

**UNITED STATES
SECURITIES AND EXCHANGE COMMISSION**

Washington, DC 20549

FORM 10-Q

(Mark One)

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

For the quarterly period ended September 30, 2023

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
(State or Other Jurisdiction of
Incorporation or Organization)

455 Grand Union Boulevard
Somerville, Massachusetts
(Address of Principal Executive Offices)

13-3680878
(IRS Employer
Identification No.)

02145
(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	<input type="checkbox"/>	Accelerated filer	<input type="checkbox"/>
Non-accelerated filer	<input checked="" type="checkbox"/>	Smaller reporting company	<input checked="" type="checkbox"/>
		Emerging growth company	<input type="checkbox"/>

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

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

As of November 3, 2023, there were 109,336,211 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 expectations and projections regarding the sufficiency of our cash, cash equivalents, marketable securities and restricted cash to fund our operations;
- 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, and our plans and expectations regarding our manufacturing activities;
- the timing or likelihood of regulatory filings and marketing approvals for our product candidates and our plans and expectations relating thereto;
- our plans and expectations regarding our commercialization activities for any approved products and the timing or success thereof, including expectations regarding our network of qualified treatment centers;
- 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;
- the scope of protection we are able to establish and maintain for intellectual property rights covering our product candidates and technology;
- estimates of our expenses, future revenues, capital requirements and our needs for additional financing;
- the potential benefits of strategic collaboration agreements and our ability to enter into strategic arrangements;
- our ability to maintain and establish collaborations and licenses;
- developments relating to our competitors and our industry;
- the impact of the general economic conditions and uncertainties, including as a result of the COVID-19 pandemic; 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.

- 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 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 commercial programs, product development efforts or other operations.
 - Among other potential adverse events, insertional oncogenesis is a significant risk of gene therapies using viral vectors that can integrate into the genome. Any such adverse events may require us to halt or delay further clinical development of our product candidates or to suspend or cease commercialization following marketing approval, and the commercial potential of our products and product candidates may be materially and negatively impacted.
 - We rely on complex, single-source supply chains for SKYSONA, ZYNTEGLO, and lovo-cel, respectively. The manufacture, testing 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, or timing needed to support our clinical programs and commercialization.
 - Changes in our manufacturing processes may cause delays in our clinical development and commercialization plans.
 - We cannot predict when or if we will obtain marketing approval to commercialize lovo-cel, and the marketing approval of our product candidates may ultimately be for more narrow indications than we expect. If lovo-cel or other 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.
 - We have limited experience as a commercial company and the marketing and sale of ZYNTEGLO, SKYSONA and of lovo-cel following marketing approval (if and when obtained), may be unsuccessful or less successful than anticipated.
 - The commercial success of ZYNTEGLO, SKYSONA and of lovo-cel following marketing approval (if and when obtained), will depend upon the degree of market acceptance by physicians, patients, payers and other stakeholders.
 - If the market opportunities for our product candidates 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.
 - 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 unique and additional challenges in obtaining adequate pricing and reimbursement for our products. 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.
 - 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 ZYNTEGLO, SKYSONA and lovo-cel.
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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 September 30, 2023	As of December 31, 2022
Assets		
Current assets:		
Cash and cash equivalents	\$ 165,347	\$ 113,006
Marketable securities	8,946	67,321
Accounts receivable	23,000	—
Prepaid expenses	11,431	8,374
Inventory	20,969	—
Other current assets	17,383	10,787
Total current assets	247,076	199,488
Marketable securities	—	1,414
Property, plant and equipment, net	9,972	9,362
Goodwill	5,646	5,646
Intangible assets	5,368	4,868
Operating lease right-of-use assets	294,717	281,996
Restricted cash and other non-current assets	50,829	52,128
Total assets	\$ 613,608	\$ 554,902
Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable	\$ 19,852	\$ 25,092
Deferred revenue	9,653	1,502
Accrued expenses and other current liabilities	57,768	50,483
Operating lease liability, current portion	71,684	51,160
Total current liabilities	158,957	128,237
Operating lease liability, net of current portion	232,023	230,230
Other non-current liabilities	92	92
Total liabilities	391,072	358,559
Commitments and contingencies (Note 9)		
Stockholders' equity:		
Preferred stock, \$0.01 par value, 5,000 shares authorized; 0 shares issued and outstanding at September 30, 2023 and December 31, 2022	—	—
Common stock, \$0.01 par value, 250,000 shares authorized; 107,022 and 82,923 shares issued and outstanding at September 30, 2023 and December 31, 2022, respectively	1,071	830
Additional paid-in capital	4,333,594	4,186,086
Accumulated other comprehensive loss	(2,227)	(4,070)
Accumulated deficit	(4,109,902)	(3,986,503)
Total stockholders' equity	222,536	196,343
Total liabilities and stockholders' equity	\$ 613,608	\$ 554,902

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 September 30,		For the nine months ended September 30,	
	2023	2022	2023	2022
Revenue:				
Product revenue, net	\$ 12,281	\$ —	\$ 21,414	\$ 2,739
Other revenue	111	71	249	795
Total revenues	12,392	71	21,663	3,534
Cost of product revenue	10,955	—	23,895	10,056
Gross margin	1,437	71	(2,232)	(6,522)
Operating expenses:				
Selling, general and administrative	40,703	33,402	118,406	106,201
Research and development	45,463	53,149	133,881	194,864
Restructuring expenses	—	(1,699)	—	4,940
Total operating expenses	86,166	84,852	252,287	306,005
Gain from sale of priority review voucher, net	—	—	92,930	—
Income (loss) from operations	(84,729)	(84,781)	(161,589)	(312,527)
Interest income, net	2,454	383	7,958	663
Other income (expense), net	10,544	7,885	30,152	13,061
Income (loss) before income taxes	(71,731)	(76,513)	(123,479)	(298,803)
Income tax (expense) benefit	—	(7)	80	(7)
Net income (loss)	\$ (71,731)	\$ (76,520)	\$ (123,399)	\$ (298,810)
Net income (loss) per share - basic	\$ (0.66)	\$ (0.94)	\$ (1.15)	\$ (3.91)
Net income (loss) per share - diluted	\$ (0.66)	\$ (0.94)	\$ (1.15)	\$ (3.91)
Weighted-average number of common shares used in computing net income (loss) per share - basic:	109,098	81,543	106,924	76,361
Weighted-average number of common shares used in computing net income (loss) per share - diluted:	109,098	81,543	106,924	76,361
Other comprehensive income (loss):				
Other comprehensive income (loss), net of tax benefit (expense) of \$0.0 million for the three and nine months ended September 30, 2023 and 2022	137	(214)	1,843	(1,719)
Total other comprehensive income (loss)	137	(214)	1,843	(1,719)
Comprehensive income (loss)	\$ (71,594)	\$ (76,734)	\$ (121,556)	\$ (300,529)

