14, *Reduction in workforce*, for further information.

8. Leases

The Company leases certain office and laboratory space, primarily located in Cambridge, Massachusetts and Somerville, Massachusetts. Additionally, the Company has embedded leases through its agreements with contract manufacturing organizations in both the United States and internationally. Except as described below, there have been no material changes in lease obligations from those disclosed in Note 10 to the consolidated financial statements included in the Company's 2021 Annual Report on Form 10-K.

Assembly Row lease

In November 2021, the Company entered into a lease agreement with Assembly Row 5B, LLC ("Landlord") for office space located at 455 Grand Union Boulevard in Somerville, Massachusetts to serve as the Company's future corporate headquarters (the “Assembly Row Lease”). Upon signing the Assembly Row Lease, the Company executed a $2.8 million letter of credit for the Landlord’s benefit, which is classified as restricted cash and other non-current assets on the Company’s condensed consolidated balance sheets. In March 2022, the Assembly Row Lease commenced upon the Landlord granting the Company control of the leased premises. The Assembly Row Lease will continue until December 31, 2032, with an option to extend for two additional five-year terms. The Company classified the Assembly Row Lease as an operating lease and recognized a right-of-use asset and lease liability upon lease commencement. The Company will recognize rent expense on a straight-line basis throughout the remaining term of the Assembly Row Lease.

50 Binney Street lease & sublease

In April 2019, the Company entered into an agreement to lease office space located at 50 Binney Street in Cambridge, Massachusetts (the “50 Binney Street Lease”). In December 2021, the Company entered into an agreement to sublease the entire office space to Meta Platforms, Inc. (“Meta”) (the "Sublease"). In April 2022, both the 50 Binney Street Lease and the Sublease commenced upon the landlord granting access to the leased premises. In connection with the execution of the 50 Binney Street Lease, the Company also entered into a purchase agreement with the landlord for furniture and equipment (the “Furniture Purchase Agreement”) located on the premises upon lease commencement. Upon execution of the Furniture Purchase Agreement, the Company made an upfront payment of $7.5 million. Upon lease commencement, the Company paid the remaining $7.25 million due under the Furniture Purchase Agreement. The fair value of the furniture is $2.4 million, and the remaining excess of the $7.25 million payment over fair value will be recognized as expense over the life of the lease. The Company classified the 50 Binney Street Lease as an operating lease and recognized the right-of-use asset and lease liability upon lease commencement. The Company will recognize rent expense on a straight-line basis throughout the remaining term of the 50 Binney Street Lease.

The Sublease will continue until December 31, 2030. The Company classified the 50 Binney Street Sub-lease as an operating lease. The Company will earn rental income through its role as a lessor throughout the term of the Sublease. The

amount of sublease income recognized through June 30, 2022 for the 50 Binney sublease is $7.5 million included as other income on the statement of operations.

9. Commitments and contingencies

Other funding commitments

The Company is party to various agreements, principally relating to licensed technology, that require future payments relating to milestones that may be met in subsequent periods or royalties on future sales of specified products.

Company may be obligated to make future development, regulatory, and commercial milestone payments, and royalty payments on future sales of specified products associated with its collaboration and license agreements. Payments under these agreements generally become due and payable upon achievement of such milestones or sales. When the achievement of these milestones or sales have occurred, the corresponding amounts are recognized in the Company’s financial statements.

Additionally, the Company is party to various contracts with contract research organizations and contract manufacturers that generally provide for termination on notice, with the exact amounts in the event of termination to be based on the timing of the termination and the terms of the agreement. As compared to the contractual obligations and commitments as disclosed in the Company's 2021 Annual Report on Form 10-K, the Company's future minimum purchase commitments as of the six months ended June 30, 2022 decreased by $23.0 million.

While there are no material legal proceedings the Company is aware of, the Company may become party to various claims and complaints arising in the ordinary course of business, including securities class action litigation. The Company enters into standard indemnification agreements in the ordinary course of business. Pursuant to the agreements, the Company indemnifies, holds harmless, and agrees to reimburse the indemnified party for losses suffered or incurred by the indemnified party, generally the Company’s business partners. The term of these indemnification agreements is generally perpetual any time after execution of the agreement. The maximum potential amount of future payments the Company could be required to make under these indemnification agreements is generally unlimited. Management does not believe that any ultimate liability resulting from any of these claims will have a material adverse effect on its results of operations, financial position, or liquidity. However, management cannot give any assurance regarding the ultimate outcome of any claims, and their resolution could be material to operating results for any particular period.

The Company also indemnifies each of its officers and directors for certain events or occurrences, subject to certain limits, while the officer or director is or was serving at the Company's request in such capacity, as permitted under Delaware law and in accordance with its certificate of incorporation and by-laws. The term of the indemnification period lasts as long as such officer or director may be subject to any proceeding arising out of acts or omissions of such officer or director in such capacity. The maximum amount of potential future indemnification is unlimited; however, the Company currently holds director and officer liability insurance. This insurance allows the transfer of risk associated with the Company's exposure and may enable it to recover a portion of any future amounts paid. The Company believes that the fair value of these indemnification obligations is minimal. Accordingly, it has not recognized any liabilities relating to these obligations.

10. Equity

On June 22, 2022, the Company entered into the Equity Distribution Agreement with Goldman to sell shares of the Company’s common stock, with aggregate gross sales proceeds of up to $75.0 million, from time to time, through an “at the market” equity offering program under which Goldman will act as manager. The Equity Distribution Agreement also provides for the sale of shares to Goldman directly as principal, in which case the Company and Goldman will enter into a separate term agreement.

Under the Equity Distribution Agreement, the Company will set the parameters for the sale of shares, including any price, time or size limits or other customary parameters or conditions. The Company intends to sell shares pursuant to the Equity Distribution Agreement from time to time in varying amounts, which may be limited, based upon factors including (among others) market conditions, trading liquidity, the trading price of the Company’s common stock, and determinations by the Company of its need for, and appropriate sources of, additional capital. Subject to the terms and conditions of the Equity Distribution Agreement, Goldman may sell the shares by any method permitted by law, including without limitation (i) by means of ordinary brokers’ transactions (whether or not solicited), (ii) to or through a market maker, (iii) directly on or through any national securities exchange or facility thereof, a trading facility of a national securities association, an alternative trading system, or any other market venue, (iv) in the over-the-counter market, (v) in privately negotiated transactions, or (vi) through a combination of any such methods. The Company will pay Goldman a commission equal to up to 3.0% of the gross proceeds of

any common stock sold through Goldman under the Equity Distribution Agreement, and also has provided Goldman with customary representations, warranties, covenants and indemnification rights. The Equity Distribution Agreement may be terminated by the Company upon written notice to Goldman or by Goldman upon written notice to the Company. In the case of any purchase of shares by Goldman directly as principal pursuant to a Terms Agreement, such Terms Agreement may be terminated by Goldman upon notice to the Company under certain circumstances, including but not limited to the occurrence of a material adverse effect in the Company.

In the three months ended June 30, 2022, the Company has sold 2.1 million shares of common stock for gross proceeds of $8.3 million ($8.0 million net of offering costs).

11. Stock-based compensation

In January 2022 and 2021, the number of shares of common stock available for issuance under the 2013 Stock Option and Incentive Plan ("2013 Plan") was increased by approximately 2.8 million and 2.7 million shares, respectively, as a result of the automatic increase provision of the 2013 Plan. As of June 30, 2022, the total number of shares of common stock available for issuance under the 2013 Plan was approximately 4.7 million.

Stock-based compensation expense

The Company recognized stock-based compensation expense totaling $8.9 million and $23.1 million during the three months ended June 30, 2022 and 2021, respectively. The Company recognized stock based compensation expense totaling $21.3 million and $54.4 million on for the six months ended June 30, 2022 and 2021, respectively. Stock-based compensation expense recognized by award type is included within the condensed consolidated statements of operations and comprehensive loss was as follows (in thousands):

	For the three months ended June 30,		For six months ended June 30,	
	2022	2021[1]	2022	2021[1]
Stock options	$ 3,685	$ 13,863	$ 8,945	$ 30,289
Restricted stock units	4,850	5,956	11,884	16,173
Employee stock purchase plan and other	372	3,307	469	7,958
	$ 8,907	$ 23,126	$ 21,298	$ 54,420

(1) Prior period amounts have been retrospectively adjusted to reflect the effects of the Separation.

Stock-based compensation expense by classification included within the condensed consolidated statements of operations and comprehensive loss was as follows (in thousands):

	For the three months ended June 30,		For six months ended June 30,	
	2022	2021[1]	2022	2021[1]
Research and development	$ 5,255	$ 10,336	$ 11,810	$ 22,726
Selling, general and administrative	3,652	12,790	9,488	31,694
	$ 8,907	$ 23,126	$ 21,298	$ 54,420

(1) Prior period amounts have been retrospectively adjusted to reflect the effects of the Separation.

Stock options

The following table summarizes the stock option activity under the Company's equity award plans and have been adjusted to reflect the effects of the Separation:

	Shares (in thousands)	Weighted-average exercise price per share
Outstanding at December 31, 2021	3,586	$ 39.23
Granted	967	$ 7.48
Exercised	(2)	$ 1.04
Canceled or forfeited	(1,482)	$ 41.11
Outstanding at June 30, 2022	3,069	$ 29.48
Exercisable at June 30, 2022	1,296	$ 51.24
Vested and expected to vest at June 30, 2022	3,069	$ 29.48

During the six months ended June 30, 2022, less than 0.1 million stock options were exercised, resulting in total proceeds to the Company of less than $0.1 million.

Restricted stock units

The following table summarizes the restricted stock unit activity under the Company's equity award plans and have been adjusted to reflect the effects of the Separation:

	Shares (in thousands)	Weighted-average grant date fair value
Unvested at December 31, 2021	3,193	$ 16.21
Granted	1,451	$ 7.51
Vested	(293)	$ 25.65
Forfeited	(1,076)	$ 12.67
Unvested at June 30, 2022	3,275	$ 12.70

Employee stock purchase plan

In June 2013, the Company adopted its 2013 Employee Stock Purchase Plan ("2013 ESPP"), which authorized the initial issuance of up to a total of 0.2 million shares of the Company's common stock to participating employees. In June 2021, the Company amended the 2013 ESPP to authorize an additional 1.4 million shares of the Company's common stock available to participating employees. During each of the six months ended June 30, 2022 and 2021, no shares and less than 0.1 million shares, respectively, of common stock were issued under the 2013 ESPP.

12. Income taxes

Deferred tax assets and deferred tax liabilities are recognized based on temporary differences between the financial reporting and tax basis of assets and liabilities using statutory rates. A valuation allowance is recorded against deferred tax assets if it is more likely than not that some or all of the deferred tax assets will not be realized. Due to the uncertainty surrounding the realization of the favorable tax attributes in future tax returns, the Company has recorded a full valuation allowance against the Company's otherwise recognizable net deferred tax assets. The tax expense recognized during the three and six months ended June 30, 2022 is immaterial due to the wind down of our operations in Europe.

In March 2021, the American Rescue Plan Act ("ARPA") was enacted and contained extenders to the refundable employee retention credit and provided further limitations to executive compensation effective for tax years beginning after 2026. The Company has concluded that the provisions in the CARES Act, Consolidated Appropriations Act, and ARPA have an immaterial impact on the Company's income tax expense due to its cumulative losses and full valuation allowance position.

13. Net loss per share

The following common stock equivalents were excluded from the calculation of diluted net loss per share for the periods indicated because including them would have had an anti-dilutive effect (in thousands):

	For the three and six months ended June 30,	
	2022	2021
Outstanding stock options [1]	4,958	6,099
Restricted stock units [1]	3,408	1,865
ESPP shares and other	264	746
	8,630	8,710

(1) Outstanding stock options and restricted stock units include awards outstanding to employees of 2seventy bio for shares of the Company's common stock.

14. Restructuring

In April 2022, the Board of Directors of the Company approved a comprehensive restructuring plan intended to reduce operating expenses. The Company intends to maintain targeted research efforts focused on in-vivo LVV gene therapy and to deprioritize direct investments in reduced toxicity conditioning and cryopreserved apheresis.

As part of the restructuring, the Company plans to reduce its workforce by 30% across the second and third quarters of 2022. The Company estimates that it will incur approximately $6.6 million in costs to implement the restructuring, comprised primarily of severance payments and continuing health care coverage over the severance period. The restructuring actions associated with these charges commenced in April 2022, and are expected to be substantially completed by the end of 2022.

The following table summarizes the accrued liabilities activity recorded in connection with the restructuring for the three and six months ended June 30, 2022:

	As of June 30, 2022	
Beginning balance	$	—
Total expense	$	6,639
Payments made from inception through June 30, 2022	$	3,989
Remaining accrual at June 30, 2022	$	2,650

15. Subsequent events

The Company has raised approximately additional gross proceeds of $24.7 million and issued 5.5 million shares of common stock under the Equity Distribution Agreement through the date of this report. Of this $24.7 million, $8.0 million in net proceeds were realized in the second quarter of 2022 and are reflected in the restricted cash, cash and cash equivalents and marketable securities balances as of June 30, 2022. Please refer to Note 10, *Equity*, for further information.

Item 3. Quantitative and Qualitative Disclosures About Market Risks

We are exposed to market risk related to changes in interest rates. As of June 30, 2022 and December 31, 2021, we had cash, cash equivalents and marketable securities of $173.2 million and $396.6 million, respectively, primarily invested in U.S. government agency securities and treasuries, corporate bonds, commercial paper, equity securities, and money market accounts. Our primary exposure to market risk is interest rate sensitivity, which is affected by changes in the general level of U.S. interest rates, particularly because our investments are in short-term securities. Our available-for-sale securities are subject to interest rate risk and will fall in value if market interest rates increase. If market interest rates were to increase immediately and uniformly by 100 basis points, or one percentage point, from levels at June 30, 2022, the net fair value of our interest-sensitive marketable securities would have resulted in a hypothetical decline of approximately $0.8 million.

Item 4. Controls and Procedures

Limitations on Effectiveness of Controls and Procedures

In designing and evaluating our disclosure controls and procedures our management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving the desired control objectives. In addition, the design of disclosure controls and procedures must reflect the fact that there are resource constraints and that management is required to apply judgment in evaluating the benefits of possible controls and procedures relative to their costs.

Evaluation of our Disclosure Controls and Procedures

Our management, with the participation of our principal executive officer and principal financial officer, has evaluated the effectiveness of our disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934), as of the end of the period covered by this Quarterly Report on Form 10-Q. Based on such evaluation, our principal executive officer and principal financial officer have concluded that as of such date, our disclosure controls and procedures were effective at the reasonable assurance level.

Changes in Internal Control over Financial Reporting

During the quarter ended June 30, 2022, there were no changes in our internal control over financial reporting, as such term is defined in Rules 13a-15(f) and 15(d)-15(f) promulgated under the Securities Exchange Act of 1934, 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

In the ordinary course of business, we are from time to time involved in lawsuits, claims, investigations, proceedings, and threats of litigation relating to intellectual property, commercial arrangements, employment and other matters. While the outcome of these proceedings and claims cannot be predicted with certainty, as of June 30, 2022, we were not party to any legal or arbitration proceedings that may have, or have had in the recent past, significant effects on our financial position. No governmental proceedings are pending or, to our knowledge, contemplated against us. We are not a party to any material proceedings in which any director, member of executive management or affiliate of ours is either a party adverse to us or our subsidiaries or has a material interest adverse to us or our subsidiaries.

On February 12, 2021, a class action complaint was filed in the United States District Court for the Eastern District of New York, *Leung v. bluebird bio, Inc., et. al.*, Case No. 1:21-cv-00777, by a purported stockholder against us and certain of our officers. The complaint alleges violations of Section 10(b) of the Securities Exchange Act and Rule 10b-5 promulgated thereunder against all defendants and violations of Section 20(a) of the Exchange Act against the officers and seeks unspecified damages. The allegations relate to our disclosure on November 4, 2020 that we were adjusting the expected timing of submission of a BLA to the FDA for LentiGlobin for sickle cell disease to late 2022. This case was subsequently transferred to the United States District Court of Massachusetts on February 26, 2021. Our Motion to Dismiss the complaint in its entirety was granted by the Court on April 21, 2022, and no appeal has been filed with the Court.

On October 21, 2021, Errant Gene Therapeutics, LLC filed a complaint against us in the United States District Court for the District of Delaware for alleged infringement of U.S. Patents 7,541,179 and 8,058,061. The allegations relate to our use of the BB305 lentiviral vector in the beti-cel program and seeks injunctive relief and money damages. On February 21, 2022, the parties stipulated to amend the case caption, in light of the plaintiff's name change, from Errant Gene Therapeutics, LLC to San Rocco Therapeutics, LLC. The Court granted this stipulation and, accordingly, the case is now captioned, *San Rocco Therapeutics, LLC v. bluebird bio, Inc. and Third Rock Ventures, LLC*, C.A. No. 21-1478-RGA. On April 6, 2022, we—along with Third Rock Ventures, LLC—filed a motion seeking various relief including to stay the proceedings and compel arbitration on two threshold issues, which we believe preclude the plaintiff's claims. The plaintiff opposed this motion and the parties fully briefed the issues. On July 26, 2022, the Court granted our request to stay the proceedings and issued an Order compelling the parties to arbitrate the threshold issues we raised. On July 28, 2022, the Court administratively closed the case.

Item 1A. Risk Factors

An investment in shares of our common stock involves a high degree of risk. You should carefully consider the following information about these risks, together with the other information appearing elsewhere in this Quarterly Report on Form 10-Q, including our financial statements and related notes hereto, before deciding to invest in our common stock. The occurrence of any of the following risks could have a material adverse effect on our business, financial condition, results of operations and future growth prospects. In these circumstances, the market price of our common stock could decline, and you may lose all or part of your investment.

Those risk factors below denoted with a "" are newly added or have been materially updated from our 2021 Annual Report on Form 10-K.*

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

We have incurred net losses in each year since our inception in 1992, including net losses from continuing operations of $100.1 million and $222.3 million for the three and six months ended June 30, 2022, respectively. As of June 30, 2022, we had an accumulated deficit of $3.94 billion. The amount of our future net losses will depend, in part, on the rate of our future expenditures and our ability to generate revenues. We have devoted significant financial resources to research and development, including our clinical and preclinical development activities, which we expect to continue for the foreseeable future. To date, we have financed our operations primarily through the sale of equity securities and, to a lesser extent, through collaboration agreements and grants from governmental agencies and charitable foundations. We have not generated material revenues from the sale of beti-cel in the European Union, and we do not expect to generate meaningful product revenues in the foreseeable future until we obtain marketing approval for products in the United States and following any potential commercial launch. Following marketing approval, our future revenues will depend upon the size of any markets in which our potential products have received approval, and our ability to achieve sufficient market acceptance, reimbursement from third-party payers and adequate market share for our potential products in those markets.

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

- continue our research and clinical development of our product candidates;

- maintain and utilize manufacturing capacity at third-party manufacturers;
- establish capabilities to support our commercialization efforts, including establishing a sales, marketing and distribution infrastructure in the United States, and to commercialize products for which we may obtain marketing approval;
- maintain, protect and potentially expand our intellectual property portfolio;
- attract and retain skilled personnel; and
- experience any delays or encounter issues with any of the above.

We may also in the foreseeable future undertake additional activities that may substantially increase our expenses, such as:

- build and expand manufacturing capacity, including capacity at third-party manufacturers;
- initiate additional research, preclinical, clinical or other programs as we seek to identify and validate additional product candidates; or
- acquire or in-license other product candidates and technologies.

The net losses we incur may fluctuate significantly from quarter to quarter and year to year, such that a period-to-period comparison of our results of operations may not be a good indication of our future performance. In any particular quarter or quarters, our operating results could be below the expectations of securities analysts or investors, which could cause our stock price to decline.

There is substantial doubt regarding our ability to continue as a going concern. We will need to raise additional funding, which may not be available on acceptable terms, or at all. Failure to obtain this necessary capital when needed may force us to delay, limit or terminate our product development efforts or other operations.

We are currently advancing our late-stage programs in severe genetic diseases through clinical development. Developing and commercializing gene therapy products is expensive, and we do not expect to generate meaningful product revenues in the foreseeable future until we obtain marketing approval for products in the United States and following any potential commercial launch.

As of June 30, 2022, we had cash and cash equivalents, and marketable securities of approximately $173.2 million. As of December 31, 2021, our cash, cash equivalents and marketable securities were $396.6 million. Based on our current business plan as of the date of our condensed consolidated financial statements appearing elsewhere in this Quarterly Report on Form 10-Q, there is substantial doubt regarding our ability to continue as a going concern for a period of one year after such date.

In April 2022, we announced a comprehensive restructuring plan intended to reduce operating expenses. We may not realize expected cost savings from the implementation of these plans at the levels we expect; we may encounter additional delays in the development of our programs, including the imposition of new clinical holds or delays in resolving existing clinical holds, that may impact our ability to meet our expected time lines and increase our costs; the internal and external costs required for our ongoing and planned activities, and the resulting impact on expense and use of cash, may be higher than expected which may cause us to use cash more quickly than we expect or change or curtail some of our plans or both; our expectations as to expenses, cash usage and cash needs may prove not to be correct for other reasons such as changes in plans or actual events being different than our assumptions. We will need to raise additional funding in order to execute on our current business plans and strategy.

Our efforts to raise additional funding or reduce expenses may divert our management from their day-to-day activities, which may adversely affect our ability to develop and commercialize our potential products following marketing approval if and when obtained. In addition, we cannot guarantee that financing will be available in sufficient amounts or on terms acceptable to us, if at all. Moreover, the terms of any financing may adversely affect the holdings or the rights of our stockholders and the issuance of additional securities, whether equity or debt, by us, or the possibility of such issuance, may cause the market price of our shares to decline. The sale of additional equity or convertible securities would dilute all of our stockholders. The incurrence of indebtedness would result in increased fixed payment obligations and we may be required to agree to certain restrictive covenants, such as limitations on our ability to incur additional debt, limitations on our ability to acquire, sell or license intellectual property rights and other operating restrictions that could adversely impact our ability to conduct our business. We could also be required to seek funds through arrangements with collaborative partners or otherwise at an earlier stage than otherwise would be desirable and we may be required to relinquish rights to some of our technologies or product candidates or otherwise agree to terms unfavorable to us, any of which may have a material adverse effect on our business, operating results and prospects.

If we are unable to obtain funding on a timely basis, or if revenues from collaboration arrangements or product sales are less than we have projected, we may be required to further revise our business plan and strategy, which may result in us

significantly curtailing, delaying or discontinuing one or more of our research or development programs or the commercialization of any product candidates or may result in our being unable to expand our operations or otherwise capitalize on our business opportunities. As a result, our business, financial condition and results of operations could be materially affected.

Insertional oncogenesis is a risk of gene therapies using viral vectors that can integrate into the genome, and several patients with CALD treated with eli-cel in our clinical studies have been diagnosed with MDS likely mediated by Lenti-D LVV insertion. These events may require us to halt or delay further clinical development of our product candidates, such as eli-cel, or to suspend or cease commercialization following marketing approval, and the commercial potential of our product candidates may be materially and negatively impacted.

A potentially significant risk in any gene therapy product using viral vectors that can integrate into the genome is that the vector will insert in or near cancer-causing genes, leading to the proliferation of certain cellular clones that can cause cancer in the patient, known as insertional oncogenesis. Several patients with CALD treated with eli-cel in our clinical studies have been diagnosed with MDS likely mediated by Lenti-D LVV insertion, and as a result, the FDA placed our clinical studies of eli-cel on clinical hold. In light of the FDA's requests for additional information about safety events and monitoring in the eli-cel clinical program, we have no assurances as to whether we will successfully resolve the clinical hold. In addition, we cannot make assurances that additional patients treated with eli-cel, beti-cel or lovo-cel in the clinical or commercial setting will not be diagnosed with MDS, leukemia or lymphoma. Patients treated with our therapies, including lovo-cel, have exhibited persistent oligoclonality, in which a portion of their hematopoietic system is comprised of cells containing at least one insertion site, as measured by integration site analysis. Based on our pharmacovigilance protocols, we increase our monitoring of patients who exhibit persistent oligoclonality. It is not clear at this time whether persistent oligoclonality represents an increased risk of developing MDS, leukemia, or lymphoma in the future, but it is a criteria used by the FDA to evaluate the safety of gene therapies over time. There is also the potential risk of other delayed adverse events following exposure to gene therapy products due to persistent biological activity of the genetic material or other components of products used to carry the genetic material. The FDA has stated that LVV possess characteristics that may pose high risks of delayed adverse events. If any such adverse events occur, further advancement of our clinical studies could be halted or delayed, we may not receive marketing approval for our product candidates, and we may be unable to commercialize any approved product. It is possible that upon occurrence or recurrence of any of these events, the FDA may place one or more of our programs on hold, impose requirements that result in delays for regulatory approval for one or more of our programs, require risk evaluation or mitigation strategies as a condition for regulatory approval, or may cause us to cease commercialization following the receipt of any marketing approval. If any of these were to occur, the commercial potential of our programs may be materially and negatively impacted.

Furthermore, treatment with our potential products involve chemotherapy or myeloablative treatments which can cause side effects or adverse events that may impact the perception of the potential benefits of our potential products. For instance, MDS leading to acute myeloid leukemia is a known risk of certain myeloablative regimens. Additionally, beti-cel, eli-cel, or lovo-cel, the procedures associated with their administration, or with the collection of patients' cells, could potentially cause other adverse events that have not yet been predicted. The inclusion of patients with significant underlying medical problems in our clinical studies may result in deaths, or other adverse medical events, due to other therapies or medications that such patients may be using, or the progression of their disease. For instance, it is possible that the events of MDS and acute myeloid leukemia previously reported in our HGB-206 clinical study were caused by lovo-cel, in combination with underlying SCD, transplant procedure, and stress on the bone marrow following drug product infusion. Even if a product such as lovo-cel, eli-cel or beti-cel is ultimately approved, such safety events may result in the product being removed from the market or its market opportunity being significantly reduced. Other patients receiving our product candidates may develop leukemia, lymphoma, or MDS in the future, which may negatively impact the commercial prospects of our product candidates. Any of these events could impair our ability to develop or commercialize our product candidates, and their commercial potential may be materially and negatively impacted.

Risks related to commercialization

We have limited experience as a commercial company and the marketing and sale of beti-cel, eli-cel, and lovo-cel following marketing approval, if and when obtained, may be unsuccessful or less successful than anticipated.

We have limited experience as a commercial company. To-date, our experience as a commercial company has been limited to commercializing beti-cel in Europe, and we have wound up our European commercial operations in order to focus in the near-term on the U.S. market. Consequently, there is limited information about our ability to overcome many of the risks and uncertainties encountered by companies commercializing products in the biopharmaceutical industry in the U.S. To execute our business plan, we will need to successfully:

- gain regulatory approval to commercialize beti-cel, eli-cel, and lovo-cel in the United States;

- obtain adequate pricing and reimbursement for beti-cel, eli-cel, and lovo-cel across payers in the United States;
- establish and maintain, in the regions where we hope to treat patients, relationships with qualified treatment centers who will be treating the patients who receive beti-cel, eli-cel, and lovo-cel;
- manage our spending as we seek marketing approvals, and engage in commercialization efforts, including for any extension of marketing approval of beti-cel, eli-cel, and lovo-cel; and
- initiate, develop and maintain successful strategic alliances.

If we are not successful in accomplishing these objectives, we may not be able to develop and commercialize beti-cel, eli-cel, or lovo-cel, raise capital, expand our business, or continue our operations.

The commercial success of beti-cel, eli-cel, and lovo-cel following marketing approval, if and when obtained, will depend upon the degree of market acceptance by physicians, patients, payers and other stakeholders.

The commercial success of beti-cel, eli-cel, and lovo-cel following marketing approval, if and when obtained, will depend in part on the medical community, patients, and third-party or governmental payers accepting gene therapy products in general, and beti-cel, eli-cel, and lovo-cel, in particular, as medically useful, cost-effective, and safe. Beti-cel, eli-cel, and lovo-cel that we may bring to the market may not gain market acceptance by physicians, patients, payers and other stakeholders. If these products do not achieve an adequate level of acceptance, we may not generate significant product revenue and may not become profitable. The degree of market acceptance of beti-cel, eli-cel, and lovo-cel following marketing approval, if and when obtained, will depend on a number of factors, including:

- the potential efficacy and potential advantages over alternative treatments;
- the prevalence and severity of any side effects, including any limitations or warnings contained in a product's approved labeling;
- the prevalence and severity of any side effects resulting from the chemotherapy and myeloablative treatments associated with the procedure by which our potential products are administered;
- relative convenience and ease of administration;
- the willingness of the target patient population to try new therapies and of physicians to prescribe these therapies;
- the strength of marketing and distribution support and timing of market introduction of competitive products;
- the pricing of our potential products;
- publicity concerning our potential products, or competing products and treatments; and
- sufficient insurance coverage or reimbursement.

Even if a potential product displays a favorable efficacy and safety profile in clinical studies, market acceptance of the product will not be known until after it is launched. Our efforts to educate the medical community and payers on the benefits of our potential products may require significant resources and may never be successful. For instance, following marketing approval of beti-cel in the European Union, we did not reach agreement with payers on an acceptable price for reimbursement in our priority markets in Europe, and we are no longer seeking to commercialize our product candidates in Europe for the foreseeable future. Our efforts to educate the marketplace may require more resources than are required by the conventional technologies marketed by our competitors. Any of these factors may cause beti-cel, eli-cel, or lovo-cel, to be unsuccessful or less successful than anticipated.

If the market opportunities for our potential products are smaller than we believe they are, and if we are not able to successfully identify patients and achieve significant market share, our revenues may be adversely affected and our business may suffer.

We focus our research and product development on treatments for severe genetic diseases. Our projections of both the number of people who have these diseases, as well as the subset of people with these diseases who have the potential to benefit from treatment with our potential products, are based on estimates. These estimates have been derived from a variety of sources, including scientific literature, surveys of clinics, patient foundations, or market research, and may prove to be incorrect. Further, new studies may change the estimated incidence or prevalence of these diseases. The number of patients may turn out to be lower or more difficult to identify than expected. Additionally, the potentially addressable patient population for our potential products may be limited or may not be amenable to treatment with our potential products. For instance, in our lovo-cel and eli-cel programs, we have received notice of safety events of acute myeloid leukemia or myelodysplastic syndrome, and additional such events may be reported in the future. The market opportunity for our gene therapies may be negatively impacted even if our gene therapies ultimately receive marketing approval.

Even if we obtain significant market share for a product within an approved indication, because the potential target populations for our potential products are small, we may never achieve profitability without obtaining marketing approval for additional indications.

Any of these factors may negatively affect our ability to generate revenues from sales of our potential products and our ability to achieve and maintain profitability and, as a consequence, our business may suffer.

We rely on a complex supply chain for beti-cel, eli-cel, and lovo-cel. The manufacture and delivery of LVV and drug products present significant challenges for us, and we may not be able to produce our vector and drug products at the quality, quantities, locations or timing needed to support our clinical programs and commercialization following marketing approval if and when obtained. In addition, we may encounter challenges with engaging or coordinating with qualified treatment centers needed to support commercialization following marketing approval if and when obtained.

We rely on third parties to manufacture the LVV and the drug product for any clinical trials that we conduct, and we intend to rely on third parties for the supply of LVV and drug product for commercialization following any marketing approval, if and when obtained. We have not secured all of the commercial-scale manufacturing capacity that we anticipate requiring for the commercialization of our therapies to meet our forecasts beyond the potential launch, if they should receive marketing approval. If we fail to secure adequate capacity to manufacture our drug products or LVV used in the manufacture of our drug products in accordance with our forecasts beyond the potential launch of our therapies, we may be unable to execute on our development and commercialization plans on the timing that we expect, or at all.

The manufacture of LVV and drug products is complex and requires significant expertise. Even with the relevant experience and expertise, manufacturers of cell therapy products often encounter difficulties in production, particularly in scaling out and validating initial production, managing the transition from clinical manufacturing to manufacturing in the commercial setting, and ensuring that the product meets required specifications. These problems include difficulties with production costs and yields, quality control, including stability of the product, quality assurance testing, operator error, shortages of qualified personnel, as well as compliance with strictly enforced federal, state and foreign regulations. We cannot make any assurances that these problems will not occur in the future, or that we will be able to resolve or address in a timely manner or with available funds problems that occur. Because of this complexity, transitioning production of either LVV or drug products to backup or second source manufacturing, or to internal manufacturing capacity, requires a lengthy technology transfer process and may require additional significant financial expenditures. Furthermore, our cost of goods development is at an early stage. The actual cost to manufacture our LVV and drug products could be greater than we expect and could materially and adversely affect the commercial viability of beti-cel, eli-cel, or lovo-cel. If we or such third-party manufacturers are unable to produce the necessary quantities of LVV and our drug products, or in compliance with GMP or other pertinent regulatory requirements, and within our planned time frame and cost parameters, the development and commercialization of our potential products may be materially harmed, result in delays in our plans or increased capital expenditures. Additionally, since the HSCs used as starting material for drug products have a limited window of stability following procurement from a patient, we must establish drug product manufacturing facilities in the regions where we wish to commercialize beti-cel, eli-cel, and lovo-cel following marketing approval, if and when obtained. We have no assurance as to when drug product manufacturing using cryopreserved apheresis starting material will be available, if ever.

In addition, any significant disruption in our supplier relationships could harm our business. We source key materials from third parties, either directly through agreements with suppliers or indirectly through our manufacturers who have agreements with suppliers. There are a small number of suppliers for certain key materials that are used to manufacture beti-cel, eli-cel, and lovo-cel. Such suppliers may not sell these key materials to us or to our manufacturers at the times we need them or on commercially reasonable terms. We do not have any control over the process or timing of the acquisition of these key materials by our manufacturers, and we currently do not have agreements for the commercial supply for all of these key materials.

Our commercial strategy is to engage apheresis and transplant centers as qualified treatment centers for the collection of patient HSCs and infusion of the drug product once manufactured. To ensure that the qualified treatment centers are prepared to collect patient HSCs and to ship them to drug product manufacturing facilities in accordance with our specifications and regulatory requirements, we train and conduct quality assessments of each center as part of engagement. These qualified treatment centers are the first and last points on our complex supply chain to reach patients in the commercial setting. We may not be able to engage qualified treatment centers in all of the regions in our commercial launch strategy, or we may encounter other challenges or delays in engaging qualified treatment centers. We may fail to manage the logistics of collecting and shipping patient material to the manufacturing site and shipping the drug product back to the patient. Logistical and shipment delays and problems caused by us, our third-party vendors, and other factors not in our control, such as weather, could prevent or delay the manufacture of or delivery of drug product to patients. If our qualified treatment centers fail to perform satisfactorily, we may suffer reputational, operational, and business harm. We are required to maintain a complex chain of identity and chain of custody with respect to patient material as it moves through the manufacturing process, from the qualified treatment center to the drug product manufacturing facility, and back to the patient. Failure to maintain chain of identity and

chain of custody could result in adverse patient outcomes, loss of product or regulatory action. Following regulatory approval of any product, it will take a period of time to prepare our commercial drug product manufacturers for operational readiness in the commercial context, and we may encounter delays in that effort. Any delay in ours or our drug product manufacturers' ability in preparing for commercial launch will negatively impact our ability to generate revenue from product sales following regulatory approval.

We have limited sales and distribution experience and limited capabilities for marketing and market access. We have invested and expect to continue to invest significant financial and management resources to establish these capabilities and infrastructure to support commercial operations following marketing approval if and when obtained. If we are unable to establish these commercial capabilities and infrastructure or to enter into agreements with third parties to market and sell our potential products, we may be unable to generate sufficient revenue to sustain our business.

We have limited prior sales or distribution experience and limited capabilities for marketing and market access, and we did not generate meaningful product sales following the commercial launch of beti-cel following marketing approval in Europe. To successfully commercialize beti-cel, eli-cel, and lovo-cel following marketing approval in the United States, if and when obtained, we will need to further develop these capabilities. We may need to expand our infrastructure to support commercial operations in the United States, either on our own or with others. Commercializing an autologous gene therapy is resource-intensive and has required, and will continue to require, substantial investment in commercial capabilities. We are competing with companies that currently have extensive and well-funded marketing and sales operations. Without significant commercial experience as a company or the support of a third-party to perform these functions, including marketing and sales functions, we may be unable to compete successfully against these more established companies. Furthermore, a significant proportion of the patient populations for beti-cel, eli-cel, and lovo-cel lies outside of the United States. We currently expect to focus our operations and efforts on markets in the United States and will need to rely heavily on third parties for commercializing any products in geographies outside of the United States. We may enter into collaborations with third parties to utilize their mature marketing and distribution capabilities, but we may be unable to enter into agreements on favorable terms, if at all. If we do not enter into collaboration arrangements with third parties to pursue regulatory authorization or commercialization of our programs for markets outside of the United States, or if our future collaborative partners do not commit sufficient resources to such efforts, we may be unable to generate sufficient revenue to sustain our business.

The insurance coverage and reimbursement status of newly-approved products in the United States is uncertain. Due to the novel nature of our technology and the potential for our product to offer lifetime therapeutic benefit in a single administration, we face additional challenges in obtaining adequate pricing and reimbursement for our product. Failure to obtain or maintain adequate coverage and reimbursement for any new or current product could limit our ability to market those products and decrease our ability to generate revenue.

The availability and extent of reimbursement by governmental and private payers is essential for most patients to be able to afford expensive treatments, such as gene therapy products. Sales of our potential products will depend substantially, both domestically and abroad, on the extent to which the costs of our potential products will be paid by health maintenance, managed care, pharmacy benefit and similar healthcare management organizations, or reimbursed by government health administration authorities, private health coverage insurers and other payers. There is no assurance that the approved prices or reimbursement levels that payers will be willing to pay will be acceptable to us. In addition, because our therapies represent new treatment approaches, the estimation of potential revenues will be complex. For products administered under the supervision of a physician, obtaining reimbursement may be particularly difficult because of the higher prices often associated with such drugs. Additionally, separate reimbursement for the product itself or the treatment or procedure in which the product is used may not be available, which may impact physician utilization.

There is significant uncertainty related to the insurance coverage and reimbursement of newly approved products, including gene therapies that are potential one-time treatments. In the United States, the principal decisions about reimbursement for new medicines are typically made by the Centers for Medicare & Medicaid Services ("CMS") an agency within the U.S. Department of Health and Human Services ("HHS"), as CMS decides whether and to what extent a new medicine will be covered and reimbursed under Medicare. Private payers tend to follow CMS to a substantial degree. It is difficult to predict what CMS will decide with respect to reimbursement for fundamentally novel products such as ours, as there is no body of established practices and precedents for these new products.

Moreover, increasing efforts by governmental and third-party payers to cap or reduce healthcare costs may cause such organizations to limit both coverage and level of reimbursement for new products approved and, as a result, they may not cover or provide adequate payment for beti-cel, eli-cel, or lovo-cel following marketing approval, if and when obtained. We expect to experience pricing pressures in connection with the sale of our potential products, due to the trend toward managed healthcare, the increasing influence of health maintenance organizations and additional legislative changes. Net prices for drugs may be reduced by mandatory discounts or rebates required by government or private payers 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 United States. The

downward pressure on healthcare costs in general, particularly prescription drugs and surgical procedures and other treatments, has become very intense. As a result, increasingly high barriers are being erected to the entry of new products.

Furthermore, because our target patient populations are relatively small, the pricing and reimbursement of our potential products must be adequate to cover the costs to treat and support the treatment of patients. If we are unable to obtain adequate levels of reimbursement, our ability to successfully market and sell our potential products will be adversely affected. Even if coverage is provided, the approved reimbursement amount may not be high enough to allow us to establish or maintain pricing sufficient to realize a sufficient return on our investment.

In addition, the administration of autologous drug products requires procedures for the collection of HSCs from the patient, followed by chemotherapy and myeloablative treatments, before infusion of the engineered cell therapy product. The manner and level at which reimbursement is provided for these services is also important. Inadequate reimbursement for such services may lead to physician resistance and adversely affect our ability to market or sell our product.