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 income (loss)	Accumulated deficit	Total stockholders' equity
	Shares	Amount				
Balances at December 31, 2022	82,923	\$ 830	\$ 4,186,086	\$ (4,070)	\$ (3,986,503)	\$ 196,343
Vesting of restricted stock units	382	3	(198)	—	—	(195)
Exercise of stock options	3	—	7	—	—	7
Purchase of common stock under employee stock purchase plan (ESPP)	62	1	226	—	—	227
Issuance of common stock	23,000	230	130,061	—	—	130,291
Stock-based compensation	—	—	5,843	—	—	5,843
Other comprehensive income (loss)	—	—	—	984	—	984
Net income (loss)	—	—	—	—	21,240	21,240
Balances at March 31, 2023	106,370	\$ 1,064	\$ 4,322,025	\$ (3,086)	\$ (3,965,263)	\$ 354,740
Vesting of restricted stock units	65	\$ 1	\$ (1)	\$ —	\$ —	\$ —
Exercise of stock options	19	—	77	—	—	77
Stock-based compensation	—	—	6,388	—	—	6,388
Other comprehensive income (loss)	—	—	—	722	—	722
Net income (loss)	—	—	—	—	(72,908)	(72,908)
Balances at June 30, 2023	106,454	\$ 1,065	\$ 4,328,489	\$ (2,364)	\$ (4,038,171)	\$ 289,019
Vesting of restricted stock units	566	\$ 6	\$ (6)	\$ —	\$ —	\$ —
Exercise of stock options	2	—	8	—	—	8
Issuance of common stock	—	—	(50)	—	—	(50)
Stock-based compensation	—	—	5,153	—	—	5,153
Other comprehensive income (loss)	—	—	—	137	—	137
Net loss	—	—	—	—	(71,731)	(71,731)
Balances at September 30, 2023	107,022	\$ 1,071	\$ 4,333,594	\$ (2,227)	\$ (4,109,902)	\$ 222,536

	Common stock		Additional paid-in capital	Accumulated other comprehensive income (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 common stock awards to settle accrued employee compensation	12	—	—	—	—	—
Other comprehensive income (loss)	—	—	—	(1,548)	—	(1,548)
Net income (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 (loss)	—	—	—	43	—	43
Net income (loss)	—	—	—	—	(100,138)	(100,138)
Balances at June 30, 2022	73,551	\$ 735	\$ 4,126,012	\$ (4,416)	\$ (3,942,215)	\$ 180,116
Vesting of restricted stock units	572	6	(6)	—	—	—
Purchase of common stock under ESPP	67	1	238	—	—	239
Issuance of common stock	8,690	87	45,937	—	—	46,024
Stock-based compensation	—	—	9,212	—	—	9,212
Other comprehensive loss	—	—	—	(214)	—	(214)
Net loss	—	—	—	—	(76,520)	(76,520)
Balances at September 30, 2022	82,880	\$ 829	\$ 4,181,393	\$ (4,630)	\$ (4,018,735)	\$ 158,857

See accompanying notes to unaudited condensed consolidated financial statements.

bluebird bio, Inc.

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

	For the nine months ended September 30,	
	2023	2022
Cash flows from operating activities:		
Net income (loss)	\$ (123,399)	\$ (298,810)
Adjustments to reconcile net income (loss) to net cash used in operating activities:		
Depreciation and amortization	3,124	3,745
Stock-based compensation expense	16,013	30,509
Gain from sale of priority review voucher	(92,930)	—
Loss (gain) on equity securities	—	3,135
Excess inventory reserve	5,333	7,519
Other non-cash items	19	2,890
Changes in operating assets and liabilities:		
Accounts receivable	(23,000)	—
Prepaid expenses and other assets	(523)	(6,197)
Inventory	(24,931)	—
Operating lease right-of-use assets	40,101	29,650
Accounts payable	(5,787)	(7,552)
Accrued expenses and other liabilities	7,125	(39,046)
Operating lease liabilities	(30,506)	(22,523)
Deferred revenue	8,152	—
Net cash used in operating activities	(221,209)	(296,680)
Cash flows from investing activities:		
Purchase of property, plant and equipment	(2,975)	(8,100)
Purchases of marketable securities	(43,297)	—
Proceeds from maturities of marketable securities	99,521	125,095
Proceeds from sales of marketable securities	5,853	30,216
Purchase of intangible assets	(868)	—
Proceeds from sale of priority review voucher	92,930	—
Net cash provided by investing activities	151,164	147,211
Cash flows from financing activities:		
Proceeds from exercise of stock options and ESPP contributions	93	3
Proceeds from vesting of restricted stock	(196)	—
Proceeds from the secondary public offering, net of issuance costs	130,072	54,365
Net cash provided by financing activities	129,969	54,368
(Decrease) increase in cash, cash equivalents and restricted cash	59,924	(95,101)
Cash, cash equivalents and restricted cash at beginning of period	158,445	206,693
Cash, cash equivalents and restricted cash at end of period	\$ 218,369	\$ 111,592
Reconciliation of cash, cash equivalents and restricted cash:		
Cash and cash equivalents	\$ 165,347	\$ 66,478
Restricted cash included in other current assets	8,885	1,565
Restricted cash included in restricted cash and other non-current assets	44,137	43,549
Total cash, cash equivalents and restricted cash	\$ 218,369	\$ 111,592
Supplemental cash flow disclosures from investing and financing activities:		
Purchases of property, plant and equipment included in accounts payable and accrued expenses	941	176
Offering expenses accrued or in accounts payable	248	298
Right-of-use assets obtained in exchange for operating lease liabilities	44,819	229,636
Increase (Reduction) of right of use asset and associated lease liability due to lease reassessment	8,003	(2,833)
Cash paid during the period for income taxes	5	—

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 Somerville, Massachusetts. The Company is a biotechnology company committed to researching, developing, and commercializing potentially curative transformative gene therapies for severe genetic diseases based on our lentiviral vector (“LVV”) gene addition platform. In 2022, following more than a decade of leadership in research and clinical development, the Company received approval from the U.S. Food and Drug Administration (the “FDA”) for two gene therapies, both of which were recently launched.