Although we have proposed novel payment models, including outcomes-based arrangements with payments over time, to assist with realizing the value and sharing the risk of a potential one-time treatment, we did not reach agreement with payers on an acceptable price for reimbursement in our priority markets in Europe. In addition, to the extent reimbursement for our product is subject to outcomes-based arrangements, the total payments received from product sales may vary, our cash collection of future payments and revenue assumptions from product sales will be at risk, and the timing of revenue recognition may not correspond to the timing of cash collection. We plan on commercializing our product candidates in the United States once approved, and will be subject to price reporting obligations set forth by CMS. To the extent reimbursement for our potential products in the United States by U.S. governmental payers is subject to outcomes-based arrangements, the increased complexity increases the risk that CMS may disagree with the assumptions and judgments that we use in our price reporting calculations, which may result in significant fines and liability.

Collectively, these factors could affect our ability to successfully commercialize our potential products and generate or recognize revenues, which would adversely impact our business, financial condition, results of operations and prospects.

Risks related to the research and development of our product candidates

We cannot predict when or if we will obtain marketing approval to commercialize beti-cel, eli-cel, or lovo-cel, and the marketing approval of our product candidates may ultimately be for more narrow indications than we expect. If our product candidates are not approved in a timely manner or at all for any reason, our business prospects, results of operations, and financial condition would be adversely affected.

Before obtaining marketing approval from regulatory authorities for the commercialization of our product candidates, we must conduct extensive clinical studies to demonstrate the safety, purity and potency, and efficacy, of the product candidates in humans. Clinical testing is expensive, time-consuming and uncertain as to outcome. There is a high failure rate for therapies proceeding through clinical studies. A number of companies in the pharmaceutical and biotechnology industries have suffered significant setbacks in later stage clinical studies even after achieving promising results in earlier stage clinical studies. We cannot guarantee that any clinical studies will be conducted as planned or completed on schedule, if at all. A failure of one or more clinical studies can occur at any stage of testing. Events that may prevent successful or timely completion of clinical development include:

- delays in reaching a consensus with regulatory agencies on study design;
- imposition of a clinical hold by regulatory agencies, after an inspection of our clinical study operations or study sites or due to unforeseen safety issues;
- delays in the testing, validation, manufacturing and delivery of our product candidates to the clinical sites;
- failure to obtain sufficient cells from patients to manufacture enough drug product or achieve target cell doses;
- delays in patient enrollment, or in having patients complete participation in a study or return for post-treatment follow-up;
- occurrence of serious adverse events associated with the product candidate that are viewed to outweigh its potential benefits; or
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols.

We have experienced delays in some of our clinical studies in the past, and we may experience similar delays in the future.

Results from previous or ongoing studies are not necessarily predictive of our future clinical study results, and initial or interim results may not continue or be confirmed upon completion of the study. There is limited data concerning long-term safety and efficacy following treatment with our product candidates. These data, or other positive data, may not continue or

occur for these patients or for any future patients in our ongoing or future clinical studies, and may not be repeated or observed in ongoing or future studies involving our product candidates. Furthermore, our product candidates may also fail to show the desired safety and efficacy in later stages of clinical development despite having successfully advanced through initial clinical studies. There can be no assurance that any of these studies will ultimately be successful or support further clinical advancement or marketing approval of our product candidates. For instance, while patients with SCD who have been treated with lovo-cel may experience a reduction of vaso-occlusive events following successful engraftment, there can be no assurance that they will not experience vaso-occlusive events in the future. We have experienced unexpected results in the past, and we may experience unexpected results in the future.

Even if our product candidates demonstrate safety and efficacy in clinical studies, regulatory delays or rejections may be encountered as a result of many factors, including changes in regulatory policy during the period of product development. We may experience delays or rejections based upon additional government regulation from future legislation or administrative action, changes in regulatory agency policy, or additional regulatory feedback or guidance during the period of product development, clinical studies and the review process. The field of cell and gene therapy is evolving, and as more products are reviewed by regulatory authorities, they may impose additional requirements that were not previously anticipated. Regulatory agencies also may approve a treatment candidate for fewer or more limited indications than requested or may grant approval subject to the performance of post-marketing studies. In addition, regulatory agencies may not approve the labeling claims that are necessary or desirable for the successful commercialization of our treatment candidates. For example, the development of our product candidates for pediatric use is an important part of our current business strategy, and if we are unable to obtain marketing approval for the desired age ranges, our business may suffer.

The BLA submission for beti-cel is based on data from patients treated in our studies, including the Phase 3 HGB-207 (Northstar-2) and HGB-212 (Northstar-3) studies, and the Phase 1/2 HGB-204 (Northstar) and HGB-205 studies, and has been accepted for filing by the FDA with priority review and a PDUFA goal date of August 19, 2022. However, it should be noted that our ability to obtain approval of a BLA is ultimately an FDA review decision, which will be dependent upon the data and information submitted in the original BLA and during review, and the data submitted may not be sufficiently robust from a safety and/or efficacy perspective, or from a manufacturing and/or quality perspective, to support the approval of the BLA. Based on the available data from these clinical studies and the information submitted, the FDA may require that we conduct additional or larger pivotal trials before we can obtain approval of the BLA for beti-cel for the treatment of patients with β-thalassemia who require regular transfusions.

The BLA submission for eli-cel is based on the safety and efficacy data from our completed Starbeam study, our ongoing ALD-104 study, and the completed ALD-103 observational study, and has been accepted for filing by the FDA for filing and and granted priority review, with a PDUFA goal date of September 16, 2022. Whether eli-cel is eligible for approval will ultimately be determined at the discretion of the FDA, and is dependent upon the data and information submitted in the BLA and during review, and the data submitted may not be sufficiently robust from a safety and/or efficacy perspective, or from a manufacturing and/or quality perspective, to support approval of the BLA. Moreover, several patients with CALD treated with eli-cel in our clinical studies have been diagnosed with MDS likely mediated by Lenti-D LVV insertion, and as a result, our clinical studies of eli-cel have been subject to a clinical hold. We may not generate the information requested by the FDA with respect to the clinical hold, and we have no assurances as to whether we will successfully resolve the clinical hold. The FDA may determine that eli-cel cannot be approved or it may require that we conduct additional follow-up or larger clinical trials before we can obtain approval of the BLA for eli-cel for the treatment of patients with CALD, if ever.

Based on our discussions with the FDA, we believe that we may be able to seek approval for lovo-cel in the United States on the basis of clinical data from Group C of our ongoing HGB-206 clinical study, and supporting data from our ongoing HGB-210 clinical study. Our clinical program for lovo-cel is on partial clinical hold for patients under the age of 18, which relates to our ongoing investigation into an adolescent patient with persistent, non-transfusion-dependent anemia following treatment with lovo-cel, who was 18 months post-treatment. We do not have any assurance as to when, if ever, we may resume enrolling patients under the age of 18 in our lovo-cel studies. The partial clinical hold has the potential to negatively impact our ability to generate the analytical comparability and validation data for our commercial manufacturing process needed to support our planned BLA submission for lovo-cel.

If our product candidates are ultimately not approved for any reason, our business, prospects, results of operations and financial condition would be adversely affected.

Changes in our manufacturing processes may cause delays in our clinical development and commercialization plans.

The manufacturing processes for our LVV and our drug products are complex. We explore improvements to our manufacturing processes on a continual basis, as we evaluate clinical and manufacturing data and based on discussions with regulatory authorities. In some circumstances, changes in the manufacturing process may require us to perform additional comparability studies, collect additional data from patients, submit additional regulatory filings, or comply with additional requirements, which may lead to delays in our clinical development and commercialization plans. For instance, following the

conditional approval of beti-cel by the European Commission, we continued to refine our commercial drug product manufacturing process to narrow some of the manufacturing process parameters and to tighten the range of commercial drug product release specifications, based on discussions with the European Medicines Agency and evolving clinical data. Implementing these changes to the beti-cel commercial manufacturing process had the effect of delaying our ability to treat the first patient in the commercial context in Europe. In lovo-cel, we plan to seek regulatory approval for drug product utilizing LVV manufactured using a scalable suspension manufacturing process using bioreactors, rather than an adherent cell tray manufacturing process, and we will need to generate analytical comparability and validation data that is acceptable to the FDA in support of such process change. Over time, we may transition the LVV manufacturing process for beti-cel in the United States to the suspension manufacturing process, and the timing in which we are able to make the transition will be dependent upon reaching agreement with the FDA, which we expect will require us to conduct additional studies, collect additional data, develop additional assays, or modify release specifications.

We face intense competition and rapid technological change and the possibility that our competitors may develop therapies that are more advanced, safer or more effective than ours, which may adversely affect our financial condition and our ability to successfully develop and commercialize beti-cel, eli-cel, and lovo-cel. If our competitors obtain orphan drug exclusivity for products that regulatory authorities determine constitute the same drug and treat the same indications as our product candidates, and they obtain marketing authorization, we may not be able to have competing products approved by the applicable regulatory authority for a significant period of time.

We are engaged in the development of gene therapies for severe genetic diseases, which is a competitive and rapidly-changing field. We have competitors both in the United States and internationally, including major multinational pharmaceutical companies, biotechnology companies and universities and other research institutions. Many of our competitors have substantially greater financial, technical and other resources, such as larger research and development staff, more experienced manufacturing capabilities, or more established commercial infrastructure. Competition may increase further as a result of advances in the commercial applicability of technologies and greater availability of capital for investment in these industries. Our competitors may succeed in developing, acquiring or licensing on an exclusive basis, products that are more effective, safer, or less costly than any products that we may develop, or achieve patent protection, marketing approval, product commercialization and market penetration earlier than us. Additionally, technologies developed by our competitors may render our potential products uneconomical or obsolete, and we may not be successful in marketing our product candidates against competitors. For additional information regarding our competition, see “Item 1. Business—Competition” in our 2021 Annual Report on Form 10-K.

Even if we are successful in achieving marketing approval to commercialize a product candidate faster than our competitors, we may face competition from biosimilars due to the changing regulatory environment. In the United States, the Biologics Price Competition and Innovation Act of 2009 created an abbreviated approval pathway for biological products that are demonstrated to be “highly similar,” or biosimilar, to or “interchangeable” with an FDA-approved biological product. This pathway could allow competitors to reference data from biological products already approved after 12 years from the time of approval. In Europe, the European Commission has granted marketing authorizations for several biosimilars pursuant to a set of general and product class-specific guidelines for biosimilar approvals issued over the past few years. In Europe, a competitor may reference data from biological products already approved, but will not be able to get on the market until 10 years after the time of approval. This 10-year period will be extended to 11 years if, during the first eight of those 10 years, the marketing authorization holder obtains an approval for one or more new therapeutic indications that bring significant clinical benefits compared with existing therapies. In addition, companies may be developing biosimilars in other countries that could compete with our potential products. If competitors are able to obtain marketing approval for biosimilars referencing our potential products, our potential products may become subject to competition from such biosimilars, with the attendant competitive pressure and consequences. Expiration or successful challenge of our applicable patent rights could also trigger competition from other products, assuming any relevant exclusivity period has expired.

In addition, although beti-cel, eli-cel, and lovo-cel have been granted orphan drug status by the FDA there are limitations to the exclusivity. In the United States, the exclusivity period for orphan drugs is seven years, while pediatric exclusivity adds six months to any existing patents or exclusivity periods. Generally, if a product with an orphan drug designation receives the first marketing approval for the indication for which it has such designation, the product is entitled to a period of marketing exclusivity, which precludes the FDA from approving another marketing application for a product that constitutes the same drug treating the same indication for that marketing exclusivity period, except in limited circumstances. If another sponsor receives such approval before we do (regardless of our orphan drug designation), we will be precluded from receiving marketing approval for our potential products for the exclusivity period for the applicable indication.

Finally, as a result of the expiration or successful challenge of our patent rights, we could face more litigation with respect to the validity and/or scope of patents relating to our competitors’ products. The availability of our competitors’ products could limit the demand, and the price we are able to charge, for any products that we may develop and commercialize.

We may not be successful in our efforts to expand applications of our platform technologies through the discovery of additional product candidates or in utilizing complementary technologies such as reduced toxicity conditioning.

The success of our business depends primarily upon our ability to identify, develop and commercialize products based on our platform technologies, such as *in vivo* product candidates. Our growth strategy also depends upon our ability to leverage advancements in complementary technologies such as in reduced toxicity conditioning or in stem cell mobilization discovered or developed by third parties. With our corporate restructuring announced in April 2022, we are making targeted investments in new technologies, and to execute on our strategies for growth, we will need to increase our investments in new programs and technologies. Our research programs may fail to identify other potential product candidates for clinical development or we may be unable to utilize such complementary technologies for a number of reasons. We may be unsuccessful in identifying potential product candidates or our potential product candidates may be shown to have harmful side effects or may have other characteristics that may make the products unmarketable or unlikely to receive marketing approval. Research programs to identify new product candidates and new technologies require substantial technical, financial and human resources. We may focus our efforts and resources on potential programs or product candidates that ultimately prove to be unsuccessful. If any of these events occur, we may be forced to abandon our research, development or commercialization efforts for a program or programs, which would have a material adverse effect on our business and could potentially cause us to cease operations.

Negative public opinion and increased regulatory scrutiny of gene therapy and genetic research may damage public perception of our potential products or adversely affect our ability to conduct our business or obtain and maintain marketing approvals for our product candidates.

Public perception may be influenced by claims that gene therapy, including gene editing technologies, is unsafe or unethical, and research activities and adverse events in the field, even if not ultimately attributable to us or our product candidates, could result in increased governmental regulation, unfavorable public perception, challenges in recruiting patients to participate in our clinical studies, potential regulatory delays in the testing or approval of our potential products, stricter labeling requirements for those product candidates that are approved, and a decrease in demand for any such product. More restrictive government regulations or negative public opinion would have a negative effect on our business or financial condition and may delay or impair the development and commercialization of our product candidates or demand for any approved products.

Risks related to our reliance on third parties

We rely on third parties to conduct some or all aspects of our LVV production, drug product manufacturing, and testing, and these third parties may not perform satisfactorily.

We do not independently conduct all aspects of our LVV production, drug product manufacturing, and testing. We currently rely, and expect to continue to rely, on third parties with respect to these items, including manufacturing and testing in the commercial context.

Our reliance on these third parties for manufacturing, testing, research and development activities reduce our control over these activities but will not relieve us of our responsibility to ensure compliance with all required regulations and study protocols. For example, for products that we develop and commercialize on our own, we will remain responsible for ensuring that each of our IND-enabling studies and clinical studies are conducted in accordance with the study plan and protocols, and that our LVV and drug products are manufactured in accordance with GMP as applied in the relevant jurisdictions.

If these third parties do not successfully carry out their contractual duties, meet expected deadlines, conduct our studies in accordance with regulatory requirements or our stated study plans and protocols, or manufacture our LVV and drug products in accordance with GMP, whether due to the impacts of COVID-19 or otherwise, we will not be able to complete, or may be delayed in completing, the preclinical and clinical studies and manufacturing process validation activities required to support future IND and BLA submissions and approval of our product candidates, or to support commercialization of our products, if approved. Many of our agreements with these third parties contain termination provisions that allow these third parties to terminate their relationships with us at any time. If we need to enter into alternative arrangements, our product development and commercialization activities could be delayed.

Reliance on third-party manufacturers entails risks to which we would not be subject if we manufactured the products ourselves, including:

- the inability to negotiate manufacturing agreements with third parties under commercially reasonable terms;
- reduced control as a result of using third-party manufacturers for all aspects of manufacturing activities;
- the risk that these activities are not conducted in accordance with our study plans and protocols;
- termination or nonrenewal of manufacturing agreements with third parties in a manner or at a time that is costly or damaging to us; and

- disruptions to the operations of our third-party manufacturers or suppliers caused by conditions unrelated to our business or operations, including the bankruptcy of the manufacturer or supplier.

We may be forced to manufacture LVV and drug product ourselves, for which we may not have the capabilities or resources, or enter into an agreement with a different manufacturer, which we may not be able to do on reasonable terms, if at all. In some cases, the technical skills required to manufacture our LVV or drug product candidates may be unique or proprietary to the original manufacturer, 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. Any of these events could lead to clinical study delays or failure to obtain marketing approval, or impact our ability to successfully commercialize our potential products. Some of these events could be the basis for FDA action, including injunction, recall, seizure or total or partial suspension of production.

We and our contract manufacturers are subject to significant regulation with respect to manufacturing our product candidates. The manufacturing facilities on which we rely may not continue to meet regulatory requirements and have limited capacity.

All entities involved in the preparation of therapeutics for clinical studies or commercial sale, including our existing contract manufacturers for our product candidates, are subject to extensive regulation. Some components of a finished therapeutic product approved for commercial sale or used in late-stage clinical studies must be manufactured in accordance with GMP. These regulations govern manufacturing processes and procedures (including record keeping) and the implementation and operation of quality systems to control and assure the quality of investigational products and products approved for sale. Poor control of production processes can lead to the introduction of adventitious agents or other contaminants, or to inadvertent changes in the properties or stability of our product candidates that may not be detectable in final product testing. We or our contract manufacturers must supply all necessary documentation in support of a BLA on a timely basis and where required, must adhere to the FDA's or other regulator's good laboratory practices ("GLP"), and GMP regulations enforced by the FDA or other regulator through facilities inspection programs. Some of our contract manufacturers have not produced a commercially-approved product and therefore have not obtained the requisite FDA or other marketing approvals to do so. Our facilities and quality systems and the facilities and quality systems of some or all of our third-party contractors must pass a pre-approval inspection for compliance with the applicable regulations as a condition of marketing approval of our potential products. In addition, the regulatory authorities may, at any time, audit or inspect a manufacturing facility involved with the preparation of our potential products or the associated quality systems for compliance with the regulations applicable to the activities being conducted. If these facilities do not pass a pre-approval plant inspection, FDA or other marketing approval of the products will not be granted.

The regulatory authorities also may, at any time following approval of a product for sale, audit the manufacturing facilities of our third-party contractors. If any such inspection or audit identifies a failure to comply with applicable regulations or if a violation of our product specifications or applicable regulations occurs independent of such an inspection or audit, we or the relevant regulatory authority may require remedial measures that may be costly and/or time-consuming for us or a third-party to implement and that may include the temporary or permanent suspension of a clinical study or commercial sales or the temporary or permanent closure of a facility. Any such remedial measures imposed upon us or third parties with whom we contract could materially harm our business.

If we or any of our third-party manufacturers fail to maintain regulatory compliance, the FDA or other regulators can impose regulatory sanctions including, among other things, refusal to approve a pending application for a biologic product, or revocation of a pre-existing approval. As a result, our business, financial condition and results of operations may be materially harmed.

Additionally, if supply from one approved manufacturer is interrupted, there could be a significant disruption in commercial supply. The number of manufacturers with the necessary manufacturing capabilities is limited. In addition, an alternative manufacturer would need to be qualified through a BLA supplement or similar regulatory submission which could result in further delay. The regulatory agencies may also require additional studies if a new manufacturer is relied upon for commercial production. Switching manufacturers may involve substantial costs and is likely to result in a delay in our desired clinical and commercial timelines.

These factors could cause the delay of clinical studies, regulatory submissions, required approvals or commercialization of our potential products, cause us to incur higher costs and prevent us from commercializing our potential products successfully. Furthermore, if our suppliers fail to meet contractual requirements, and we are unable to secure one or more replacement suppliers capable of production at a substantially equivalent cost, our clinical studies may be delayed or we could lose potential revenues.

We expect to rely on third parties to conduct, supervise and monitor our clinical studies, and if these third parties perform in an unsatisfactory manner, it may harm our business.

We expect to rely on CROs and clinical study sites to ensure our clinical studies are conducted properly and on time. While we will have agreements governing their activities, we will have limited influence over their actual performance. We will control only certain aspects of our CROs' activities. Nevertheless, we will be responsible for ensuring that each of our clinical studies is conducted in accordance with the applicable protocol, legal, regulatory and scientific standards, and our reliance on the CROs does not relieve us of our regulatory responsibilities.