On August 17, 2022, ZYNTGLO (betibeglogene autotemcel, also known as beti-cel), was approved by the FDA for the treatment of adult and pediatric patients with β -thalassemia who require regular red blood cell transfusions. On September 16, 2022, the FDA granted Accelerated Approval of SKYSONA (elivaldogene autotemcel, also known as eli-cel), to slow the progression of neurologic dysfunction in boys 4-17 years of age with early active cerebral adrenoleukodystrophy (“CALD”). On June 21, 2023, the Company announced that the FDA had accepted for priority review the Company's biologics licensing application (“BLA”) for its third gene therapy candidate (lovotibeglogene autotemcel, also known as lovo-cel) which was submitted with a proposed indication for the treatment of patients 12 and older with sickle cell disease (“SCD”) with a history of vaso-occlusive-events. The FDA set a Prescription Drug User Fee Act (PDUFA) goal date for lovo-cel of December 20, 2023 and if approved, the Company anticipates commercial launch in early 2024.

The Company is focusing its development and commercialization efforts in the U.S. market. The Company has obtained the withdrawal of the marketing authorization for beti-cel in the European Union, which became effective on March 24, 2022. On November 18, 2021, the Company obtained the withdrawal of the marketing authorization for eli-cel in the European Union. The Company withdrew its marketing applications for beti-cel and eli-cel from the MHRA in the United Kingdom. The Company is 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.

Since its inception in 1992, the Company has devoted substantially all of its resources to its development and commercialization efforts relating to its products and product candidates, including activities to manufacture product candidates in compliance with good manufacturing practices (“GMP”) to conduct clinical studies of its product candidates, to provide selling, general and administrative support for these operations, to market, commercially manufacture and distribute its approved products and to protect its intellectual property. The Company has not generated material revenue from product sales. The Company has funded its operations primarily through the sale of common stock in its public offerings, private placements of preferred stock and warrants, the sale of two Rare Pediatric Disease Priority Review Vouchers (“PRVs”) and through collaborations.

In August 2022 and September 2022 the Company received the two PRVs under an FDA program intended to encourage the development of treatments for rare pediatric diseases. In the first quarter of 2023, the Company sold its second PRV for aggregate net proceeds of \$92.9 million. In October 2023, the Company entered into an advance agreement to sell a third PRV, if granted in connection with the potential approval of lovo-cel, for \$103.0 million.

In the first quarter of 2023, the Company sold 23.0 million shares of common stock (inclusive of shares sold pursuant to an option to the underwriters in connection with the offering) through an underwritten public offering at a price of \$6.00 per share for aggregate net proceeds of \$130.5 million.

In April 2022, the board of directors of the Company (the “Board of Directors”) approved a comprehensive restructuring plan intended to reduce operating expenses and enhance the Company’s focus on achieving FDA approval for its programs in the U.S. As part of the restructuring, the Company reduced its workforce by approximately 30% across the second and third quarters of 2022. Refer to Note 14, *Restructuring*, for more information on this restructuring.

In accordance with Accounting Standards Codification (“ASC”) 205-40, Going Concern, the Company has evaluated whether there are conditions and events, considered in the aggregate, that raise substantial doubt about the Company’s ability to continue as a going concern within one year after the date that these consolidated financial statements are issued. As of September 30, 2023, the Company had an accumulated deficit of \$4.11 billion. During the nine months ended September 30,

2023, the Company had a net loss of \$123.4 million and used \$221.2 million of cash in operations. As of September 30, 2023, the Company had cash, cash equivalents and marketable securities of \$174.3 million.

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 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 and the release of restricted cash related to the Company's 50 Binney Street sublease 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 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 consolidated financial statements are issued. Management's plans to alleviate the conditions that raise substantial doubt include evaluating 2023 spending 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. Accordingly, 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 consolidated financial statements.

The Company will assess on a quarterly basis whether the determination for estimates remain appropriate based on actual data observed. However, the Company has based this estimate on assumptions that may prove to be wrong, and its operating plan may change as a result of many factors currently unknown to it. As a result, the Company could deplete its capital resources sooner than it currently expects. The Company expects to finance its future cash needs through the issuance of equity, or debt, or other alternative means. If the Company is unable to obtain funding on a timely basis, or if revenues from collaboration arrangements or product sales are less than it has projected, the Company may be required to further revise its business plan and strategy, which may result in the Company significantly curtailing, delaying or discontinuing one or more of its research or development programs or the commercialization of any product candidates or may result in the Company being unable to expand its operations or otherwise capitalize on its business opportunities. As a result, the Company's business, financial condition and results of operations could be materially affected.

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 September 30, 2023 and 2022.

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, 2022, and the notes thereto, which are included in the

Company's Annual Report on Form 10-K for the fiscal year ended December 31, 2022, filed with the Securities and Exchange Commission (the "SEC") on March 29, 2023 (the "2022 Annual Report on Form 10-K").

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. All intercompany balances and transactions have been eliminated in consolidation. The Company views its operations and manages its business in one operating segment.

Significant accounting policies

The significant accounting policies used in preparation of these condensed consolidated financial statements for the three and nine months ended September 30, 2023 are consistent with those discussed in Note 2 to the consolidated financial statements included in the Company's 2022 Annual Report on Form 10-K.

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, gross to net revenue reserves, inventory reserved, 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.

Inventory

Inventories are stated at the lower of cost or net realizable value under the first-expired, first-out ("FEFO") methodology. Given human gene therapy products are a new and novel category of therapeutics and future economic benefit is not probable until regulatory approval for the product has been obtained, the Company has only considered inventory for capitalization upon and after regulatory approval. Manufacturing costs incurred prior to regulatory approval for pre-launch inventory that did not qualify for capitalization and clinical manufacturing costs were charged to research and development expense in the Company's consolidated statements of operations and comprehensive loss as costs were incurred. Additionally, inventory that initially qualifies for capitalization but that may ultimately be used for the production of clinical drug product is expensed as research and development expense when it has been designated for the manufacture of clinical drug product.

Inventory consists of cell banks, plasmids, LVV, other materials and compounds sourced from third party suppliers and utilized in the manufacturing process, and drug product, which has been produced for the treatment of specific patients, that are owned by the Company.

Management periodically reviews inventories for excess or obsolescence, considering factors such as sales forecasts compared to quantities on hand and firm purchase commitments as well as remaining shelf life of on hand inventories. The Company writes-down its inventory that is obsolete or otherwise unmarketable to its estimated net realizable value in the period in which the impairment is first identified. Any such adjustments are included as a component of cost of goods sold within cost of product revenue on the Company's consolidated statements of operations and comprehensive loss.

Revenue recognition

Under ASC Topic 606, *Revenue from Contracts with Customers* ("Topic 606"), an entity recognizes revenue when its customer obtains control of promised goods or services, in an amount that reflects the consideration that the entity expects to receive in exchange for those goods or services. To determine revenue recognition for arrangements that an entity determines

are within the scope of Topic 606, the entity performs the following five steps: (i) identify the contract(s) with a customer; (ii) identify the performance obligations in the contract; (iii) determine the transaction price, including variable consideration, if any; (iv) allocate the transaction price to the performance obligations in the contract; and (v) recognize revenue when (or as) the entity satisfies a performance obligation. The Company only applies the five-step model to contracts when it is probable that the entity will collect the consideration to which it is entitled in exchange for the goods or services it transfers to the customer.

Once a contract is determined to be within the scope of Topic 606, the Company assesses the goods or services promised within each contract and determines those that are performance obligations. Arrangements that include rights to additional goods or services that are exercisable at a customer's discretion are generally considered options. The Company assesses if these options provide a material right to the customer and if so, they are considered performance obligations.

The Company assesses whether each promised good or service is distinct for the purpose of identifying the performance obligations in the contract. This assessment involves subjective determinations and requires management to make judgments about the individual promised goods or services and whether such are separable from the other aspects of the contractual relationship. Promised goods and services are considered distinct provided that: (i) the customer can benefit from the good or service either on its own or together with other resources that are readily available to the customer (that is, the good or service is capable of being distinct) and (ii) the entity's promise to transfer the good or service to the customer is separately identifiable from other promises in the contract (that is, the promise to transfer the good or service is distinct within the context of the contract).

The transaction price is then determined and allocated to the identified performance obligations in proportion to their standalone selling prices ("SSP") on a relative SSP basis. SSP is determined at contract inception and is not updated to reflect changes between contract inception and when the performance obligations are satisfied.

If the consideration promised in a contract includes a variable amount, the Company estimates the amount of consideration to which it will be entitled in exchange for transferring the promised goods or services to a customer. The Company determines the amount of variable consideration by using the expected value method or the most likely amount method. The Company includes the unconstrained amount of estimated variable consideration in the transaction price. The amount included in the transaction price is constrained to the amount for which it is probable that a significant reversal of cumulative revenue recognized will not occur. At the end of each subsequent reporting period, the Company re-evaluates the estimated variable consideration included in the transaction price and any related constraint, and if necessary, adjusts its estimate of the overall transaction price. Any such adjustments are recorded on a cumulative catch-up basis in the period of adjustment.

If a license arrangement includes development and regulatory milestone payments, the Company evaluates whether the milestones are considered probable of being reached and estimates the amount to be included in the transaction price using the most likely amount method. If it is probable that a significant revenue reversal would not occur, the associated milestone value is included in the transaction price. Milestone payments that are not within the Company's control or the licensee's control, such as regulatory approvals, are generally not considered probable of being achieved until those approvals are received.

In determining the transaction price, the Company adjusts consideration for the effects of the time value of money if the timing of payments provides the Company with a significant benefit of financing. The Company does not assess whether a contract has a significant financing component if the expectation at contract inception is such that the period between payment by the licensees and the transfer of the promised goods or services to the licensees will be one year or less. The Company has assessed each of its revenue generating arrangements in order to determine whether a significant financing component exists and concluded that a significant financing component does not exist in any of its arrangements.

The Company then recognizes as revenue the amount of the transaction price that is allocated to the respective performance obligation when (or as) each performance obligation is satisfied, at a point in time.

The Company recognizes revenue within the following financial statement captions:

Product revenue, net

The Company recognizes product revenue, net in accordance with Topic 606. Product revenue, net represents sales of ZYNTEGLO and SKYSONA.

In 2022, the Company received approval of ZYNTEGLO and SKYSONA from the FDA. The amount of revenue recognized by the Company is equal to the amount of consideration that is expected to be received from the sale of product to its customers. The Company has Specialty Distributors ("SD") and Specialty Pharmacies ("SP") that deliver product to the

Qualified Treatment Centers ("QTC"). Revenue is only recognized when the performance obligation is satisfied. The Company recognizes revenue upon infusion to the patient. To determine whether a significant reversal will occur in future periods, the Company assesses both the likelihood and magnitude of any such potential reversal of revenue.

Other revenue

In 2021, the Company entered into a grant agreement with the Bill and Melinda Gates Foundation. The Company recognizes grant revenue in accordance with ASC 958-605, *Revenue Recognition Not-for-Profit Entities*, when qualifying costs are incurred and barriers to restriction have been overcome. When grant funds are received after costs have been incurred, the Company records revenue and a corresponding grant receivable. Cash received from grants in advance of incurring qualifying costs is recorded as deferred revenue and recognized as revenue when qualifying costs are incurred. In 2023, the Company ceased further research work and is in the process of winding down such collaboration.

Recent accounting pronouncements

During the periods presented, the Company was not required to adopt any recently issued accounting standards. The Company does not expect any recently issued accounting standards to have a material impact on its financial statements.

3. Marketable securities

The following table summarizes the marketable securities held at September 30, 2023 and December 31, 2022 (in thousands):

Description	Amortized cost / Cost	Unrealized gains	Unrealized losses	Fair value
September 30, 2023				
U.S. government agency securities and treasuries	8,949	—	(3)	8,946
Total	<u>\$ 8,949</u>	<u>\$ —</u>	<u>\$ (3)</u>	<u>\$ 8,946</u>
December 31, 2022				
U.S. government agency securities and treasuries	\$ 67,970	\$ —	\$ (1,733)	\$ 66,237
Corporate bonds	2,524	—	(26)	2,498
Total	<u>\$ 70,494</u>	<u>\$ —</u>	<u>\$ (1,759)</u>	<u>\$ 68,735</u>

No available-for-sale debt securities held as of September 30, 2023 or December 31, 2022 had remaining maturities greater than one year.

4. 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 September 30, 2023 and December 31, 2022 (in thousands):

Description	Total	Quoted prices in active markets (Level 1)	Significant other observable inputs (Level 2)	Significant unobservable inputs (Level 3)
September 30, 2023				
Assets:				
Cash and cash equivalents	\$ 165,347	\$ 165,347	\$ —	\$ —
Marketable securities:				
U.S. government agency securities and treasuries	8,946	—	8,946	—
Total	\$ 174,293	\$ 165,347	\$ 8,946	\$ —
December 31, 2022				
Assets:				
Cash and cash equivalents	\$ 113,006	\$ 113,006	\$ —	\$ —
Marketable securities:				
U.S. government agency securities and treasuries	66,237	—	66,237	—
Corporate bonds	2,498	—	2,498	—
Total	\$ 181,741	\$ 113,006	\$ 68,735	\$ —

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 September 30, 2023 and December 31, 2022, cash and cash equivalents comprise funds in cash and money market accounts held at multiple banking and asset management institutions.

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 September 30, 2023 and December 31, 2022, 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 realized losses recognized on the sale or maturity of available-for-sale debt securities during the three months ended September 30, 2023 and 2022. There were \$0.1 million and no realized losses recognized on the sale or maturity of available-for-sale debt securities during the nine months ended September 30, 2023 and 2022, respectively.