We and our CROs are required to comply with the FDA's and other regulatory authorities' GCPs for conducting, recording and reporting the results of clinical studies to assure that the data and reported results are credible and accurate and that the rights, integrity and confidentiality of clinical study participants are protected. If we or our CROs fail to comply with applicable GCPs, the clinical data generated in our future clinical studies may be deemed unreliable and the FDA and other regulatory authorities may require us to perform additional clinical studies before approving any marketing applications.

If our CROs do not successfully carry out their contractual duties or obligations, fail to meet expected deadlines, or if the quality or accuracy of the clinical data they obtain is compromised due to the failure to adhere to our clinical protocols or regulatory requirements, or for any other reasons, our clinical studies may be extended, delayed or terminated, and we may not be able to obtain marketing approval for, or successfully commercialize our product candidates. As a result, our financial results and the commercial prospects for our product candidates would be harmed, our costs could increase, and our ability to generate revenues could be delayed.

Our reliance on third parties requires us to share our trade secrets, which increases the possibility that a competitor will discover them or that our trade secrets will be misappropriated or disclosed.

Because we rely on third parties to manufacture our vectors and our drug products, and because we collaborate with various organizations and academic institutions on the advancement of our gene therapy platform, we must, at times, share trade secrets with them. We seek to protect our proprietary technology in part by entering into confidentiality agreements and, if applicable, material transfer agreements, collaborative research agreements, consulting agreements or other similar agreements with our collaborators, advisors, employees and consultants prior to beginning research or disclosing proprietary information. These agreements typically limit the rights of the third parties to use or disclose our confidential information, such as trade secrets. Despite the contractual provisions employed when working with third parties, the need to share trade secrets and other confidential information increases the risk that such trade secrets become known by our competitors, are inadvertently incorporated into the technology of others, or are disclosed or used in violation of these agreements. Given that our proprietary position is based, in part, on our know-how and trade secrets, a competitor's discovery of our trade secrets or other unauthorized use or disclosure would impair our competitive position and may have a material adverse effect on our business.

In addition, these agreements typically restrict the ability of our collaborators, advisors, employees and consultants to publish data potentially relating to our trade secrets. Our academic collaborators typically have rights to publish data, provided that we are notified in advance and may delay publication for a specified time in order to secure our intellectual property rights arising from the collaboration. In other cases, publication rights are controlled exclusively by us, although in some cases we may share these rights with other parties. We also conduct joint research and development programs that may require us to share trade secrets under the terms of our research and development partnerships or similar agreements. Despite our efforts to protect our trade secrets, our competitors may discover our trade secrets, either through breach of these agreements, independent development or publication of information including our trade secrets in cases where we do not have proprietary or otherwise protected rights at the time of publication. A competitor's discovery of our trade secrets would impair our competitive position and have an adverse impact on our business.

Risks related to our financial condition and capital requirements

We have not generated material revenue from product sales and may never be profitable.

Our ability to generate revenues and achieve profitability depends on our ability, alone or with strategic collaboration partners, to successfully complete the development of, and obtain the regulatory, pricing and reimbursement approvals necessary to commercialize beti-cel, eli-cel, or lovo-cel. Our ability to generate revenues from product sales depends heavily on our success in:

- completing research and preclinical and clinical development of our product candidates;
- seeking and obtaining regulatory and marketing approvals for product candidates for which we complete clinical studies;

- developing a sustainable, commercial-scale, reproducible, and transferable manufacturing process for our vectors and drug products;
- establishing and maintaining supply and manufacturing relationships with third parties that can provide adequate (in amount and quality) products and services to support clinical development for our product candidates and commercial demand for any approved product;
- launching and commercializing any approved product, either by collaborating with a partner or, if launched independently, by establishing a field-based team, marketing and distribution infrastructure;
- obtaining sufficient pricing and reimbursement for any approved product from private and governmental payers;
- obtaining market acceptance and adoption of any approved product and gene therapy as a viable treatment option;
- addressing any competing technological and market developments;
- negotiating favorable terms in any collaboration, licensing or other arrangements into which we may enter; and
- maintaining, protecting and expanding our portfolio of intellectual property rights, including patents, trade secrets and know-how.

We expect to continue to incur significant expenditures for the foreseeable future, and we expect these expenditures to increase, which costs may increase further as competitors enter the market. Our expenses could increase beyond expectations if we are required by the FDA or other regulatory agencies, domestic or foreign, to perform clinical and other studies in addition to those that we currently anticipate. Even if we are able to generate material product revenues, we may not become profitable and may need to obtain additional funding to continue operations.

If the estimates we make, or the assumptions on which we rely, in preparing our consolidated financial statements are incorrect, our actual results may vary from those reflected in our projections and accruals.

Our consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States of America ("GAAP"). The preparation of these consolidated financial statements requires us to make estimates and judgments that affect the reported amounts of our assets, liabilities, revenues and expenses, 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. We may be incorrect in our assumptions regarding the applicability of drug pricing programs and rebates that may be applicable to our potential products, which may result in our under- or over-estimating our anticipated product revenues especially as applicable laws and regulations governing pricing evolve over time. In addition, to the extent payment for our potential products is subject to outcomes-based arrangements over time, the total payments received from product sales may vary, our cash collection of future payments and revenue assumptions from product sales will be at risk, and the timing of revenue recognition may not correspond to the timing of cash collection.

Further, from time to time we issue financial guidance relating to our expectations for our cash, cash equivalents, and marketable 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.

Our operating results may fluctuate significantly, which makes our future operating results difficult to predict and could cause our operating results to fall below expectations or our guidance.

Our operating results are difficult to predict and will likely fluctuate from quarter to quarter and year to year. We expect that following marketing approval, if and when obtained, revenues from product sales will be difficult to predict from period to period, given the absence of historical sales data for beti-cel, eli-cel and lovo-cel.

Further, changes in our operations, such as increased development, manufacturing and clinical trial expenses in connection with expanding our pipeline programs, or our undertaking of additional programs, or business activities, or entry into strategic transactions, including potential future acquisitions of products, technologies or businesses may also cause significant fluctuations in our expenses.

The cumulative effects of these factors, further exacerbated by the impacts of the ongoing COVID-19 pandemic on healthcare systems and economic conditions, will likely result in large fluctuations and unpredictability in our quarterly and annual operating results. As a result, comparing our operating results on a period-to-period basis may not be meaningful. Investors should not rely on our past results as an indication of our future performance. This variability and unpredictability could also result in our failing to meet the expectations of industry or financial analysts or investors for any period. If our

revenue or operating results fall below the expectations of analysts or investors or below any forecasts we may provide to the market, or if the forecasts we provide to the market are below the expectations of analysts or investors, the price of our common stock could decline substantially. Such a stock price decline could occur even when we have met any previously publicly stated revenue or earnings guidance we may provide.

Risks related to our business operations

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

We are highly dependent on our executive team and key employees, the loss of whose services may adversely impact the achievement of our objectives. While we have entered into employment agreements with each of our executive officers, any of them could leave our employment at any time, as all of our employees are "at will" employees. Recruiting and retaining other qualified employees, consultants and advisors for our business, including scientific and technical personnel, will also be critical to our success. There is currently a shortage of skilled executives in our industry, which is likely to continue. As a result, competition for skilled personnel is intense and our turnover rate has been high. We may not be able to attract and retain personnel on acceptable terms given the competition among numerous pharmaceutical and biotechnology companies for individuals with similar skill sets. In addition, our financial condition and recent delays in our late-stage programs have made it more challenging to recruit and retain qualified personnel. The inability to recruit or loss of the services of any executive, key employee, consultant or advisor may impede the progress of our research, development and commercialization objectives.

Our business may be materially and adversely affected by the ongoing COVID-19 pandemic. The COVID-19 pandemic has had, and may continue to have, an impact on various aspects of our business and that of third parties on which we rely. The extent to which the COVID-19 pandemic impacts our business will depend in part on future developments, which are uncertain and unpredictable in nature.

Since March 2020, when the World Health Organization characterized COVID-19 as a pandemic, the related adverse public health developments, including orders to shelter-in-place, travel restrictions, and the imposition of additional requirements on businesses, have adversely affected workforces, organizations, healthcare communities, economies, and financial markets globally, leading to economic uncertainty and increased market volatility. It has also disrupted the normal operations of businesses across industries, including ours. As a result of the COVID-19 pandemic, we have experienced and expect to experience disruptions in our operations and business, and those of third parties upon whom we rely. For instance, we have experienced disruptions in the conduct of our clinical trials, manufacturing and commercialization efforts, including the commercial launch of beti-cel in Germany and the treatment of patients in the commercial context. We cannot reasonably assess or predict at this time the full extent of the negative impact that the COVID-19 pandemic and related effects may have on our business, financial condition, results of operations and cash flows. We expect to continue experiencing these disruptions in our operations and those of our third parties for an unknown period of time, as the trajectory of the COVID-19 pandemic remains uncertain and continues to evolve in the United States. These impacts, which may materially and adversely affect our business, include the following:

- We are conducting a number of clinical studies across our programs in geographies which are affected by the COVID-19 pandemic. The COVID-19 pandemic has had, and will likely continue to have, an impact on various aspects of our clinical studies. Policies at various clinical sites and federal, state, local and foreign laws, rules and regulations are continuing to evolve, including through the implementation of quarantines and travel restrictions, and direction of healthcare resources toward pandemic response efforts. For instance, the availability of intensive care unit beds and related healthcare resources available to support activities unrelated to COVID-19 response have fluctuated with the incidence of severe cases of COVID-19 in the surrounding communities, and we anticipate that the availability of healthcare resources will continue to fluctuate and may become significantly constrained, with variability across geographies. The COVID-19 pandemic has disrupted the conduct of our ongoing clinical studies, with the result of slower patient enrollment and treatment as well as delays in post-treatment patient follow-up visits. These impacts have varied by clinical study, with the most significant impacts being on our ongoing HGB-210 study for lovo-cel. It is possible that these delays may impact the timing of our regulatory submissions. It is unknown how long these disruptions could continue.
- We currently rely on third parties to manufacture, perform quality testing, and ship LVV and drug product for our clinical studies and, if and when we receive marketing approval for our therapies, expect to rely on such third parties to support commercialization efforts. The third parties in our supply chain have been and may continue to be subject to restrictions in operations arising from the COVID-19 pandemic, and in addition, a number of these third parties have experienced operational disruptions, which have affected activities necessary for our research and development efforts, as well as our commercialization efforts in the United States. These restrictions and disruptions in operations have also given rise to staffing shortages from time to time, which may result in production slowdowns and/or disruptions in delivery systems, potentially interrupting our supply chain and limiting our ability to manufacture LVV and drug

product for our clinical studies and for commercial use. At this time, it is unknown how long these disruptions may continue, or the full extent of their impacts.

- The operations of health regulatory agencies globally have been impacted as a result of the COVID-19 pandemic. They have communicated slower response times to regulatory interactions and submissions and, in the future, may lack resources to continue to monitor our clinical studies or to engage in other activities related to review of regulatory submissions in drug development. As a result, timelines for the review of regulatory submissions for our programs have been impacted, and we may experience other delays of unknown duration in the review, inspection, and other regulatory interactions. Any de-prioritization of our clinical studies or delay in regulatory review or interaction resulting from such disruptions could materially affect the development of our product candidates. In addition, we have been engaging in reimbursement discussions with governmental health programs as part of our commercial preparation activities.
- The trading prices for our shares of common stock and other biopharmaceutical companies have been highly volatile as a result of the economic volatility and uncertainty caused by the COVID-19 pandemic. As a result, we may face difficulties raising capital through sales of shares of our common stock or such sales may be on unfavorable terms. In addition, a recession, depression or other sustained adverse market event resulting from the spread of, or failure to manage or contain, the COVID-19 pandemic will materially and adversely affect our business, the value of our common stock, and our ability to operate under our operating plan and execute our strategy. Our business and operating plan have already been impacted by the COVID-19 pandemic, the associated governmental restrictions, and the resulting economic conditions, leading us to reduce and defer costs, adjust our priorities, timelines and expectations, and review and revise our operating plans with the intention that it would enable us to advance our corporate strategy and pipeline during an extended period of uncertainty.

The extent of the impacts described above will depend on numerous evolving factors that we may not be able to accurately predict, including:

- the duration, severity, and scope of the pandemic in the United States and globally;
- the effectiveness of governmental, business and individuals' protocols and actions that have been and continue to be taken in response to the pandemic;
- the impact of the pandemic on economic activity and actions taken in response;
- the effect on patients, healthcare providers and business partners;
- uncertainty as to when we will be able to resume normal clinical study enrollment and patient treatment or follow up activities, particularly at clinical study sites located in highly impacted geographies as a result of disruptions at these sites;
- the ability to obtain or deliver sufficient and timely supplies, given the disruptions to the production capabilities of our manufacturers and suppliers, particularly with respect to the priority given to the development, regulatory approval, and manufacture of COVID-19 vaccines and diagnostic tests;
- our access to the debt and equity markets on satisfactory terms, or at all;
- disruptions in regulatory oversight and actions, as a result of significant and unexpected resources expended to address the COVID-19 by regulators and industry professionals; and
- any impacts on our and our partners' offices, operations and facilities.

The ultimate impact of the COVID-19 pandemic on our business operations is highly uncertain and subject to change and will depend on future developments which are difficult to predict, including the duration of the pandemic, the ultimate geographic spread of the disease, additional or modified government actions, new information that will emerge concerning the severity and impact of COVID-19 and other actions taken to contain or address its impact in the short and long term, among others. We do not yet know the full extent of potential delays or impacts on our business, our clinical studies, our research programs, our commercial-readiness activities in the United States, healthcare systems or the global economy. If the ultimate impact of the COVID-19 pandemic and the resulting uncertain economic and healthcare environment is more severe than we anticipated, we may not be able to execute on our current operating plan or on our strategy. If the duration of the COVID-19 pandemic and the associated period of business and social restrictions and economic uncertainty is longer than we anticipated, our cash, cash equivalents, and marketable securities may not be sufficient to fund the activities under our operating plan for the time period that we anticipated, and we may be required to revise our operating plan further. To the extent the COVID-19 pandemic adversely affects our business and financial results, it may also have the effect of heightening many of the other risks described in this "Risk Factors" section.

Even if we receive marketing approval for a product candidate, any approved product will remain subject to regulatory scrutiny.

Even if we obtain marketing approval in a jurisdiction, regulatory authorities may still impose significant restrictions on the indicated uses or marketing of any approved products, or impose ongoing requirements for potentially costly post-approval studies, post-market surveillance or patient or drug restrictions. For example, the FDA typically advises that patients treated with gene therapy undergo follow-up observations for potential adverse events for a 15-year period. Additionally, the holder of an approved BLA is obligated to monitor and report adverse events and any failure of a product to meet the specifications in the BLA. The holder of an approved BLA must also submit new or supplemental applications and obtain FDA approval for certain changes to the approved product, product labeling or manufacturing process. Advertising and promotional materials must comply with FDA rules and are subject to FDA review, in addition to other potentially applicable federal and state laws. We have experienced interruptions in our marketing of beti-cel in Europe due to safety concerns arising from our lovo-cel program, and we can make no assurance that we will not experience interruptions in any marketing or other commercialization activities in the future, whether due to safety concerns in any approved products, or due to events arising from programs that utilize technologies similar to or related to ours.

In addition, product manufacturers and their facilities are subject to payment of user fees and continual review and periodic inspections by the FDA and other regulatory authorities for compliance with good manufacturing practices ("GMP") and adherence to commitments made in the BLA. If we or a regulatory agency discovers previously unknown problems with a product such as adverse events of unanticipated severity or frequency, or problems with the facility where the product is manufactured, a regulatory agency may impose restrictions relative to that product or the manufacturing facility, including requiring recall or withdrawal of the product from the market or suspension of manufacturing.

If we fail to comply with applicable regulatory requirements following marketing approval for a product, a regulatory agency may:

- issue a warning letter asserting that we are in violation of the law;
- seek an injunction or impose civil or criminal penalties or monetary fines;
- suspend or withdraw marketing approval;
- suspend any ongoing clinical studies;
- refuse to approve a pending marketing application, such as a BLA or supplements to a BLA submitted by us;
- seize product; or
- refuse to allow us to enter into supply contracts, including government contracts.

Any government investigation of alleged violations of law could require us to expend significant time and resources in response and could generate negative publicity. The occurrence of any event or penalty described above may inhibit our ability to commercialize any approved product and generate revenues.

We are subject, directly or indirectly, to federal and state healthcare fraud and abuse laws, false claims laws and health information privacy and security laws. If we are unable to comply, or have not fully complied, with such laws, we could face substantial penalties, reputational harm, and diminished profits and future earnings.

In the United States, the research, manufacturing, distribution, sale, and promotion of drugs and biologic products are subject to regulation by various federal, state, and local authorities in addition to FDA, including CMS, other divisions of the HHS, (e.g., the Office of Inspector General), the United States Department of Justice offices of the United States Attorney, the Federal Trade Commission and state and local governments. Our operations are directly, or indirectly through our prescribers, customers and purchasers, subject to various federal and state fraud and abuse laws and regulations described in more detail under *"Item 1. Business--Government regulation"* in our Annual Report. These include the federal Anti-Kickback Statute, federal civil and criminal false claims laws and civil monetary penalty laws (including False Claims Laws), HIPAA, transparency requirements created under the Affordable Care Act, as well as analogous state and foreign laws.

These laws apply to, among other things, our sales, marketing and educational programs. State and federal regulatory and enforcement agencies continue actively to investigate violations of health care laws and regulations, and the United States Congress continues to strengthen the arsenal of enforcement tools. Most recently, the Bipartisan Budget Act of 2018 increased the criminal and civil penalties that can be imposed for violating certain federal health care laws, including the Anti-Kickback Statute. Enforcement agencies also continue to pursue novel theories of liability under these laws. In particular, government agencies have recently increased regulatory scrutiny and enforcement activity with respect to programs supported or sponsored by pharmaceutical companies, including reimbursement and co-pay support, funding of independent charitable foundations and

other programs that offer benefits for patients. Several investigations into these programs have resulted in significant civil and criminal settlements.

Because of the breadth of these laws and the narrowness of the statutory exceptions and safe harbors available, it is possible that some of our business activities could be subject to challenge under one or more of such laws. If our operations are found to be in violation of any of the laws described above or any other government regulations that apply to us, we may be subject to penalties, including civil and criminal penalties, damages, fines, exclusion from participation in government health care programs, such as Medicare and Medicaid, imprisonment and the curtailment or restructuring of our operations, any of which could adversely affect our ability to operate our business and our results of operations. Even if we are not determined to have violated these laws, government investigations into these issues typically require the expenditure of significant resources and generate negative publicity, which could harm our financial condition and divert the attention of our management from operating our business.

In addition, we may be subject to patient privacy laws by both the federal government and the states in which we conduct our business. For example, HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act of 2009 ("HITECH") and their respective implementing regulations, imposes requirements on certain covered healthcare providers, health plans, and healthcare clearinghouses as well as their respective business associates that perform services for them that involve the use, or disclosure of, individually identifiable health information, relating to the privacy, security and transmission of individually identifiable health information. HITECH also created new tiers of civil monetary penalties, amended HIPAA to make civil and criminal penalties directly applicable to business associates, and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce the federal HIPAA laws and seek attorneys' fees and costs associated with pursuing federal civil actions In addition to HIPAA, as amended by HITECH, and their respective implementing regulations, California recently enacted the California Consumer Privacy Act ("CCPA") which creates new individual privacy rights for California consumers (as defined in the law) and places increased privacy and security obligations on entities handling personal data of consumers or households. The CCPA requires covered companies to provide certain disclosures to consumers about its data collection, use and sharing practices, and to provide affected California residents with ways to opt-out of certain sales or transfers of personal information. While there is currently an exception for protected health information that is subject to HIPAA, as currently written, the CCPA may impact our business activities. The California Attorney General has proposed draft regulations, which have not been finalized to date, that may further impact our business activities if they are adopted. The uncertainty surrounding the implementation of CCPA exemplifies the vulnerability of our business to the evolving regulatory environment related to personal data and protected health information.

We face potential product liability, and, if successful claims are brought against us, we may incur substantial liability and costs. If the use of our product candidates harms patients, or is perceived to harm patients even when such harm is unrelated to our product candidates, our marketing approvals could be revoked or otherwise negatively impacted and we could be subject to costly and damaging product liability claims.