Accrued interest receivable on the Company's available-for-sale debt securities totaled \$0.3 million and \$0.1 million as of September 30, 2023 and December 31, 2022, respectively. No accrued interest receivable was written off during the three and nine months ended September 30, 2023 or 2022.

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 September 30, 2023 and December 31, 2022 (in thousands):

Description	Less than 12 months		12 months or greater		Total	
	Fair value	Unrealized losses	Fair value	Unrealized losses	Fair value	Unrealized losses
September 30, 2023						
U.S. government agency securities and treasuries	\$ 8,946	\$ (3)	\$ —	\$ —	\$ 8,946	\$ (3)
Total	\$ 8,946	\$ (3)	\$ —	\$ —	\$ 8,946	\$ (3)
December 31, 2022						
U.S. government agency securities and treasuries	\$ —	\$ —	\$ 66,237	\$ (1,733)	\$ 66,237	\$ (1,733)
Corporate bonds	—	—	2,498	(26)	2,498	(26)
Total	\$ —	\$ —	\$ 68,735	\$ (1,759)	\$ 68,735	\$ (1,759)

The Company determined that there was no material change in the credit risk of the above investments during the nine months ended September 30, 2023. As such, an allowance for credit losses was not recognized.

5. Inventory

Inventory, net, consists of the following (in thousands):

	As of September 30, 2023	As of December 31, 2022
Raw materials	\$ 7,392	\$ —
Work in progress	9,725	—
Finished goods	3,852	—
Inventory	\$ 20,969	\$ —

Raw materials inventory consists of completed materials meeting quality acceptance standards to be used in the manufacture of drug product. Materials may include small molecules, plasmids, or vector products. Work in progress inventory consists of materials that are either partially completed or fully manufactured but are pending quality acceptance. Finished goods are completed drug product having full quality acceptance that may be shipped to a qualified treatment center, but has not yet been infused in the patient.

As of December 31, 2022, the Company did not have any manufactured inventory that was in progress or had received final quality acceptance after the FDA approval of ZYNTEGLO or SKYSONA. Prior to FDA approval, the existing inventory was expensed to research and development expense.

6. Property, plant and equipment, net

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

	As of September 30, 2023	As of December 31, 2022
Laboratory equipment	\$ 18,591	\$ 25,092
Computer equipment and software	2,267	1,854
Office equipment	4,646	4,348
Leasehold improvements	1,140	—
Construction-in-progress	410	—
Total property, plant and equipment	27,054	31,294
Less accumulated depreciation and amortization	(17,082)	(21,932)
Property, plant and equipment, net	\$ 9,972	\$ 9,362

7. Accrued expenses and other current liabilities

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

	As of September 30, 2023	As of December 31, 2022
Accrued manufacturing costs	\$ 6,183	\$ 7,199
Accrued goods and services	7,709	8,134
Accrued clinical and contract research organization costs	13,689	12,368
Accrued employee compensation	19,442	20,095
Accrued professional fees	2,748	1,939
Other	7,997	748
Total accrued expenses and other current liabilities	\$ 57,768	\$ 50,483

8. Leases

The Company leases certain office and laboratory space, primarily located in 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 8 to the consolidated financial statements included in the Company's 2022 Annual Report on Form 10-K.

60 Binney Street lease & sublease

In August 2023, the Company completed the construction of its new office and laboratory space and terminated the 60 Binney Street sublease. On the termination date the remaining right-of-use asset and lease liability were removed.

Embedded operating leases

In September 2023, the Company entered into a second amendment to the June 2016 commercial manufacturing agreement with Lonza Houston, Inc. to manufacture gene therapies ZYNTEGLO and SKYSONA. Pursuant to the amendment, both parties agreed to increased manufacturing capacity, a revised fee schedule and modified payment terms on invoices. The revised fee schedule replaced the fixed suite fee with manufacturing slot fees.

The amended contract terms continue to provide exclusive use during the term of the agreement and the classification of the lease remained accounted for as an operating lease. The Company determined that the amendment should be accounted for as a lease modification applicable under ASC 842, not as a separate contract. For contract manufacturing arrangements, the Company has elected to account for lease and non-lease components separately. At the effective date of modification, the Company recorded an increase to the right-of-use asset and lease liability in the amount of \$6.5 million.

In connection with the modified payment terms, the Company is required to post a letter of credit in the amount of \$6.9 million for the benefit of the manufacturer, subject to gradual decreases upon payment of invoices. The letter of credit has been secured by cash and is presented as restricted cash and other current assets.

In December 2022, the Company entered into an agreement reserving manufacturing capacity with a contract manufacturing organization. The Company concluded that this agreement contains an embedded operating lease as the Company is using the entire capacity of a manufacturing suite at the facility. Under the terms of the agreement, the Company will be required to pay suite fees of \$13.5 million in 2023 and \$18.0 million per year in 2024 and 2025, in addition to the cost of any services provided. The term of the agreement is three years. The Company recorded a right-of-use asset and lease liability for this operating lease upon lease commencement in April 2023 and is recognizing rent expense on a straight-line basis throughout the remaining term of the embedded lease.

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.

The 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 2022 Annual Report on Form 10-K, the Company's future minimum purchase commitments as of the nine months ended September 30, 2023 decreased by \$0.6 million.

The Company is, and may become, party to various claims and complaints arising in the ordinary course of business, including securities class action and intellectual property 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 January 18, 2023, the Company entered into an underwriting agreement (the "Underwriting Agreement") with Goldman Sachs & Co. LLC and J.P. Morgan Securities LLC in connection with the public offering, issuance and sale by the Company of 20.0 million shares of the Company's common stock, \$0.01 par value per share, at a public offering price of \$6.00 per share, less underwriting discounts and commissions. Under the terms of the Underwriting Agreement, the Company also granted the underwriters an option exercisable for 30 days to purchase up to an additional 3.0 million shares of Common Stock at the public offering price, less underwriting discounts and commissions, which the underwriters exercised in full. The offering closed on January 23, 2023.

For the nine months ended September 30, 2023, the Company sold 23.0 million shares of common stock for gross proceeds of \$138.0 million (\$130.5 million net of offering costs), pursuant to the Underwriting Agreement.

11. Stock-based compensation

In January 2023 and 2022, the number of shares of common stock available for issuance under the 2013 Stock Option and Incentive Plan ("2013 Plan") was increased by approximately 3.3 million and 2.8 million shares, respectively, as a result of the automatic increase provision of the 2013 Plan. On June 16, 2023, the Company's stockholders approved the 2023 Incentive Award Plan (the "2023 Plan"), which replaced the 2013 Plan. Following approval of the 2023 Plan, no further awards will be granted under the 2013 Plan. As of September 30, 2023, the total number of shares of common stock available for issuance under the 2023 Plan was approximately 4.8 million.