The use of our product candidates in clinical studies and the sale of any products for which we obtain marketing approval exposes us to the risk of product liability claims. Product liability claims might be brought against us by patients participating in clinical trials, consumers, healthcare providers, pharmaceutical companies or others selling or otherwise coming into contact with our product candidates. There is a risk that our product candidates may induce adverse events. If we cannot successfully defend against product liability claims, we could incur substantial liability and costs. In addition, regardless of merit or eventual outcome, product liability claims may result in:

- impairment of our business reputation;
- withdrawal of clinical study participants;
- costs due to related litigation;
- distraction of management's attention from our primary business;
- substantial monetary awards to patients or other claimants;
- the inability to develop our product candidates or commercialize any approved product; and
- decreased demand for any approved product.

We carry product liability insurance and we believe our product liability insurance coverage is sufficient in light of our current clinical programs and approved product; however, we may not be able to maintain insurance coverage at commercially reasonable cost or in sufficient amounts to protect us against losses due to liability. On occasion, large judgments have been awarded in class action lawsuits based on drugs or medical treatments that had unanticipated adverse effects. A successful product liability claim or series of claims brought against us could cause our stock price to decline and, if judgments exceed our insurance coverage, could adversely affect our results of operations and business.

Patients with the diseases targeted by our product candidates are often already in severe and advanced stages of disease and have both known and unknown significant pre-existing and potentially life-threatening health risks. During the course of treatment, patients may suffer adverse events, including death, for reasons that may be related to our product candidates. Such events could subject us to costly litigation, require us to pay substantial amounts of money to injured patients, delay, negatively impact or end our opportunity to receive or maintain marketing approval for any approved product, or require us to suspend or abandon our commercialization efforts. Even in a circumstance in which we do not believe that an adverse event is related to our product candidates the investigation into the circumstance may be time-consuming or inconclusive. These investigations may interrupt our sales efforts, delay our marketing approval process in other countries, or impact and limit the type of marketing approval our product candidates may receive or any approved product maintains. As a result of these factors, a product liability claim, even if successfully defended, could have a material adverse effect on our business, financial condition or results of operations.

Healthcare legislative reform measures may have a material adverse effect on our business and results of operations.

The United States has enacted or proposed legislative and regulatory changes affecting the healthcare system that could prevent or delay marketing approval of our potential products, restrict or regulate post-approval activities and affect our ability to profitably sell any product for which we obtain marketing approval. Changes in regulations, statutes or the interpretation of existing regulations could impact our business in the future by requiring, for example: (i) changes to our manufacturing arrangements; (ii) additions or modifications to product labeling; (iii) the recall or discontinuation of our products; or (iv) additional record-keeping requirements. If any such changes were to be imposed, they could adversely affect the operation of our business.

In the United States, there have been and continue to be a number of legislative initiatives to contain healthcare costs. For example, in March 2010, the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act of 2010 ("Affordable Care Act"), was passed, which substantially changed the way health care is financed by both governmental and private insurers, and significantly impacts the U.S. pharmaceutical industry. The Affordable Care Act, among other things, addressed 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, increased the minimum Medicaid rebates owed by manufacturers under the Medicaid Drug Rebate Program and extended the rebate program to individuals enrolled in Medicaid managed care organizations, established annual fees and taxes on manufacturers of certain branded prescription drugs, expanded the types of entities eligible for the 340B drug discount program, and a new Medicare Part D coverage gap discount program, in which manufacturers must agree to offer 70% (increased pursuant to the Bipartisan Budget Act of 2018, effective as of 2019) point-of-sale discounts off negotiated prices of applicable brand drugs to eligible beneficiaries during their coverage gap period, as a condition for the manufacturer’s outpatient drugs to be covered under Medicare Part D.

Since its enactment, there have been numerous judicial, administrative, executive, and legislative challenges to certain aspects of the Affordable Care Act, and we expect there will be additional challenges and amendments to the Affordable Care Act in the future. Various portions of the Affordable Care Act are currently undergoing legal and constitutional challenges in the Fifth Circuit Court and the United States Supreme Court. It is unclear whether the Affordable Care Act will be overturned, repealed, replaced, or further amended. We cannot predict what effect further changes to the Affordable Care Act would have on our business.

In addition, other legislative changes have been proposed and adopted since the Affordable Care Act was enacted. In August 2011, President Obama signed into law the Budget Control Act of 2011, which, among other things, created the Joint Select Committee on Deficit Reduction to recommend to Congress proposals in spending reductions. The Joint Select Committee on Deficit Reduction did not achieve a targeted deficit reduction, which triggered the legislation’s automatic reduction to several government programs. This includes aggregate reductions to Medicare payments to providers of, on average, 2% per fiscal year through 2025 unless Congress takes additional action. These reductions were extended through 2029 through subsequent legislative amendments. In January 2013, the American Taxpayer Relief Act of 2012, among other things, further reduced Medicare payments to several providers, including hospitals and cancer treatment centers, and increased the statute of limitations period for the government to recover overpayments to providers from three to five years.

There has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been several recent U.S. Congressional inquiries and proposed 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. At the federal level, the Trump administration’s budget proposal for fiscal years 2019 and 2020 contain further drug price control measures that could be enacted during the budget process or in other future legislation, including, for example, measures to permit Medicare Part D plans to negotiate the price of certain drugs under Medicare Part B, to allow some states to negotiate drug prices under Medicaid, and to eliminate cost sharing for generic drugs for low-income

patients. At the state level, legislatures have increasingly passed legislation and implemented regulations designed to control pharmaceutical and biological product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures, and, in some cases, designed to encourage importation from other countries and bulk purchasing.

We expect that the healthcare reform measures that have been adopted and may be adopted in the future, may result in more rigorous coverage criteria and in additional downward pressure on the price that we receive for any approved product and could seriously harm our future revenues. Any reduction in reimbursement from Medicare or other government programs may result in a similar reduction in payments from private third-party payers.

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

Our computer systems, or those of our third-party collaborators, service providers, contractors or consultants, may fail or suffer security breaches, which could result in a material disruption of our product candidates' development programs and have a material adverse effect on our reputation, business, financial condition or results of operations.

Our computer systems and those of our current or future third-party collaborators, service providers, contractors and consultants may fail and are vulnerable to damage from computer viruses, unauthorized access, natural disasters, terrorism, war and telecommunication and electrical failures. The size and complexity of our information technology systems, and those of our collaborators, service providers, contractors and consultants, and the large amounts of information stored on those systems make those systems vulnerable to service interruptions, security breaches, or other failures, resulting from inadvertent or intentional actions by our employees or those of third-party business partners, or from cyber-attacks by malicious third parties. Attacks on information technology systems are increasing in their frequency, levels of persistence, sophistication and intensity, and they are being conducted by increasingly sophisticated and organized groups and individuals with a wide range of motives and expertise. In addition to extracting sensitive information, such attacks could include the deployment of harmful malware, ransomware, denial-of-service attacks, social engineering and other means to affect service reliability and threaten the confidentiality, integrity and availability of information. The prevalent use of mobile devices also increases the risk of data security incidents. If we experience a material system failure, accident or security breach that causes interruptions in our operations or the operations of third-party collaborators, service providers, contractors and consultants, it could result in significant reputational, financial, legal, regulatory, business or operational harm. For example, the loss of clinical trial data for our product candidates could result in delays in our marketing approval efforts and significantly increase our costs to recover or reproduce the data. To the extent that any disruption or security breach results in a loss of or damage to our data or applications or other data or applications relating to our technology or product candidates, or inappropriate disclosure of confidential or proprietary information, we could incur liabilities and the further development of our product candidates could be delayed. In addition, we rely on third-party service providers for management of the manufacture and delivery of drug product to patients in the commercial context, including for chain of identity and chain of custody. We also rely on third-party service providers for aspects of our internal control over financial reporting and such service providers may experience a material system failure or fail to carry out their obligations in other respects, which may impact our ability to produce accurate and timely financial statements, thus harming our operating results, our ability to operate our business, and our investors' view of us. In addition, our liability insurance may not be sufficient in type or amount to cover us against claims related to material failures, security breaches, cyberattacks and other related breaches.

Any failure or perceived failure by us or any third-party collaborators, service providers, contractors or consultants to comply with our privacy, confidentiality, data security or similar obligations to third parties, or any data security incidents or other security breaches that result in the unauthorized access, release or transfer of sensitive information, including personally identifiable information, may result in governmental investigations, enforcement actions, regulatory fines, litigation or public statements against us. These events could cause third parties to lose trust in us or could result in claims by third parties asserting that we have breached our privacy, confidentiality, data security or similar obligations, any of which could have a material adverse effect on our reputation, business, financial condition or results of operations. Moreover, data security incidents and other security breaches can be difficult to detect, and any delay in identifying them may lead to increased harm. While we have implemented data security measures intended to protect our information technology systems and infrastructure, there can be no assurance that such measures will successfully prevent service interruptions or data security incidents.

Risks related to the separation of our oncology programs and portfolio

We may incur operational difficulties or be exposed to claims and liabilities as a result of the separation of 2seventy bio.

On November 4, 2021, we distributed all of the outstanding shares of 2seventy bio, Inc. ("2seventy") common stock to our stockholders in connection with the separation of our oncology programs and portfolio. In connection with the distribution, we entered into a separation agreement and various other agreements (including a tax matters agreement, an employee matters agreement, transition services agreements and an intellectual property license agreement). These agreements govern the separation and distribution and the relationship between us and 2seventy going forward, including with respect to potential tax-related losses associated with the separation and distribution. They also provide for the performance of services by each company for the benefit of the other for a period of time.

The separation agreement provides for indemnification obligations designed to make 2seventy financially responsible for many liabilities that may exist relating to its business activities, whether incurred prior to or after the distribution, including any pending or future litigation, but we cannot guarantee that 2seventy will be able to satisfy its indemnification obligations. It is also possible that a court would disregard the allocation agreed to between us and 2seventy and require us to assume responsibility for obligations allocated to 2seventy. Third parties could also seek to hold us responsible for any of these liabilities or obligations, and the indemnity rights we have under the separation agreement may not be sufficient to fully cover all of these liabilities and obligations. Even if we are successful in obtaining indemnification, we may have to bear costs temporarily. In addition, our indemnity obligations to 2seventy, including those related to assets or liabilities allocated to us, may be significant. These risks could negatively affect our business, financial condition or results of operations.

The separation of 2seventy continues to involve a number of additional risks, including, among other things, the potential that management's and our employees' attention will be significantly diverted by the provision of transitional services or that we may incur other operational challenges or difficulties as a result of the separation. Certain of the agreements described above provide for the performance of services by each company for the benefit of the other for a period of time. If 2seventy is unable to satisfy its obligations under these agreements, we could incur losses and may not have sufficient resources available for such services. These arrangements could also lead to disputes over rights to certain shared property and over the allocation of costs and revenues for products and operations. Our inability to effectively manage the transition activities and related events could adversely affect our business, financial condition or results of operations.

We may fail to realize some or all of the anticipated benefits of the separation of 2seventy.

The anticipated operational, financial, strategic and other benefits of the separation of 2seventy may not be achieved. The combined value of the common stock of the two publicly-traded companies may not be equal to or greater than what the value of our common stock would have been had the separation not occurred. The combined value of the common stock of the two companies could be lower than anticipated for a variety of reasons, including the failure of either company to operate and compete effectively as an independent company. The common stock price of each company may experience periods of extreme volatility. In addition, following the separation we are smaller and less diversified, with a narrower business focus, and may be more vulnerable to changing market conditions. The separation also presents a number of significant risks to our internal processes, including the failure to maintain an adequate control environment due to changes to our infrastructure technology systems and financial reporting processes.

Completion of the separation of 2seventy resulted in substantial changes in our board of directors and management.

Completion of the separation of 2seventy resulted in substantial changes in our board of directors and management. In particular, our former chief executive officer, Nick Leschly, resigned from that position (although Mr. Leschly continues to serve on our board of directors). In addition, Philip Gregory, our former chief scientific officer, and Chip Baird, our former chief financial officer, resigned from their positions with us to join management positions with 2seventy. Furthermore, Dan Lynch, Ramy Ibrahim, Denice Torres, William Sellers, Sarah Glickman and Marcela Maus resigned as members of our board of directors upon the completion of the separation. These senior officer and board level changes could be disruptive to our operations, present significant management challenges and could harm our business.

The separation may result in disruptions to, and harm our relationships with, our strategic business partners.

Uncertainty related to the separation may lead the suppliers, research organizations, and other parties with which we currently do business or may do business in the future to terminate or attempt to negotiate changes in our existing business relationships, or cause them to delay entering into business relationships with us or consider entering into business relationships with parties other than us. These disruptions could have a material and adverse effect on our business, prospects, financial condition and results of operations.

If the distribution of shares of 2seventy bio, together with certain related transactions, does not qualify as a transaction that is generally tax-free for U.S. federal income tax purposes, we and our stockholders could be subject to significant tax liabilities.

The completion of the distribution was conditioned upon, among other things, our receipt of a private letter ruling from the IRS, and an opinion from Goodwin Procter LLP, both satisfactory to our board of directors and both continuing to be valid, together confirming that the distribution, together with certain related transactions, generally is tax-free for U.S. federal income tax purposes under Sections 355 and 368(a)(1)(D) of the Code. We have received a favorable private letter ruling from the IRS addressing one significant issue of the qualification of the distribution under Section 355 of the Code. However, the private letter ruling does not address the remaining issues that are relevant to determining whether the distribution, together with certain related transactions, qualifies as a transaction that is generally tax-free for U.S. federal income tax purposes. The IRS private letter ruling and opinion of Goodwin Procter LLP were based, among other things, on various facts and assumptions, as well as certain representations, statements and undertakings from us and 2seventy bio (including those relating to the past and future conduct of us and 2seventy bio) and were subject to certain caveats. If any of these facts, assumptions, representations, statements or undertakings is, or becomes, inaccurate or incomplete, or if we or 2seventy bio breach any of our respective covenants relating to the separation, the IRS private letter ruling and tax opinion may be invalid. Moreover, the opinion is not binding on the IRS or any courts. Accordingly, notwithstanding receipt of the IRS private letter ruling and an opinion of Goodwin Procter LLP, the IRS could determine that the distribution and certain related transactions should be treated as taxable transactions for U.S. federal income tax purposes.

If the distribution, together with certain related transactions, were to fail to qualify as a transaction that is generally tax-free under Sections 355 and 368(a)(1)(D) of the Code, in general, for U.S. federal income tax purposes, we would recognize taxable gain as if we have sold 2seventy bio's distributed common stock in a taxable sale for its fair market value and our stockholders who receive shares of 2seventy bio common stock in the distribution would be subject to tax as if they had received a taxable distribution equal to the fair market value of such shares.

In connection with the distribution, we and 2seventy bio entered into a tax matters agreement pursuant to which each party is responsible for certain liabilities and obligations following the distribution. In general, under the terms of the tax matters agreement, if the distribution, together with certain related transactions, were to fail to qualify as a transaction that is generally tax-free for U.S. federal income tax purposes under Sections 355 and 368(a)(1)(D) of the Code, and if and to the extent that such failure results from a prohibited change of control in us under Section 355(e) of the Code, or an acquisition of our stock or assets or certain actions, omissions or failures to act, by us, then we will bear any resulting taxes, interest, penalties and other costs. If and to the extent that such failure results from a prohibited change of control in 2seventy bio under Section 355(e) of the Code or an acquisition of 2seventy bio stock or assets or certain actions by 2seventy bio, then 2seventy bio will be obligated to indemnify us for any resulting taxes, interest, penalties and other costs, including any reductions in our net operating loss carryforwards or other tax assets. If such failure does not result from a prohibited change of control in bluebird bio or 2seventy bio under Section 355(e) of the Code and both we and 2seventy bio are responsible for such failure, liability will be shared according to relative fault. If neither we nor 2seventy bio is responsible for such failure, we will bear any resulting taxes, interest, penalties and other costs.

Risks related to our intellectual property

If we are unable to obtain or protect intellectual property rights related to our product candidates, we may not be able to compete effectively in our markets.

We rely upon a combination of patents, trade secret protection and confidentiality agreements to protect the intellectual property related to our product candidates. The strength of patents in the biotechnology and pharmaceutical field involves complex legal and scientific questions and can be uncertain. The patent applications that we own or in-license may fail to result in issued patents with claims that cover our product candidates in the United States or in other foreign countries. There is no assurance that all of the potentially relevant prior art relating to our patents and patent applications has been found, which can invalidate a patent or prevent a patent from issuing from a pending patent application. Even if patents do successfully issue and even if such patents cover our product candidates, third parties may challenge their validity, enforceability or scope, which may result in such patents being narrowed or invalidated. Furthermore, even if they are unchallenged, our patents and patent applications may not adequately protect our intellectual property, provide exclusivity for our product candidates or prevent others from designing around our claims. Any of these outcomes could impair our ability to prevent competition from third parties, which may have an adverse impact on our business.

If the patent applications we hold or have in-licensed with respect to our programs or product candidates fail to issue, if their breadth or strength of protection is threatened, or if they fail to provide meaningful exclusivity for our product candidates, it could dissuade companies from collaborating with us to develop product candidates, and threaten our ability to commercialize, future products. Several patent applications covering our product candidates have been filed recently. We

cannot offer any assurances about which, if any, patents will issue, the breadth of any such patent or whether any issued patents will be found invalid and unenforceable or will be threatened by third parties. Any successful opposition to these patents or any other patents owned by or licensed to us could deprive us of rights necessary for the successful commercialization of any product candidates that we may develop. Further, if we encounter delays in regulatory approvals, the period of time during which we could market a product candidate under patent protection could be reduced. Since patent applications in the United States and most other countries are confidential for a period of time after filing, and some remain so until issued, we cannot be certain that we were the first to file any patent application related to a product candidate. Furthermore, if third parties have filed such patent applications, an interference proceeding in the United States can be initiated by a third-party to determine who was the first to invent any of the subject matter covered by the patent claims of our applications. In addition, patents have a limited lifespan. In the United States, the natural expiration of a patent is generally 20 years after it is filed. Various extensions may be available however the life of a patent, and the protection it affords, is limited. Even if patents covering our product candidates are obtained, once the patent life has expired for a product, we may be open to competition from generic medications.

In addition to the protection afforded by patents, we rely on trade secret protection and confidentiality agreements to protect proprietary know-how that is not patentable or that we elect not to patent, processes for which patents are difficult to enforce and any other elements of our product candidate discovery and development processes that involve proprietary know-how, and information or technology that is not covered by patents. However, trade secrets can be difficult to protect. We seek to protect our proprietary technology and processes, in part, by entering into confidentiality agreements with our employees, consultants, scientific advisors and contractors. We also seek to preserve the integrity and confidentiality of our data and trade secrets by maintaining physical security of our premises and physical and electronic security of our information technology systems. While we have confidence in these individuals, organizations and systems, agreements or security measures may be breached, and we may not have adequate remedies for any breach. In addition, our trade secrets may otherwise become known or be independently discovered by competitors.

Although we expect all of our employees and consultants to assign their inventions to us, and all of our employees, consultants, advisors and any third parties who have access to our proprietary know-how, information or technology to enter into confidentiality agreements, we cannot provide any assurances that all such agreements have been duly executed or that our trade secrets and other confidential proprietary information will not be disclosed or that competitors will not otherwise gain access to our trade secrets or independently develop substantially equivalent information and techniques. Misappropriation or unauthorized disclosure of our trade secrets could impair our competitive position and may have a material adverse effect on our business. Additionally, if the steps taken to maintain our trade secrets are deemed inadequate, we may have insufficient recourse against third parties for misappropriating the trade secret. In addition, others may independently discover our trade secrets and proprietary information. For example, the FDA, as part of its Transparency Initiative, is currently considering whether to make additional information publicly available on a routine basis, including information that we may consider to be trade secrets or other proprietary information, and it is not clear at the present time how the FDA's disclosure policies may change in the future, if at all.

Further, the laws of some foreign countries do not protect proprietary rights to the same extent or in the same manner as the laws of the United States. As a result, we may encounter significant problems in protecting and defending our intellectual property both in the United States and abroad. If we are unable to prevent material disclosure of the non-patented intellectual property related to our technologies to third parties, and there is no guarantee that we will have any such enforceable trade secret protection, we may not be able to establish or maintain a competitive advantage in our market, which could materially adversely affect our business, results of operations and financial condition.

Third-party claims of intellectual property infringement may prevent or delay our development and commercialization efforts.

Our commercial success depends in part on our avoiding infringement of the patents and proprietary rights of third parties. There is a substantial amount of litigation, both within and outside the United States, involving patent and other intellectual property rights in the biotechnology and pharmaceutical industries, including patent infringement lawsuits, interferences, oppositions, *ex parte* reexaminations, post-grant review, and *inter partes* review proceedings before the U.S. Patent and Trademark Office ("U.S. PTO") and corresponding foreign patent offices. Numerous U.S. and foreign issued patents and pending patent applications, which are owned by third parties, exist in the fields in which we are pursuing development candidates. As the biotechnology and pharmaceutical industries expand and more patents are issued, the risk increases that our product candidates may be subject to claims of infringement of the patent rights of third parties.

Third parties have asserted and in the future may assert that we are employing their proprietary technology without authorization. There may be third-party patents or patent applications with claims to materials, formulations, methods of manufacture or methods for treatment related to the use or manufacture of our product candidates. Because patent applications can take many years to issue, there may be currently pending patent applications which may later result in issued patents that our product candidates may infringe. In addition, third parties may obtain patents in the future and claim that use of our

technologies infringes upon these patents. If any third-party patents were held by a court of competent jurisdiction to cover the manufacturing process of any of our product candidates, any molecules formed during the manufacturing process or any final product itself, the holders of any such patents may be able to block our ability to commercialize such product candidate unless we obtained a license under the applicable patents, or until such patents expire. Similarly, if any third-party patents were held by a court of competent jurisdiction to cover aspects of our formulations, processes for manufacture or methods of use, including combination therapy, the holders of any such patents may be able to block our ability to develop and commercialize the applicable product candidate unless we obtained a license or until such patent expires. In either case, such a license may not be available on commercially reasonable terms or at all.

Parties making claims against us may obtain injunctive or other equitable relief, which could effectively block our ability to further develop and commercialize one or more of our product candidates. Defense of these claims, regardless of their merit, would involve substantial litigation expense and would be a substantial diversion of employee resources from our business. In the event of a successful claim of infringement against us, we may have to pay substantial damages, including treble damages and attorneys' fees for willful infringement, pay royalties, redesign our infringing products or obtain one or more licenses from third parties, which may be impossible or require substantial time and monetary expenditure.

We may not be successful in obtaining or maintaining necessary rights to gene therapy product components and processes for our development pipeline through acquisitions and in-licenses.

Presently we have rights to the intellectual property, through licenses from third parties and under patents that we own, to develop our product candidates and commercialize our potential products. Because our programs may involve additional product candidates that may require the use of proprietary rights held by third parties, the growth of our business will likely depend in part on our ability to acquire, in-license or use these proprietary rights. In addition, our product candidates may require specific formulations to work effectively and efficiently and these rights may be held by others. We may be unable to acquire or in-license any compositions, methods of use, processes or other third-party intellectual property rights from third parties that we identify. The licensing and acquisition of third-party intellectual property rights is a competitive area, and a number of more established companies are also pursuing strategies to license or acquire third-party intellectual property rights that we may consider attractive. These established companies may have a competitive advantage over us due to their size, cash resources and greater clinical development and commercialization capabilities.

For example, we sometimes collaborate with U.S. and foreign academic institutions to accelerate our preclinical research or clinical development under written agreements with these institutions. Typically, these institutions provide us with an option to negotiate a license to any of the institution's rights in technology resulting from the collaboration. Regardless of such right of first negotiation for intellectual property, we may be unable to negotiate a license within the specified time frame or under terms that are acceptable to us. If we are unable to do so, the institution may offer the intellectual property rights to other parties, potentially blocking our ability to pursue our program.

In addition, companies that perceive us to be a competitor may be unwilling to assign or license rights to us. We also may be unable to license or acquire third-party intellectual property rights on terms that would allow us to make an appropriate return on our investment. If we are unable to successfully obtain rights to required third-party intellectual property rights, our business, financial condition and prospects for growth could suffer.

If we fail to comply with our obligations in the agreements under which we license intellectual property rights from third parties or otherwise experience disruptions to our business relationships with our licensors, we could lose license rights that are important to our business.

We are a party to a number of intellectual property license agreements that are important to our business and expect to enter into additional license agreements in the future. Our existing license agreements impose, and we expect that future license agreements will impose, various diligence, milestone payment, royalty and other obligations on us. Pursuant to an intellectual property license agreement with 2seventy, we granted sublicenses to 2seventy to certain existing license agreements. If we fail to comply with our obligations under these agreements, we or 2seventy materially breach these agreements, or we are subject to a bankruptcy, the licensor may have the right to terminate the license, in which event we would not be able to market products covered by the license.

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

In many cases, patent prosecution of our licensed technology is controlled solely by the licensor. If our licensors fail to obtain and maintain patent or other protection for the proprietary intellectual property we license from them, we could lose our rights to the intellectual property or our exclusivity with respect to those rights, and our competitors could market competing products using the intellectual property. In certain cases, we control the prosecution of patents resulting from licensed technology. In the event we breach any of our obligations related to such prosecution, we may incur significant liability to our licensing partners. Licensing of intellectual property is of critical importance to our business and involves complex legal, business and scientific issues and is complicated by the rapid pace of scientific discovery in our industry. Disputes may arise regarding intellectual property subject to a licensing agreement, including:

- the scope of rights granted under the license agreement and other interpretation-related issues;
- the extent to which our technology and processes infringe on intellectual property of the licensor that is not subject to the licensing agreement;
- the sublicensing of patent and other rights under our collaborative development relationships;
- our diligence obligations under the license agreement and what activities satisfy those diligence obligations;
- the ownership of inventions and know-how resulting from the joint creation or use of intellectual property by our licensors and us and our partners; and
- the priority of invention of patented technology.

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

We may be involved in lawsuits to protect or enforce our patents or the patents of our licensors, which could be expensive, time-consuming and unsuccessful.

Competitors may infringe our patents or the patents of our licensors. To counter infringement or unauthorized use, we may be required to file infringement claims, which can be expensive and time-consuming. In addition, in an infringement proceeding, a court may decide that a patent of ours or our licensors is not valid, is unenforceable and/or is not infringed, or may refuse to stop the other party from using the technology at issue on the grounds that our patents do not cover the technology in question. In patent litigation in the United States, defendant counterclaims alleging invalidity and/or unenforceability are commonplace. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including patent eligible subject matter, lack of novelty, obviousness or non-enablement. Grounds for an unenforceability assertion could be an allegation that someone connected with prosecution of the patent withheld relevant information from the U.S. PTO, or made a misleading statement, during prosecution. Third parties may also raise similar claims before administrative bodies in the United States or abroad, even outside the context of litigation. Such mechanisms include re-examination, post grant review, and equivalent proceedings in foreign jurisdictions (e.g., opposition proceedings). Such proceedings could result in revocation or amendment to our patents in such a way that they no longer cover our product candidates. The outcome following legal assertions of invalidity and unenforceability is unpredictable. With respect to the validity question, for example, we cannot be certain that there is no invalidating prior art, of which we and the patent examiner were unaware during prosecution. If a defendant were to prevail on a legal assertion of invalidity and/or unenforceability, we would lose at least part, and perhaps all, of the patent protection on our potential products. Such a loss of patent protection would have a material adverse impact on our business.

Interference proceedings provoked by third parties or brought by us may be necessary to determine the priority of inventions with respect to our patents or patent applications or those of our licensors. An unfavorable outcome could require us to cease using the related technology or to attempt to license rights to it from the prevailing party. Our business could be harmed if the prevailing party does not offer us a license on commercially reasonable terms. Our defense of litigation or interference proceedings may fail and, even if successful, may result in substantial costs and distract our management and other employees. We may not be able to prevent, alone or with our licensors, misappropriation of our intellectual property rights, particularly in countries where the laws may not protect those rights as fully as in the United States.

Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation, there is a risk that some of our confidential information could be compromised by disclosure during this type of litigation. There could also be public announcements of the results of hearings, motions or other interim proceedings or developments. If securities analysts or investors perceive these results to be negative, it could have a material adverse effect on the price of our common stock.

We may be subject to claims that our employees, consultants or independent contractors have wrongfully used or disclosed confidential information of third parties or that our employees have wrongfully used or disclosed alleged trade secrets of their former employers.

We employ individuals who were previously employed at universities or other biotechnology or pharmaceutical companies, including our competitors or potential competitors. Although we try to ensure that our employees, consultants and independent contractors do not use the proprietary information or know-how of others in their work for us, we may be subject to claims that we or our employees, consultants or independent contractors have inadvertently or otherwise used or disclosed intellectual property, including trade secrets or other proprietary information, of any of our employee's former employer or other third parties. Litigation may be necessary to defend against these claims. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights or personnel, which could adversely impact our business. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management and other employees.

We may be subject to claims challenging the inventorship or ownership of our patents and other intellectual property.

We may also be subject to claims that former employees, collaborators or other third parties have an ownership interest in our patents or other intellectual property. We have had in the past, and we may also have in the future, ownership disputes arising, for example, from conflicting obligations of consultants or others who are involved in developing our product candidates. Litigation may be necessary to defend against these and other claims challenging inventorship or ownership. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights, such as exclusive ownership of, or right to use, valuable intellectual property. Such an outcome could have a material adverse effect on our business. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management and other employees.

Obtaining and maintaining our patent protection depends on compliance with various procedural, document submission, fee payment and other requirements imposed by governmental patent agencies, and our patent protection could be reduced or eliminated for non-compliance with these requirements.

Periodic maintenance fees, renewal fees, annuity fees and various other governmental fees on patents and/or applications will be due to be paid to the U.S. PTO and various governmental patent agencies outside of the United States in several stages over the lifetime of the patents and/or applications. We have systems in place to remind us to pay these fees, and we employ an outside firm and rely on our outside counsel to pay these fees due to non-U.S. patent agencies. The U.S. PTO and various non-U.S. governmental patent agencies require compliance with a number of procedural, documentary, fee payment and other similar provisions during the patent application process. We employ reputable law firms and other professionals to help us comply, and in many cases, an inadvertent lapse can be cured by payment of a late fee or by other means in accordance with the applicable rules. However, there are situations in which non-compliance can result in abandonment or lapse of the patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, our competitors might be able to enter the market and this circumstance would have a material adverse effect on our business.

Changes in U.S. patent law could diminish the value of patents in general, thereby impairing our ability to protect our potential products.

As is the case with other biotechnology companies, our success is heavily dependent on intellectual property, particularly patents. Obtaining and enforcing patents in the biotechnology industry involve both technological and legal complexity, and is therefore costly, time-consuming and inherently uncertain. In addition, the United States has recently enacted and is currently implementing wide-ranging patent reform legislation. Recent U.S. Supreme Court rulings have narrowed the scope of patent protection available in certain circumstances and weakened the rights of patent owners in certain situations. In addition to increasing uncertainty with regard to our ability to obtain patents in the future, this combination of events has created uncertainty with respect to the value of patents, once obtained. Depending on decisions by the U.S. Congress, the federal courts, and the U.S. PTO, the laws and regulations governing patents could change in unpredictable ways that would weaken our ability to obtain new patents or to enforce our existing patents and patents that we might obtain in the future.

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

Filing, prosecuting and defending patents on product candidates in all countries throughout the world would be prohibitively expensive, and our intellectual property rights in some countries outside the United States can be less extensive than those in the United States. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the United States. Consequently, we may not be able to prevent third parties from practicing our inventions in all countries outside the United States, or from selling or importing products made using our inventions in and into the United States or other jurisdictions. Competitors may use our technologies in jurisdictions where we

have not obtained patent protection to develop their own products and further, may export otherwise infringing products to territories where we have patent protection, but enforcement is not as strong as that in the United States. These products may compete with our potential products and our patents or other intellectual property rights may not be effective or sufficient to prevent them from competing.

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

Risks related to ownership of our common stock

The market price of our common stock may be highly volatile, and you may not be able to resell your shares at or above the price at which you purchase them.

Companies trading in the stock market in general, and The Nasdaq Global Select Market in particular, have experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of these companies. Broad market and biotechnology and pharmaceutical industry factors may negatively affect the market price of our common stock, regardless of our actual operating performance.

The market price of our common stock has been volatile in the past, and may continue to be volatile for the foreseeable future. Our stock price could be subject to wide fluctuations in response to a variety of factors, including the following:

- adverse results or delays in preclinical or clinical studies;
- reports of adverse events in our product candidates or other gene therapy products, or in clinical studies of such products;
- inability to obtain additional funding;
- any delay in filing an IND or BLA for any of our product candidates, and any adverse development or perceived adverse development with respect to the regulatory authority's review of that IND or BLA;
- failure to successfully manage the commercial launch of beti-cel, eli-cel, or lovo-cel following marketing approval, if and when obtained, including failure to manage our supply chain operations in the coordination and delivery of drug product to patients at qualified treatment centers;
- failure to obtain sufficient pricing and reimbursement for beti-cel, eli-cel, or lovo-cel from private and governmental payers following marketing approval, if and when obtained;
- failure to obtain market acceptance and adoption of beti-cel, eli-cel, or lovo-cel following marketing approval, if and when obtained;
- developments concerning the separation of our programs into two independent, publicly-traded companies;
- failure to maintain our existing strategic collaborations or enter into new collaborations;
- failure by us or our licensors and strategic collaboration partners to prosecute, maintain or enforce our intellectual property rights;
- changes in laws or regulations applicable to future products;
- inability to obtain adequate product supply for beti-cel, eli-cel, or lovo-cel, or the inability to do so at acceptable prices;
- adverse regulatory decisions;
- announcements of clinical trial results or progress in the development of programs by our competitors, and the introduction of new products, services or technologies by our competitors;
- failure to meet or exceed financial projections we may provide to the public;

- failure to meet or exceed the financial projections of the investment community;
- the perception of the pharmaceutical industry by the public, legislatures, regulators and the investment community;
- the effects of the separation of 2seventy bio;
- announcements of significant acquisitions, strategic partnerships, joint ventures or capital commitments by us, our strategic collaboration partner or our competitors;
- disputes or other developments relating to proprietary rights, including patents, litigation matters and our ability to obtain patent protection for our technologies;
- additions or departures of key scientific or management personnel;
- significant lawsuits, including patent or stockholder litigation;
- changes in the market valuations of similar companies;
- sales of our common stock by us or our stockholders in the future; and
- trading volume of our common stock.

Actual or potential sales of our common stock by our employees, including our executive officers, pursuant to pre-arranged stock trading plans could cause our stock price to fall or prevent it from increasing for numerous reasons, and actual or potential sales by such persons could be viewed negatively by other investors.

In accordance with the guidelines specified under Rule 10b5-1 of the Securities Exchange Act of 1934, as amended, and our policies regarding stock transactions, a number of our employees, including executive officers and members of our board of directors, have adopted and may continue to adopt stock trading plans pursuant to which they have arranged to sell shares of our common stock from time to time in the future. Generally, sales under such plans by our executive officers and directors require public filings. Actual or potential sales of our common stock by such persons could cause the price of our common stock to fall or prevent it from increasing for numerous reasons.

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

Additional capital will be needed in the future to continue our planned operations. To the extent we raise additional capital by issuing equity securities, including under our Equity Distribution Agreement with Goldman Sachs & Co. LLC, our stockholders may experience substantial dilution. We may sell common stock, convertible securities or other equity securities in one or more transactions at prices and in a manner we determine from time to time. If we sell common stock, convertible securities or other equity securities, investors may be materially diluted by subsequent sales. These sales may also result in material dilution to our existing stockholders, and new investors could gain rights superior to our existing stockholders.

Pursuant to our 2013 Stock Option and Incentive Plan (the "2013 Plan") our management is authorized to grant stock options and other equity-based awards to our employees, directors and consultants. The number of shares available for future grant under the 2013 Plan automatically increases each year by up to 4% of all shares of our capital stock outstanding as of December 31 of the prior calendar year, subject to the ability of our board of directors or compensation committee to take action to reduce the size of the increase in any given year. Currently, we plan to register the increased number of shares available for issuance under the 2013 Plan each year. If our board of directors or compensation committee elects to increase the number of shares available for future grant by the maximum amount each year, our stockholders may experience additional dilution, which could cause our stock price to fall. We make equity grants to certain new employees joining the company pursuant to an inducement plan, and our compensation committee may elect to increase the number of shares available for future grant without stockholder approval. We also have an Employee Stock Purchase Plan and any shares of common stock purchased pursuant to that plan will also cause dilution.

We may be subject to securities class action litigation, which may result in substantial costs and a diversion of management's attention and resources, which could harm our business.

In the past, securities class action litigation has often been brought against a company following a decline in the market price of its securities, and we have in the past litigated class action complaints in the United States District Court for the District of Massachusetts and for the District of Delaware, filed by purported stockholders against us and certain of our directors and officers. We may face additional securities class action litigation in the future. This risk is especially relevant for us because biotechnology and pharmaceutical companies have experienced significant stock price volatility in recent years, and we expect

to experience continued stock price volatility. Defending against any future litigation could result in substantial costs and a diversion of management's attention and resources, which could harm our business.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited.

Under Section 382 of the Internal Revenue Code of 1986, as amended, if a corporation undergoes an "ownership change," generally defined as a greater than 50% change (by value) in its equity ownership over a three-year period, the corporation's ability to use its pre-change net operating loss carryforwards ("NOLs") and other pre-change tax attributes (such as research tax credits) to offset its post-change income may be limited. We have completed several financings since our inception and prior to our initial public offering in 2013, which we believe have resulted in a change in control as defined by IRC Section 382. We completed a study through December 2020 confirming no ownership changes have occurred since our initial public offering in 2013. We may also experience ownership changes in the future as a result of subsequent shifts in our stock ownership. As a result, if we earn net taxable income, our ability to use our pre-change net operating loss carryforwards to offset U.S. federal taxable income may be subject to limitations, which could potentially result in increased future tax liability to us. In addition, at the state level, there may be periods during which the use of NOLs is suspended or otherwise limited, which could accelerate or permanently increase state taxes owed.

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

We have never declared or paid any cash dividends on our common stock. We currently anticipate that we will retain future earnings for the development, operation and expansion of our business and do not anticipate declaring or paying any cash dividends for the foreseeable future. Any return to stockholders will therefore be limited to the appreciation of their stock.

Provisions in our amended and restated certificate of incorporation and by-laws, as well as provisions of Delaware law, could make it more difficult for a third-party to acquire us or increase the cost of acquiring us, even if doing so would benefit our stockholders or remove our current management.

Our amended and restated certificate of incorporation, amended and restated by-laws and Delaware law contain provisions that may have the effect of delaying or preventing a change in control of us or changes in our management. Our amended and restated certificate of incorporation and by-laws, include provisions that:

- authorize "blank check" preferred stock, which could be issued by our board of directors without stockholder approval and may contain voting, liquidation, dividend and other rights superior to our common stock;
- create a classified board of directors whose members serve staggered three-year terms;
- specify that special meetings of our stockholders can be called only by our board of directors, the chairperson of our board of directors, our chief executive officer or our president;
- prohibit stockholder action by written consent;
- establish an advance notice procedure for stockholder approvals to be brought before an annual meeting of our stockholders, including proposed nominations of persons for election to our board of directors;
- provide that our directors may be removed only for cause;
- provide that vacancies on our board of directors may be filled only by a majority of directors then in office, even though less than a quorum;
- specify that no stockholder is permitted to cumulate votes at any election of directors;
- expressly authorize our board of directors to modify, alter or repeal our amended and restated by-laws; and
- require supermajority votes of the holders of our common stock to amend specified provisions of our amended and restated certificate of incorporation and amended and restated by-laws.

These provisions, alone or together, could delay or prevent hostile takeovers and changes in control or changes in our management.

In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which limits the ability of stockholders owning in excess of 15% of our outstanding voting stock to merge or combine with us.