Stock-based compensation expense

The Company recognized stock-based compensation expense totaling \$4.9 million and \$9.2 million during the three months ended September 30, 2023 and 2022, respectively. The Company recognized stock-based compensation expense totaling \$16.0 million and \$30.5 million for the nine months ended September 30, 2023 and 2022, respectively. Stock-based compensation expense recognized by award type is included within the condensed consolidated statements of operations and comprehensive loss as follows (in thousands):

	For the three months ended September 30,		For the nine months ended September 30,	
	2023	2022	2023	2022
Stock options	\$ 1,758	\$ 2,886	\$ 5,192	\$ 11,800
Restricted stock units	2,916	6,142	10,552	18,000
Employee stock purchase plan and other	194	184	269	600
	<u>\$ 4,868</u>	<u>\$ 9,212</u>	<u>\$ 16,013</u>	<u>\$ 30,500</u>

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 September 30,		For the nine months ended September 30,	
	2023	2022	2023	2022
Cost of product revenue	342	—	435	—
Selling, general and administrative	2,461	3,975	7,503	13,462
Research and development	2,065	5,237	8,075	17,047
	<u>\$ 4,868</u>	<u>\$ 9,212</u>	<u>\$ 16,013</u>	<u>\$ 30,509</u>

During the nine months ended September 30, 2023, the Company had \$1.4 million of stock compensation expense that was capitalized into inventory.

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 November 2021 separation of our severe genetic disease and oncology programs into two separate, publicly traded companies:

	Shares (in thousands)	Weighted- average exercise price per share
Outstanding at December 31, 2022	2,668	\$ 24.38
Granted	2,015	\$ 4.95
Exercised	(3)	\$ 2.74
Canceled, forfeited, or expired	(453)	\$ 31.39
Outstanding at September 30, 2023	<u>4,227</u>	<u>\$ 14.35</u>
Exercisable at September 30, 2023	<u>1,347</u>	<u>\$ 30.52</u>
Vested and expected to vest at September 30, 2023	<u>4,227</u>	<u>\$ 14.35</u>

During the nine months ended September 30, 2023, 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 November 2021 separation of our severe genetic disease and oncology programs into two separate, publicly traded companies:

	Shares (in thousands)	Weighted- average grant date fair value
Unvested at December 31, 2022	2,415	\$ 11.4
Granted	3,117	\$ 4.9
Vested	(987)	\$ 14.7
Forfeited	(395)	\$ 8.5
Unvested at September 30, 2023	<u>4,150</u>	<u>\$ 6.3</u>

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 nine months ended September 30, 2023 and 2022, less than 0.1 million 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 benefit recognized during the three and nine months ended September 30, 2023 was \$0.0 million and \$0.1 million, respectively, due to the wind down of our operations in Europe and the full valuation allowance.

On August 16, 2022, the Inflation Reduction Act ("IRA") was enacted and introduced a 15% corporate alternative minimum tax ("CAMT"), effective for tax years beginning after December 31, 2022, for corporations with average annual adjusted financial statement income for any consecutive three-year tax period ending after December 31, 2021 and preceding the tax year that exceeds \$1 billion, as well as a 1% excise tax on stock repurchases made by public companies. The Company has concluded that the provisions in the IRA 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 months ended September 30,	
	2023	2022
Outstanding stock options	5,875	4,548
Restricted stock units	4,194	2,473
ESPP shares and other	—	67
	<u>10,069</u>	<u>7,088</u>

14. Restructuring

In April 2022, the Board of Directors approved a comprehensive restructuring plan intended to reduce operating expenses. As part of the restructuring, the Company reduced its workforce by nearly 30% across the second and third quarters of 2022. The Company incurred approximately \$4.9 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 were completed by September 30, 2022.

15. Subsequent events

Pre-funded warrants

On October 18, 2023, the Company received exercise notifications for all pre-funded warrants issued in September 2021. The exercises were done as a cashless exercise and resulted in the issuance of 2,264,916 common shares.

Sale of priority review voucher

On October 30, 2023, the Company announced that it had entered into an advance agreement to sell a third PRV, if granted, in connection with the potential approval of lovo-cel, for \$103.0 million. Closing of the transaction remains subject to the approval of lovo-cel and receipt of a PRV, as well as customary closing conditions.

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, 2022, which was filed with the Securities and Exchange Commission, or the SEC, on March 29, 2023 (the "2022 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 on Form 10-Q. 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 on Form 10-Q, 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 curative transformative gene therapies for severe genetic diseases based on our lentiviral vector ("LVV") gene addition platform. In 2022, following more than a decade of leadership in research and clinical development, we received approval from the U.S. Food and Drug Administration (the "FDA") for two gene therapies, both of which were recently launched.

On August 17, 2022, ZYNTÉGLO (betibeglogene autotemcel, also known as beti-cel), was approved by the FDA for the treatment of adult and pediatric patients with β -thalassemia who require regular red blood cell transfusions. On September 16, 2022, the FDA granted Accelerated Approval of SKYSONA (elivaldogene autotemcel, also known as eli-cel), to slow the progression of neurologic dysfunction in boys 4-17 years of age with early active cerebral adrenoleukodystrophy ("CALD"). On June 21, 2023, we announced that the FDA had accepted for priority review our biologics licensing application ("BLA") for our third gene therapy candidate (lovotibeglogene autotemcel, also known as lovo-cel) which was submitted with a proposed indication for the treatment of patients 12 and older with sickle cell disease ("SCD") with a history of vaso-occlusive-events. The FDA set a Prescription Drug User Fee Act (PDUFA) goal date for lovo-cel of December 20, 2023 and if approved, we anticipate commercial launch in early 2024.

We are focusing our development and commercialization efforts in the U.S. market. We have obtained the withdrawal of the marketing authorization for beti-cel in the European Union, which became effective on March 24, 2022. On November 18, 2021, we obtained the withdrawal of the marketing authorization for eli-cel in the European Union. We withdrew our marketing applications for beti-cel and eli-cel from the MHRA in the United Kingdom. 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.

Since our inception in 1992, we have devoted substantially all of our resources to our development and commercialization efforts relating to our products and product candidates, including activities to manufacture product candidates in compliance with good manufacturing practices ("GMP") to conduct clinical studies of our product candidates, to provide selling, general and administrative support for these operations, to market, commercially manufacture and distribute our approved products 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, the sale of two Rare Pediatric Disease Priority Review Vouchers ("PRVs") and through collaborations.

In August 2022 and September 2022 we received the two PRVs under an FDA program intended to encourage the development of treatments for rare pediatric diseases. In the first quarter of 2023, we sold our second PRV for aggregate net proceeds of \$92.9 million, inclusive of additional legal costs incurred. In October 2023, we entered into an advance agreement to sell a third PRV, if granted, in connection with the potential approval of lovo-cel, for \$103.0 million.