Any provision of our amended and restated certificate of incorporation or amended and restated by-laws or Delaware law that has the effect of delaying or deterring a change in control could limit the opportunity for our stockholders to receive a premium for their shares of our common stock, and could also affect the price that some investors are willing to pay for our common stock.

Our amended and restated certificate of incorporation and amended and restated by-laws designate specific courts as the exclusive forum for certain litigation that may be initiated by our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us.

Our amended and restated certificate of incorporation and amended and restated by-laws specify that, unless we consent in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware will be the sole and exclusive forum for most legal actions involving claims brought against us by stockholders, other than suits brought to enforce any liability or duty created by the Securities Exchange Act of 1934, as amended (the "Exchange Act") or any other claim for which the federal courts have exclusive jurisdiction and any action that the Court of Chancery of the State of Delaware has dismissed for lack of subject matter jurisdiction, which may be brought in another state or federal court sitting in the State of Delaware. Our amended and restated by-laws also specify that, unless we consent in writing to the selection of an alternate forum, the United States District Court for the District of Massachusetts shall be the sole and exclusive forum for the resolution of any complaint asserting a cause of action arising under the Securities Act of 1933, as amended (the "Securities Act"). Any person or entity purchasing or otherwise acquiring any interest in shares of our capital stock shall be deemed to have notice of and to have consented to the provisions of our amended and restated certificate of incorporation and amended and restated by-laws described above.

We believe these provisions benefit us by providing increased consistency in the application of Delaware law by chancellors particularly experienced in resolving corporate disputes or federal judges experienced in resolving Securities Act disputes, efficient administration of cases on a more expedited schedule relative to other forums and protection against the burdens of multi-forum litigation. However, the provision may have the effect of discouraging lawsuits against our directors, officers, employees, and agents as it may limit any stockholder's ability to bring a claim in a judicial forum that such stockholder finds favorable for disputes with us or our directors, officers, employees, or agents and result in increased costs for stockholders to bring a claim. The enforceability of similar choice of forum provisions in other companies' certificates of incorporation and by-laws has been challenged in legal proceedings, and it is possible that, in connection with any applicable action brought against us, a court could find the choice of forum provisions contained in our amended and restated certificate of incorporation and amended and restated by-laws to be inapplicable or unenforceable in such action. If a court were to find the choice of forum provision contained in our amended and restated certificate of incorporation or amended and restated by-laws to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could adversely affect our business, financial condition, or results of operations.

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

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

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

The global economy, including credit and financial markets, has recently experienced extreme volatility and disruptions, including severely diminished liquidity and credit availability, rising interest and inflation rates, declines in consumer confidence, declines in economic growth, increases in unemployment rates and uncertainty about economic stability. If the equity and credit markets continue to deteriorate or the United States enters a recession, it may make any necessary debt or equity financing more difficult to obtain in a timely manner or on favorable terms, more costly or more dilutive. In addition, there is a risk that one or more of our CMOs, suppliers or other third-party providers may not survive an economic downturn or recession. As a result, our business, results of operations and price of our common stock may be adversely affected.

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

None

Item 3. Defaults Upon Senior Securities

None

Item 4. Mine Safety Disclosures

None

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

The following information should be read in conjunction with the unaudited financial information and the notes thereto included in this Quarterly Report on Form 10-Q and the audited financial information and the notes thereto included in our Annual Report on Form 10-K for the year ended December 31, 2021, which was filed with the Securities and Exchange Commission, or the SEC, on March 4, 2022 (the "2021 Annual Report on Form 10-K").

Except for the historical information contained herein, the matters discussed in this Quarterly Report on Form 10-Q may be deemed to be forward-looking statements that involve risks and uncertainties. We make such forward-looking statements pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995 and other federal securities laws. In this Quarterly Report on Form 10-Q, words such as "may," "expect," "anticipate," "estimate," "intend," "plan," and similar expressions (as well as other words or expressions referencing future events, conditions or circumstances) are intended to identify forward-looking statements.

Our actual results and the timing of certain events may differ materially from the results discussed, projected, anticipated, or indicated in any forward-looking statements. We caution you that forward-looking statements are not guarantees of future performance and that our actual results of operations, financial condition and liquidity, and the development of the industry in which we operate may differ materially from the forward-looking statements contained in this Quarterly Report. In addition, even if our results of operations, financial condition and liquidity, and the development of the industry in which we operate are consistent with the forward-looking statements contained in this Quarterly Report, they may not be predictive of results or developments in future periods.

The following information and any forward-looking statements should be considered in light of factors discussed elsewhere in this Quarterly Report on Form 10-Q, including those risks identified under Part II, Item 1A. Risk Factors.

We caution readers not to place undue reliance on any forward-looking statements made by us, which speak only as of the date they are made. We disclaim any obligation, except as specifically required by law and the rules of the SEC, to publicly update or revise any such statements to reflect any change in our expectations or in events, conditions or circumstances on which any such statements may be based, or that may affect the likelihood that actual results will differ from those set forth in the forward-looking statements.

Overview

We are a biotechnology company committed to researching, developing, and commercializing potentially transformative gene therapies for severe genetic diseases. We have built an integrated product platform with broad therapeutic potential in a variety of indications based on our lentiviral gene addition platform. Our gene therapy programs in severe genetic diseases include programs for β-thalassemia, SCD, and CALD. The BLA for beti-cel as a treatment for patients with β-thalassemia who receive regular RBC transfusions was accepted for priority review by the FDA, and the Prescription Drug User Fee Act ("PDUFA") goal date is August 19, 2022. The BLA for eli-cel as a treatment for patients less than 18 years of age with early CALD was accepted for priority review by the FDA, and the PDUFA goal date is September 16, 2022. We remain in active communication with the FDA to resolve the clinical hold of eli-cel, and we anticipate resolving the FDA's questions concurrently with the agency's ongoing review of our BLA. We are developing lovo-cel as a treatment for patients with SCD.

Based on our discussions with the FDA, we believe that we may be able to seek approval for lovo-cel in the United States on the basis of clinical data from HGB-206 Group C, with supporting data from HGB-210. We have treated all of the patients who will form the primary basis of efficacy for approval and completed manufacturing of commercial drug product validation lots, with the demonstration of analytical comparability as the key remaining actions prior to submission of our planned BLA for lovo-cel. In December 2021, the FDA placed a partial clinical hold on our clinical program for lovo-cel for enrolling patients under the age of 18. During the partial clinical hold, we are continuing our clinical study activities as planned for patients 18 and older in HGB-210, as well as follow-up activities for treated patients of all ages in all studies.

We are focusing our development and commercialization efforts in the U.S. market, and we have withdrawn the marketing authorizations for beti-cel and eli-cel in European markets. We are continuing the long-term follow-up of patients previously enrolled within the clinical trial programs in Europe as planned but do not intend to initiate any new clinical trials in Europe for β-thalassemia, CALD or SCD. As a result, we anticipate a reduction of selling, general and administrative costs and an impact on our excess inventory analysis as future lots are produced, which is based on forecasted consumption levels driven by sales forecasts.

Since our inception in 1992, we have devoted substantially all of our resources to our development efforts relating to our product candidates, including activities to manufacture product candidates in compliance with good manufacturing practices, or

GMP, to conduct clinical studies of our product candidates, to provide selling, general and administrative support for these operations and to protect our intellectual property. We have not generated material revenue from product sales. We have funded our operations primarily through the sale of common stock in our public offerings, private placements of preferred stock and warrants, and through collaborations.

On June 22, 2022, we entered into an Equity Distribution Agreement (the "Equity Distribution Agreement") with Goldman Sachs & Co. LLC ("Goldman") to sell shares of our common stock up to $75.0 million, from time to time, through an "at the market" equity offering program under which Goldman will act as manager. In the three months ended June 30, 2022, we sold 2.1 million shares of common stock at-the-market under the Equity Distribution Agreement, resulting in gross proceeds to us of approximately $8.3 million ($8.0 million net of offering costs).

As of June 30, 2022, we had cash, cash equivalents and marketable securities of approximately $173.2 million. We have never been profitable and have incurred net losses in each year since inception. Our net loss was $100.1 million and $222.3 million for the three and six months ended June 30, 2022, respectively, and our accumulated deficit was $3.94 billion as of June 30, 2022. Substantially all of our net losses resulted from costs incurred in connection with our research and development programs and from selling, general and administrative costs associated with our operations. We expect to continue to incur significant expenses and operating losses for at least the next several years, as we:

- fund activities related to the potential commercial launches of our late-stage product candidates in the United States;
- seek regulatory approval for our product candidates;
- scale our manufacturing capabilities in support of potential commercialization following any regulatory approvals;
- conduct clinical studies for our clinical program in SCD; and
- potentially initiate research and development-related activities for the discovery and development of new product candidates and technologies in severe genetic diseases.

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

Business update

In April 2022, we announced that we were initiating a comprehensive restructuring plan to deliver cost savings over the next two years. The restructuring is anticipated to produce up to $160 million in cost savings over the next two years. As part of the restructuring, we plan to reduce our workforce by approximately 30% in 2022. See Note 14, *Reduction in Workforce*, to our condensed consolidated financial statements appearing elsewhere in this Quarterly Report on Form 10-Q for more information on this restructuring plan.

We had cash, cash equivalents and marketable securities of approximately $173.2 million as of June 30, 2022. In accordance with Accounting Standards Codification ("ASC") 205-40, *Going Concern*, we evaluated whether there are conditions and events, considered in the aggregate, that raise substantial doubt about our ability to continue as a going concern within one year after the date that the condensed consolidated financial statements are issued. This evaluation initially does not take into consideration the potential mitigating effect of our plans that have not been fully implemented as of the date the financial statements are issued. When substantial doubt exists under this methodology, we evaluate whether the mitigating effect of our plans sufficiently alleviates substantial doubt about our ability to continue as a going concern. The mitigating effect of our plans, however, is only considered if both (1) it is probable that the plans will be effectively implemented within one year after the date that the financial statements are issued, and (2) it is probable that the plans, when implemented, will mitigate the relevant conditions or events that raise substantial doubt about our ability to continue as a going concern within one year after the date that the financial statements are issued. In performing this analysis, we excluded certain elements of our operating plan that cannot be considered probable. Under ASC 205-40, the future receipt of potential funding from future equity or debt issuances, the release of restricted cash related to the Company's 50 Binney Street lease, and the potential sale of priority review vouchers, if received, cannot be considered probable at this time because none of the plans are entirely within the Company's control or have been approved by the Board of Directors as of the date of the financial statements. The restructuring plan described above was approved by the Board of Directors in April 2022 and therefore was incorporated into our assessment of our ability to continue as a going concern within one year after the date of these condensed consolidated financial statements are issued.

Our expectation to generate operating losses and negative operating cash flows in the future and the need for additional funding to support our planned operations raise substantial doubt regarding our ability to continue as a going concern for a period of one year after the date that the financial statements are issued. Our plan to alleviate the conditions that raise substantial doubt include implementing reduced 2022 spending, including projected savings through the move of the Company's headquarters to Assembly Row in Somerville, Massachusetts, the orderly wind down of European operations, the potential sale of priority review vouchers that would be issued with potential U.S. regulatory approvals of BLAs for beti-cel and/or eli-cel, and the pursuit of additional cash resources through public or private equity or debt financings. We have concluded the likelihood that our plan to successfully obtain sufficient funding from one or more of these sources or adequately reduce expenditures, while reasonably possible, is less than probable. Accordingly, we have concluded that substantial doubt exists about our ability to continue as a going concern for a period of at least 12 months from the date of issuance of the condensed consolidated financial statements.

The accompanying financial statements have been prepared on a going concern basis, which contemplates the realization of assets and satisfaction of liabilities in the ordinary course of business. The financial statements do not include any adjustments relating to the recoverability and classification of recorded asset amounts or the amounts and classification of liabilities that might result from the outcome of the uncertainties described above.

Our legacy business

On November 4, 2021, we completed the separation of our severe genetic disease and oncology programs into two separate, publicly traded companies: bluebird bio, Inc. and 2seventy bio, Inc. ("2seventy bio"), a Delaware corporation and wholly-owned subsidiary prior to the separation (the "Separation"). The Separation was effected by means of a distribution of all of the outstanding shares of common stock of 2seventy bio in which each bluebird stockholder received one share of common stock, par value $0.0001 per share, of 2seventy bio for every three shares of common stock, par value $0.01 per share, of bluebird held as of the close of business on October 19, 2021 (the "Distribution").

In connection with the Separation, we entered into a separation agreement with 2seventy bio, dated as of November 3, 2021, that, among other things, sets forth our agreements with 2seventy bio regarding the principal actions to be taken in connection with the Separation, including the Distribution. In connection with the Separation, we also entered into certain other agreements with 2seventy bio, including transition services agreements. Pursuant to the transition services agreements, we are obligated to provide and are entitled to receive certain transition services related to corporate functions, such as finance, human resources, internal audit, research and development, financial reporting, and information technology. The separation and the aforementioned agreements are more fully described in Note 3, *Discontinued operations*, to our consolidated financial statements appearing in our 2021 Annual Report on Form 10-K, and in Note 3, *Discontinued operations*, to our condensed consolidated financial statements appearing elsewhere in this Quarterly Report on Form 10-Q.

Financial operations overview

Product revenue

Our revenues have primarily been derived from product revenues associated with the sale of ZYNTEGLO in Germany.

Other revenue

We have recognized an immaterial amount of revenue associated with grants and collaboration agreements.

Research and development expenses

Research and development expenses consist primarily of costs incurred for the development of our product candidates, which include:

- employee-related expenses, including salaries, benefits, travel and stock-based compensation expense;
- expenses incurred under agreements with CROs and clinical sites that conduct our clinical studies;
- facilities, depreciation, and other expenses, which include direct and allocated expenses for rent and maintenance of facilities, information technology, insurance, and other supplies in support of research and development activities;
- costs associated with our research platform and preclinical activities;
- milestones and upfront license payments;
- costs associated with our regulatory, quality assurance and quality control operations; and

Research and development costs are expensed as incurred. Costs for certain development activities are recognized based on an evaluation of the progress to completion of specific tasks using information and data provided to us by our vendors and our clinical sites. We cannot determine with certainty the duration and completion costs of the current or future clinical studies of our product candidates or if, when, or to what extent we will generate revenues from the commercialization and sale of any of our product candidates that obtain regulatory approval. We may not succeed in achieving regulatory approval for all of our product candidates. The duration, costs, and timing of clinical studies and development of our product candidates will depend on a variety of factors, any of which could mean a significant change in the costs and timing associated with the development of our product candidates, including:

- the scope, rate of progress, and expense of our ongoing as well as any additional clinical studies and other research and development activities we undertake;
- future clinical study results;
- uncertainties in clinical study enrollment rates;
- new manufacturing processes or protocols that we may choose to or be required to implement in the manufacture of our LVV or drug product;
- regulatory feedback on requirements for regulatory approval, as well as changing standards for regulatory approval; and
- the timing and receipt of any regulatory approvals.

We plan to continue to incur research and development expenses for the foreseeable future as we continue to advance the development of beti-cel, eli-cel, and lovo-cel, and conduct research activities for our platform technology. Our research and development expenses include expenses associated with the following activities:

- for the clinical studies of beti-cel, consisting of HGB-207, HGB-212, and the associated long-term follow-up protocol;
- for the clinical studies of lovo-cel, consisting of HGB-206, HGB-210 study, and the associated long-term follow-up protocol;
- for the clinical study of eli-cel, consisting of ALD-104, and the associated long-term follow-up protocol;
- research and development activities for our platform technology; and
- for the manufacture of clinical study materials in support of our clinical studies.

Our direct research and development expenses consist principally of external costs, such as fees paid to investigators, consultants, central laboratories and CROs in connection with our clinical studies, and costs related to acquiring and manufacturing clinical study materials. We allocate salary and benefit costs directly related to specific programs. We do not allocate personnel-related discretionary bonus or stock-based compensation costs, laboratory and related expenses, certain license and other collaboration costs, depreciation or other indirect costs that are deployed across multiple projects under development and, as such, the costs are separately classified as other research and development expenses in the table below:

	For the three months ended June 30,		For the six months ended June 30,	
	2022	2021[1]	2022	2021[1]
	(in thousands)		(in thousands)	
beti-cel	$ 15,588	$ 14,654	$ 27,058	$ 28,360
lovo-cel (formerly LentiGlobin for SCD)	16,878	16,030	42,554	29,192
eli-cel	9,046	16,792	19,963	30,103
Preclinical programs	1,054	1,412	5,956	2,942
Total direct research and development expense	42,566	48,888	95,531	90,597
Employee-and contractor-related expenses	7,179	13,152	17,108	26,910
Stock-based compensation expense	5,255	10,336	11,810	22,726
Laboratory and related expenses	107	1,257	1,048	4,102
Facility expenses	8,734	11,012	16,219	23,153
Total other research and development expenses	21,275	35,757	46,185	76,891
Total research and development expense	$ 63,841	$ 84,645	$ 141,716	$ 167,488

(1) Prior period amounts have been retrospectively adjusted to reflect the effects of the Separation.

Selling, general and administrative expenses

Selling, general and administrative expenses consist primarily of salaries and related costs for personnel, including stock-based compensation and travel expenses for our employees in executive, operational, finance, legal, business development, commercial, information technology, and human resource functions. Other selling, general and administrative expenses include facility-related costs, professional fees for accounting, tax, legal and consulting services, directors' fees and expenses associated with obtaining and maintaining patents.

We anticipate that our selling, general and administrative expenses will decrease in the future as we implement our restructuring plans and reduce headcount in these functions.

Cost of product revenue

Cost of product revenue includes costs associated with the sale of ZYNTEGLO in Germany.

Restructuring expenses

We record costs and liabilities associated with postemployment nonretirement benefits in accordance with ASC 712, *Postemployment Nonretirement Benefits*. Such costs are based on the estimate of fair value in the period the liabilities are incurred. We evaluate and adjust costs as appropriate for changes in circumstances as additional information becomes available.

Interest income, net

Interest income, net consists primarily of interest income earned on investments.

Other (expense) income, net

Other (expense) income, net consists primarily of gains and losses on equity securities held by us, rental income on sublease, gains and losses on disposal of fixed assets, and gains and losses on foreign currency transactions.

Discontinued operations

Net loss from discontinued operations consists of the results of our oncology business and our manufacturing facility in Durham, North Carolina and is reported as a separate component of income.

Critical accounting policies and estimates

Our management's discussion and analysis of our financial condition and results of operations are based on our financial statements, which have been prepared in accordance with generally accepted accounting principles in the U.S. The preparation of these financial statements requires us to make estimates and judgments that affect the reported amounts of assets, liabilities, and expenses and the disclosure of contingent assets and liabilities in our financial statements. On an ongoing basis, we evaluate our estimates and judgments, including expected business and operational changes, sensitivity and volatility associated with the assumptions used in developing estimates, and whether historical trends are expected to be representative of future

trends. We base our estimates on historical experience, known trends and events and various other factors that are believed to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions. In making estimates and judgments, management employs critical accounting policies. During the six months ended June 30, 2022, there were no material changes to our critical accounting policies as reported in our 2021 Annual Report on Form 10-K, except as otherwise described in Note 2, *Basis of presentation, principles of consolidation and significant accounting policies*, in the Notes to Condensed Consolidated Financial Statements appearing elsewhere in this Quarterly Report on Form 10-Q.

Results of Operations

Comparison of the three months ended June 30, 2022 and 2021:

	For the three months ended June 30,		
	2022	2021	Change
	(in thousands)		
Revenue:			
Product revenue	$ 1,331	$ —	$ 1,331
Other revenue	188	143	45
Total revenues	1,519	143	1,376
Operating expenses:			
Research and development	63,841	84,645	(20,804)
Selling, general and administrative	36,694	54,984	(18,290)
Cost of product revenue	1,745	15,215	(13,470)
Restructuring expense	6,639	—	6,639
Total operating expenses	108,919	154,844	(45,925)
Loss from operations	(107,400)	(154,701)	47,301
Interest income, net	174	218	(44)
Other (expense) income, net	7,088	(1,274)	8,362
Loss before income taxes	(100,138)	(155,757)	55,619
Income tax (expense) benefit	—	(216)	216
Net loss from continuing operations	(100,138)	(155,973)	55,835
Net loss from discontinued operations	—	(85,729)	85,729
Net loss	$ (100,138)	$ (241,702)	$ 141,564

Revenues. Total revenue was $1.5 million for the three months ended June 30, 2022, compared to $0.1 million for the three months ended June 30, 2021. The increase of $1.4 million was primarily attributable to sales of ZYNTEGLO in Germany.

Research and development expenses. Research and development expenses were $63.8 million for the three months ended June 30, 2022, compared to $84.6 million for the three months ended June 30, 2021. The net decrease of $20.8 million was primarily attributable to the following:

- $15.6 million of decreased net employee compensation, benefit, and other headcount-related expenses, which is primarily driven by a decrease of $5.1 million in stock-based compensation expense due to an overall decrease in the value of awards and by stock-based compensation expense incurred related to our employee retention program in 2021;
- $2.0 million of decreased information technology and facility-related costs;
- $2.0 million of decreased lab expenses and platform costs; and
- $1.4 million of decreased clinical trial costs primarily driven by the completion of clinical trials in late 2021;

These decreased costs were partially offset by $1.3 million of increased material production fees.

Selling, general and administrative expenses. Selling, general and administrative expenses were $36.7 million for the three months ended June 30, 2022, compared to $55.0 million for the three months ended June 30, 2021. The decrease of $18.3 million was primarily due to the following:

- $25.3 million of decreased employee compensation, benefit, and other headcount-related expenses, which is primarily driven by a decrease of $9.1 million in stock-based compensation expense due to an overall decrease in the value of awards and by stock-based compensation expense incurred related to our employee retention program in 2021; and
- $1.3 million of decreased costs related to commercial readiness activities due to our decision to focus our efforts on the U.S. market for beti-cel, eli-cel, and lovo-cel.

These decreased costs were partially offset by $8.6 million of increased information technology and facility-related costs due to addition of commencement of the 50 Binney Street sublease and the commencement of the Assembly Row Lease.

Cost of product revenue. Cost of product revenue was $1.7 million for the three months ended June 30, 2022, compared to $15.2 million for the three months ended June 30, 2021. The decrease is primarily attributable to reserves for excess inventory recognized during the second quarter of 2021 as a result of the exit from the European market.

Restructuring expenses. The increase in restructuring expenses is primarily related to the costs associated with the reduction in workforce as a result of our decision to reduce our workforce by 30% across the second and third quarters of 2022.

Interest income, net. The decrease in interest income, net was primarily related to lower interest income earned on investments due to an overall decrease in investments.

Other (expense) income, net. The increase in other (expense) income, net is primarily related the rental income from the 50 Binney Street sublease of $7.5 million for the three months ended June 30, 2022.

Comparison of the six months ended June 30, 2022 and 2021:

	For the six months ended June 30,		
	2022	2021	Change
	(in thousands)		
Revenue:			
Product revenue	$ 2,739	$ 724	2,015
Other revenue	725	313	412
Total revenues	3,464	1,037	2,427
Operating expenses:			
Research and development	141,716	167,488	(25,772)
Selling, general and administrative	72,800	118,553	(45,753)
Cost of product revenue	10,055	15,791	(5,736)
Restructuring expense	6,639	—	6,639
Total operating expenses	231,210	301,832	(70,622)
Loss from operations	(227,746)	(300,795)	73,049
Interest income, net	280	573	(293)
Other (expense) income, net	5,176	23,027	(17,851)
Loss before income taxes	(222,290)	(277,195)	54,905
Income tax (expense) benefit	—	(282)	282
Net loss from continuing operations	$ (222,290)	$ (277,477)	$ 55,187
Net loss from discontinued operations	$ —	$ (170,033)	$ 170,033
Net loss	$ (222,290)	$ (447,510)	$ 225,220

Revenues. Total revenue was $3.5 million for the six months ended June 30, 2022, compared to $1.0 million for the six months ended June 30, 2021. The increase of $2.4 million was primarily attributable to sales of ZYNTEGLO in Germany.

Research and development expenses. Research and development expenses were $141.7 million for the six months ended June 30, 2022, compared to $167.5 million for the six months ended June 30, 2021. The net decrease of $25.8 million was primarily attributable to the following:

- $28.0 million of decreased net employee compensation, benefit, and other headcount-related expenses, which is primarily driven by a decrease of $10.9 million in stock-based compensation expense due to an overall decrease in the value of awards and by stock-based compensation expense incurred related to our employee retention program in 2021;
- $5.1 million of decreased clinical trial costs primarily driven by the completion of clinical trials in late 2021;
- $5.0 million of decreased information technology and facility-related costs; and
- $4.5 million of decreased lab expenses and platform costs.

These decreased costs were partially offset by $16.9 million of increased material production fees.

Selling, general and administrative expenses. Selling, general and administrative expenses were $72.8 million for the six months ended June 30, 2022, compared to $118.6 million for the six months ended June 30, 2021. The decrease of $45.8 million was primarily due to the following:

- $51.1 million of decreased employee compensation, benefit, and other headcount-related expenses, which is primarily driven by a decrease of $22.2 million in stock-based compensation expense due to an overall decrease in the value of awards and by stock-based compensation expense incurred related to our employee retention program in 2021; and
- $3.0 million of decreased costs related to commercial readiness activities due to our decision to focus our efforts on the U.S. market for beti-cel, eli-cel, and lovo-cel.

These decreased costs were partially offset by the following:

- $8.0 million of increased information technology and facility-related costs due to addition of commencement of the 50 Binney Street sublease and the commencement of the Assembly Row Lease; and
- $1.3 million of increased consultant and professional service fees.

Cost of product revenue. Cost of product revenue was $10.1 million for the six months ended June 30, 2022, compared to $15.8 million for the six months ended June 30, 2021. The decrease is primarily attributable to reserves for excess inventory being recorded to research and development expenses during the second quarter of 2022.

Restructuring expense. The increase in restructuring expenses is primarily related to the costs associated with the reduction in workforce as a result of our decision to reduce our workforce3 by 30% across the second and third quarters of 2022.

Interest income, net. The decrease in interest income, net was primarily related to lower interest income earned on investments due to an overall decrease in investments.

Other (expense) income, net. The decrease in other (expense) income, net was primarily related to changes in fair value of equity securities offset by rental income of $7.5 million generated by the 50 Binney Street sublease. During the six months ended June 30, 2021, we recognized a gain on the sale of equity securities.

Liquidity and Capital Resources

As of June 30, 2022, we had cash, cash equivalents and marketable securities of approximately $173.2 million. Cash in excess of immediate requirements is invested in accordance with our investment policy, primarily with a view to liquidity and capital preservation. As of June 30, 2022, our funds are primarily held in U.S. government agency securities and treasuries, corporate bonds, commercial paper, equity securities, and money market accounts.

We have incurred losses and cumulative negative cash flows from operations since our inception in April 1992, and as of June 30, 2022 we had an accumulated deficit of $3.94 billion. We expect that we will continue to incur significant research and development and selling, general and administrative expenses and, as a result, we will need additional capital to fund our operations within the next twelve months, which we may raise through public or private equity or debt financings, strategic collaborations, or other sources which are not entirely within our control nor have been approved by our Board of Directors as

of the date of this filing. Potential additional funding from other sources includes the sale of priority review vouchers, if received.

The likelihood of our long-term success must be considered in light of the expenses, difficulties, and potential delays to be encountered in the development and commercialization of new pharmaceutical products, competitive factors in the marketplace and the complex regulatory environment in which we operate. We may never achieve significant revenue or profitable operations. These factors create substantial doubt about our ability to continue as a going concern. The accompanying Condensed Consolidated Financial Statements were prepared on a going concern basis, which contemplates the realization of assets and the settlement of liabilities and commitments in the normal course of business. The Condensed Consolidated Financial Statements do not include any adjustments that might be necessary if we are unable to continue as a going concern.

On June 22, 2022, we entered into the Equity Distribution Agreement with Goldman to sell shares of our common stock up to $75.0 million, from time to time, through an “at the market” equity offering program under which Goldman will act as manager. In the three months ended June 30, 2022, we sold 2.1 million shares of common stock at-the-market under the Equity Distribution Agreement, resulting in gross proceeds to us of approximately $8.3 million ($8.0 million net of offering costs). Refer to Note 10, *Equity*, in the Notes to Condensed Consolidated Financial Statements appearing elsewhere in this Quarterly Report on Form 10-Q for more information.

Sources of Liquidity

The discussion of our cash flows that follows does not include the impact of any adjustments to remove discontinued operations, unless otherwise noted, and is stated on a total company consolidated basis. The separation of our oncology business may have a negative impact on our cash flows in future periods.

Cash Flows

The following table summarizes our cash flow activity:

	For six months ended June 30,	
	2022	2021
	(in thousands)	
Net cash used in operating activities	$ (219,654)	$ (348,975)
Net cash provided by investing activities	131,602	381,720
Net cash provided by financing activities	8,043	4,192
Net (decrease) increase in cash, cash equivalents and restricted cash	$ (80,009)	$ 36,937

Operating Activities. The $129.3 million decrease in cash used in operating activities for the six months ended June 30, 2022 compared to the six months ended June 30, 2021 was primarily due to the decrease in net loss during this period of $225.2 million, which was driven primarily by the separation of our oncology business in November 2021 and the sale of our manufacturing facility in Durham, North Carolina in September 2021. Cash used in operating activities was also driven by changes in operating assets and liabilities and adjustments for non-cash items.

Discontinued operations inclusive of noncash expenses disclosed in Note 3, *Discontinued operations, in the Notes to the Condensed Consolidated Financial Statements*, contributed a net loss of $170.0 million for the six months ended June 30, 2021.

Investing Activities. The $250.1 million decrease in cash provided by investing activities for the six months ended June 30, 2022 was primarily due to a decrease in proceeds from maturities of marketable securities of $449.5 million and a decrease in proceeds from sales of marketable securities of $1.1 million, partially offset by a decrease in cash used to purchase marketable securities of $196.1 million compared to the six months ended June 30, 2021.

Financing Activities. The $3.9 million increase in cash provided by financing activities was primarily due to the proceeds from the sale of the Company's common stock, partially offset by a decrease in proceeds from exercise of stock options of $4.2 million during the six months ended June 30, 2022 compared to the six months ended June 30, 2021.

Contractual Obligations and Commitments

Except as discussed in Note 8, *Leases*, and Note 9, *Commitments and contingencies*, in the Notes to Condensed Consolidated Financial Statements appearing elsewhere in this Quarterly Report on Form 10-Q, there have been no material changes to our contractual obligations and commitments as included in our 2021 Annual Report on Form 10-K.

Item 5. Other Information

Our policy governing transactions in our securities by our directors, officers, and employees permits our officers, directors and certain other persons to enter into trading plans complying with Rule 10b5-1 under the Securities Exchange Act of 1934, as amended. We have been advised that none of our officers have entered into trading plans covering periods after the date of this Quarterly Report on Form 10-Q in accordance with Rule 10b5-1 and our policy governing transactions in our securities. Generally, under these trading plans, the individual relinquishes control over the transactions once the trading plan is put into place. Accordingly, sales under these plans may occur at any time, including possibly before, simultaneously with, or immediately after significant events involving our company. We do not undertake to report Rule 10b5-1 trading plans that may be adopted by any officers or directors in the future, or to report any modifications or termination of any publicly announced trading plan, except to the extent required by law.

Item 6. Exhibits

The exhibits filed as part of this Quarterly Report on Form 10-Q are set forth in the Exhibit Index below, which is incorporated herein by reference.

Exhibit Index

Exhibit Number	Exhibit Title	Incorporated by Reference			
		Form	File no.	Exhibit	Filing Date
2.1*	Separation Agreement, dated as of November 3, 2021, by and between the Registrant and 2seventy bio, Inc.	8-K	001-35966	2.1	November 4, 2021
3.1	Amended and Restated Certificate of Incorporation of the Registrant	8-K	001-35966	3.1	June 24, 2013
3.2	Amended and Restated By-laws of the Registrant	10-K	001-35966	3.2	February 23, 2021
4.1	Specimen Common Stock Certificate	S-1/A	333-188605	4.1	June 4, 2013
4.2	Form of Pre-Funded Warrant	8-K	001-35966	4.1	September 8, 2021
10.1*	Amendment No. 4 to Clinical and Commercial Supply Agreement Viral Vector Product by and between bluebird bio (Switzerland) GmbH and SAFC Carlsbad, Inc.	—	—	—	Filed herewith
10.2*	Amendment to the Transition Services Agreement, by and between 2seventy bio, Inc. and the Registrant	—	—	—	Filed herewith
31.1	Certification of Principal Executive Officer pursuant to Rule 13a-14(a) or Rule 15d-14(a) of the Securities Exchange Act of 1934, as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.	—	—	—	Filed herewith
31.2	Certification of Principal Financial Officer pursuant to Rule 13a-14(a) or Rule 15d-14(a) of the Securities Exchange Act of 1934, as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.	—	—	—	Filed herewith
32.1	Certification of Principal Executive Officer and Principal Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.	—	—	—	Furnished herewith
101.INS	Inline XBRL Instance Document (the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document)				Filed herewith
101.SCH	Inline XBRL Taxonomy Extension Schema Document.	—	—	—	Filed herewith
101.CAL	Inline XBRL Taxonomy Extension Calculation Linkbase Document.	—	—	—	Filed herewith
101.DEF	Inline XBRL Taxonomy Extension Definition Linkbase Document.	—	—	—	Filed herewith
101.LAB	Inline XBRL Taxonomy Extension Label Linkbase Document.	—	—	—	Filed herewith
101.PRE	Inline XBRL Taxonomy Extension Presentation Linkbase Document.	—	—	—	Filed herewith
104	Cover Page Interactive Data File (formatted as Inline XBRL with applicable taxonomy extension information contained in Exhibits 101)	—	—	—	Filed herewith

* Schedules and exhibits have been omitted pursuant to Item 601(b)(2) of Regulation S-K. The Registrant will furnish copies of any such schedules and exhibits to the SEC upon request.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) 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.

bluebird bio, Inc.

Date: August 4, 2022

By: /s/ Andrew Obenshain

Andrew Obenshain
President, Chief Executive Officer and Director
(Principal Executive Officer and Duly Authorized Officer)

Date: August 4, 2022

By: /s/ Jason Cole

Jason Cole
Chief Strategy & Financial Officer
(Principal Financial Officer, Principal Accounting Officer and Dul Authorized Officer)

Exhibit 10.1

Amendment No. 4

to

Clinical and Commercial Supply Agreement

Viral Vector Product

This Amendment No. 4 to the Clinical and Commercial Supply Agreement-Viral Vector Product (the "Amendment") is made effective as of the date of last signature below, ("Amendment Effective Date") by and between bluebird bio (Switzerland) GmbH ("Company"), and SAFC Carlsbad, Inc., a California corporation ("SAFC"). Company and SAFC may hereinafter be referred to as a Party or as the Parties. Capitalized terms used but not otherwise defined herein shall have the meanings given to such terms in the Agreement.

WHEREAS, Company and SAFC are parties to that certain Clinical and Commercial Supply Agreement- Viral Vector Product, as amended, dated November 27, 2017, and having an Effective Date of January 1, 2018 (the "Agreement");

WHEREAS, the Parties wish to amend, modify, and clarify their respective obligations for performance, manufacture, forecasting, minimum batch requirements, payments, and other related business requirements during the mutually agreed upon Capacity Term (as defined hereinafter); and

WHEREAS, the Parties agree that the intent of this Amendment and the Amendment Effective Date is to extend the Term (as defined in the Agreement, as amended) and the terms and conditions of the Agreement continuously and apply to any and all Services ordered or performed between December 31, 2021 and the Amendment Effective Date.

WHEREAS, the Parties desire to mutually amend, modify, or delete certain terms and conditions of the Agreement as more particularly described herein and in Appendix A entitled Task Order #52.

NOW, THEREFORE, in consideration of the mutual covenants contained herein, and for other good and valuable consideration, the amount and sufficiency of which are hereby acknowledged, the Parties hereby agree as follows:

1. Section 10.1 Term of the Agreement is hereby deleted and replaced in its entirety as follows:

   "10.1 Term. The Term of this Agreement shall commence on the Effective Date and shall expire on December 31, 2022."

2. This Amendment, together with the Agreement, constitutes the final, complete and exclusive agreement between the Parties pertaining to its subject matter and supersedes any and all prior and contemporaneous understandings or agreements of the parties with respect thereto.

3. This Amendment may be executed in counterparts, each of which shall constitute an original, but all of which when taken together shall constitute a single instrument. Delivery of an executed counterpart of a signature page to this Amendment by telecopier or other electronic means (e.g., via PDF) shall be effective delivery of a manually executed counterpart of this Amendment.

4. Except as provided herein, all terms and conditions of the Agreement shall remain the same and are in full force and effect.

IN WITNESS WHEREOF, the Parties hereto have each caused this Amendment to be executed by their duly authorized representatives as of the Amendment Effective Date above.

SAFC CARLSBAD, INC.		**bluebird bio (Switzerland) GmbH**	
By:	/s/ Lisa Freeman-Cook 01-Apr-2022	By:	/s/ Jason Cole 30-Mar-2022
Name:	Lisa Freeman-Cook	Name:	Jason Cole
Title:	Interim Site Head	Title:	Director

Exhibit 10.2

AMENDMENT TO THE TRANSITION SERVICES AGREEMENT

This Amendment to the Transition Services Agreement, effective as of this 28th day of July, 2022 (the "**Amendment Effective Date**"), is between bluebird bio, Inc. a Delaware corporation with a principal address at 455 Grand Union Blvd, Somerville, MA 02145 ("**bluebird**".) and 2seventy bio, Inc., a Delaware corporation with a principal address at 60 Binney St., Cambridge, MA 02142 ("**2seventy**").

WHEREAS, 2seventy and bluebird entered into a Transition Services Agreement dated November 1, 2021 (the "**TSA**");

WHEREAS, the parties desire to amend and restate Service Schedules 9.1, 9.2, 9.3, 9.4 and 9.5.

NOW, THEREFORE, in consideration of the promises and mutual covenants contained herein, the parties hereby agree to modify the TSA as follows:

1. Service Schedules 9.1, 9.2, 9.3, 9.4 and 9.5 shall be amended and restated in its entirety as set forth on Exhibit A attached hereto.

2. Except as specifically amended herein, the TSA will remain in full force and effect. All terms capitalized herein but not otherwise defined shall have the meanings ascribed to such terms in the TSA. This Amendment may be executed in one or more counterparts, each of which will be deemed an original and all of which together will be deemed to be one and the same instrument.

[Signature Page Follows]

In Witness Whereof, the authorized representatives of the parties have executed this Amendment to the Transition Services Agreement as of the Amendment Effective Date.

Acknowledged and Agreed:

bluebird bio, Inc.		**2seventy bio, Inc.**	
By	/s/ Jason Cole	By	/s/ Teresa Jurgensen
Name	Jason Cole	Name	Teresa Jurgensen
Title	Chief Strategy & Financial Officer	Title	SVP, General Counsel

Exhibit 31.1

CERTIFICATIONS

I, Andrew Obenshain, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q of bluebird bio, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer 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 15(d)-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: August 4, 2022

By: /s/ Andrew Obenshain

Andrew Obenshain
President and Chief Executive Officer
(Principal Executive Officer)

Exhibit 31.2

CERTIFICATIONS

I, Jason Cole, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q of bluebird bio, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer 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 15(d)-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: August 4, 2022

By: /s/ Jason Cole

Jason Cole
Chief Strategy & Financial Officer
(Principal Financial Officer, Principal Accounting Officer and Duly Authorized Signer)

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 bluebird bio, Inc. (the "Company") for the period ended June 30, 2022 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), each of the undersigned officers of the Company hereby certifies, pursuant to 18 U.S.C. Section 1350, that to his or her 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.

Date: August 4, 2022

By: /s/ Andrew Obenshain

Andrew Obenshain
President, Chief Executive Officer and Director
(Principal Executive Officer and Duly Authorized Signer)

Date: August 4, 2022

By: /s/ Jason Cole

Jason Cole
Chief Strategy & Financial Officer
(Principal Financial Officer, Principal Accounting Officer and Duly Authorized Signer)