In the first quarter of 2023, we sold 23.0 million shares of common stock (inclusive of shares sold pursuant to an option to the underwriters in connection with the offering) through an underwritten public offering at a price of \$6.00 per share for aggregate net proceeds of \$130.5 million, inclusive of additional offering costs incurred.

In April 2022, we initiated a comprehensive restructuring plan intended to reduce operating expenses. As part of the restructuring, we reduced our workforce by approximately 30% in the second and third quarters of 2022. See Note 14, Restructuring, to our consolidated financial statements appearing elsewhere in this Quarterly Report on Form 10-Q for more information on this restructuring plan.

As of September 30, 2023, we had cash, cash equivalents and marketable securities of approximately \$174.3 million. Absent the sale of our PRVs, we have never been profitable and have incurred net losses in each year since inception. Our net loss was \$71.7 million and \$123.4 million for the three and nine months ended September 30, 2023, respectively, and our accumulated deficit was \$4.11 billion as of September 30, 2023. 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 commercial launches of ZYNTEGLO and SKYSONA in the United States;
- seek regulatory approval for lovo-cel and any other product candidates;
- scale our manufacturing capabilities in support of commercialization of ZYNTEGLO and SKYSONA and lovo-cel, if approved;
- conduct clinical studies; and
- increase research and development-related activities for 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. We may not be able to generate substantial revenue from the sale of our products, and 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. Until we generate significant revenues from product sales, if ever, we expect to continue to seek to fund our operations through public or private equity or debt financings, strategic collaborations, or other sources. However, we may be unable to raise additional funds or enter into such other arrangements when needed on favorable terms or at all. Our failure to raise capital or enter into such other arrangements as and when needed would have a negative impact on our financial condition and our ability to develop our product candidates.

Business update

We had cash, cash equivalents and marketable securities of approximately \$174.3 million as of September 30, 2023. Our expectation is that we will continue to generate operating losses and negative operating cash flows in the foreseeable future as we commercialize ZYNTEGLO and SKYSONA and lovo-cel, if approved, and seek regulatory approval of lovo-cel for SCD and will require the need for additional funding to support our planned operations before becoming profitable.

Based on our current business plan, management has concluded that there is substantial doubt regarding our ability to continue as a going concern, and we anticipate our cash, cash equivalents, and marketable securities as of September 30, 2023, including anticipated cash flows from operations, will be sufficient to fund our operations into the second quarter of 2024. We have based this estimate on assumptions of revenues and operating costs that may prove to be wrong. Our cash runway estimate does not include use of our restricted cash of \$53.0 million, which is currently unavailable for use, and we believe at least

\$45.4 million of this restricted cash is unlikely to be released in the near term. Furthermore, pursuant to the terms of certain agreements we have in place, we could be required to further increase our restricted cash due, in part, to recent concerns related to the stability of the banking sector, which would consequently reduce the amount of cash available to fund our operations. In addition, our future net product revenues will depend upon the size of the markets, our ability to obtain regulatory approval of lovo-cel for SCD, our ability to timely scale our manufacturing capabilities to meet market demand, our ability to achieve sufficient market acceptance, reimbursement from third-party payers, adequate market share in those markets and the performance of drug product subject to outcome-based programs. As a result, we could deplete our capital resources sooner than we currently expect. If, for any reason, our revenues or our expenses differ materially from our assumptions or we utilize our cash more quickly than anticipated, or if we are unable to obtain funding on a timely basis, we may be required to revise our business plan and strategy, which may result in bluebird significantly curtailing, delaying or discontinuing one or more of our research or development programs or the commercialization of any products or may result in bluebird 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.

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.

Financial operations overview

Product revenue, net

Our revenues have primarily been derived from product revenues associated with the sale of SKYSONA and ZYNTEGLO in the United States.

Other revenue

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

Cost of product revenue

Cost of product revenue includes costs associated with the sale of SKYSONA and ZYNTEGLO in the United States.

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. These expenses include lease expense related to 50 Binney Street; however, sublease income is presented in other income (expense), net.

We anticipate that our selling, general and administrative expenses, including payroll and sales and marketing expenses, will continue to increase in the future relative to current levels as we continue commercialization activities for ZYNTEGLO and SKYSONA in the United States and perform commercial readiness activities in the United States for lovo-cel, in anticipation of potential approval.

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 contract research organizations ("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; and

- costs associated with our regulatory, quality assurance and quality control operations.

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 to what extent we will generate revenues from the commercialization and sale of our approved products and 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 lovo-cel, and conduct research activities for our platform technology. Absent new initiatives, we expect our research and development expenses to decrease in conjunction with an increase in commercial activities and selling, general and administrative expense due to the approvals of ZYNTEGLO and SKYSONA and the performance of commercial readiness activities for lovo-cel in anticipation of potential approval. Our research and development expenses include expenses associated with the following activities:

- the long-term follow-up protocol associated with the clinical studies of ZYNTEGLO, and a postmarketing study for the same;
- the long-term follow-up protocol associated with the clinical studies of SKYSONA, and a postmarketing study for the same;
- the clinical studies of lovo-cel, consisting of HGB-206, HGB-210 study, and the associated long-term follow-up protocol;
- research and development activities for our platform technology; and
- 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		For the	
	three months ended September 30,		nine months ended September 30,	
	2023	2022	2023	2022
	(in thousands)		(in thousands)	
ZYNTEGLO (beti-cel)	\$ 2,627	\$ 8,307	\$ 8,678	\$ 35,366
lovo-cel (formerly LentiGlobin for SCD)	19,282	17,396	58,189	59,950
SKYSONA (eli-cel)	3,123	4,909	10,863	24,872
Preclinical programs	373	778	889	6,732
Total direct research and development expense	25,405	31,390	78,619	126,920
Employee-and contractor-related expenses	8,003	5,404	22,201	22,512
Stock-based compensation expense	2,284	5,237	8,294	17,047
License and other related expenses	1,877	5,000	1,988	5,000
Laboratory and other expenses	1,174	(241)	2,808	806
Facility expenses	6,720	6,359	19,971	22,579
Total other research and development expenses	20,058	21,759	55,262	67,944
Total research and development expense	\$ 45,463	\$ 53,149	\$ 133,881	\$ 194,864

Restructuring expenses

Restructuring expenses consist of costs 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 expenses were incurred.

Gain from sale of priority review voucher, net

Gain from sale of priority review voucher, net consists of gain from sale of priority review voucher. In the first quarter of 2023, we sold our second PRV for aggregate net proceeds of \$92.9 million. We received the PRV in August 2022 under an FDA program intended to encourage the development of treatments for rare pediatric diseases.

Interest income, net

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

Other income (expense), net

Other income (expense), net consists primarily of rental income on sublease, gains and losses on investments, gains and losses on disposal of fixed assets, and gains and losses on foreign currency transactions.

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 nine months ended September 30, 2023, there were no material changes to our critical accounting policies as reported in our 2022 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 September 30, 2023 and 2022:

	For the three months ended September 30,		Change
	2023	2022	
	(in thousands)		
Revenue:			
Product revenue, net	\$ 12,281	\$ —	\$ 12,281
Other revenue	111	71	40
Total revenues	12,392	71	12,321
Cost of product revenue	10,955	—	10,955
Gross margin	1,437	71	1,366
Operating expenses:			
Selling, general and administrative	40,703	33,402	7,301
Research and development	45,463	53,149	(7,686)
Restructuring expenses	—	(1,699)	1,699
Total operating expenses	86,166	84,852	1,314
Income (loss) from operations	(84,729)	(84,781)	52
Interest income, net	2,454	383	2,071
Other income (expense), net	10,544	7,885	2,659
Income (loss) before income taxes	(71,731)	(76,513)	4,782
Income tax (expense) benefit	—	(7)	7
Net income (loss)	\$ (71,731)	\$ (76,520)	\$ 4,789

Revenues. Total revenue was \$12.4 million for the three months ended September 30, 2023, compared to \$0.1 million for the three months ended September 30, 2022. The increase of \$12.3 million was primarily attributable to revenue recognized for the sales of SKYSONA and ZYNTEGLO in the United States in 2023, after receiving FDA approval in September and August 2022, respectively.

Cost of product revenue. Cost of product revenue was \$11.0 million for the three months ended September 30, 2023, compared to \$0.0 million for the three months ended September 30, 2022. The increase is primarily attributable to costs recognized for the sales of SKYSONA and ZYNTEGLO in 2023.

Selling, general and administrative expenses. Selling, general and administrative expenses were \$40.7 million for the three months ended September 30, 2023, compared to \$33.4 million for the three months ended September 30, 2022. The net increase of \$7.3 million was primarily attributable to the following:

- \$3.1 million of increased commercial costs driven by marketing activities for ZYNTEGLO and SKYSONA in the United States and the performance of commercial readiness activities in the United States for lovo-cel, in anticipation of potential FDA approval;
- \$2.2 million of increased net employee compensation, benefit, and other headcount-related expenses, driven by increased headcount in selling, general and administrative costs in 2023 offset by a decrease in stock-based compensation expense due to an overall decrease in the value of awards.
- \$2.0 million of increased professional fees driven by increased legal, audit, and public relations costs; and
- \$0.6 million of increased information technology and facility-related costs.

These increased costs were partially offset by \$0.8 million of decreased costs related to consultants.

Research and development expenses. Research and development expenses were \$45.5 million for the three months ended September 30, 2023, compared to \$53.1 million for the three months ended September 30, 2022. The net decrease of \$7.6 million was primarily attributable to the following:

- \$3.5 million of decreased manufacturing costs primarily driven by material production now being included in inventory and cost of product revenue;
- \$3.2 million of decreased license and milestone fees;
- \$3.0 million of decreased net employee compensation, benefit, and other headcount-related expenses, including a decrease of \$3.0 million in stock-based compensation expense, driven by related expenses now being included in inventory and cost of product revenue; and
- \$2.0 million of decreased information technology and facility related costs driven by decreased information technology spending related to expenses now being included in inventory and cost of product revenue, and the impact of lease changes.

These decreased costs were partially offset by the following:

- \$2.7 million of increased clinical costs driven by an increase in clinical treatment fees and CRO costs;
- \$1.3 million of increased costs related to lab expenses, primarily driven by an increase in consumables; and
- \$1.0 million of increased costs related to consultants.

Restructuring expenses. There were no restructuring expenses recorded during the third quarter of 2023 compared to a credit of \$1.7 million during the third quarter of 2022, which was related to an adjustment of restructuring expenses incurred in the second quarter of 2022.

Interest income, net. The increase in interest income, net was primarily related to higher interest income earned on investments and dividends related to our operating account.

Other income (expense), net. The increase in other income (expense), net was primarily related to the common area maintenance ("CAM") rental income on our sublease.

Comparison of the nine months ended September 30, 2023 and 2022:

	For the nine months ended September 30,		Change
	2023	2022	
(in thousands)			
Revenue:			
Product revenue, net	\$ 21,414	\$ 2,739	\$ 18,675
Other revenue	249	795	(546)
Total revenues	21,663	3,534	18,129
Cost of product revenue	23,895	10,056	13,839
Gross margin	(2,232)	(6,522)	4,290
Operating expenses:			
Selling, general and administrative	118,406	106,201	12,205
Research and development	133,881	194,864	(60,983)
Restructuring expenses	—	4,940	(4,940)
Total operating expenses	252,287	306,005	(53,718)
Gain from sale of priority review voucher, net	92,930	—	92,930
Income (loss) from operations	(161,589)	(312,527)	150,938
Interest income, net	7,958	663	7,295
Other income (expense), net	30,152	13,061	17,091
Income (loss) before income taxes	(123,479)	(298,803)	175,324
Income tax (expense) benefit	80	(7)	87
Net income (loss)	\$ (123,399)	\$ (298,810)	\$ 175,411

Revenues. Total revenue was \$21.7 million for the nine months ended September 30, 2023, compared to \$3.5 million for the nine months ended September 30, 2022. The increase of \$18.1 million was primarily attributable to revenue recognized for the sales of SKYSONA and ZYNTEGLO in the United States in 2023, after receiving FDA approval in September and August 2022, respectively.

Cost of product revenue. Cost of product revenue was \$23.9 million for the nine months ended September 30, 2023, compared to \$10.1 million for the nine months ended September 30, 2022. The increase is primarily attributable to costs recognized for the sales of SKYSONA and ZYNTEGLO in 2023, partially offset by inventory reserved during the first quarter of 2022 upon the Company's exit from Europe.

Selling, general and administrative expenses. Selling, general and administrative expenses were \$118.4 million for the nine months ended September 30, 2023, compared to \$106.2 million for the nine months ended September 30, 2022. The net increase of \$12.2 million was primarily attributable to the following:

- \$12.7 million of increased information technology and facility-related costs driven by the commencements of the 50 Binney sublease in April 2022, and the Assembly Row Lease in March 2022;
- \$5.7 million of increased commercial readiness related costs; and
- \$2.2 million of increased professional service fees.

These increased costs were partially offset by the following:

- \$7.0 million of decreased costs related to consultants; and
- \$2.5 million of decreased employee compensation, benefit, and other headcount-related expenses.

Research and development expenses. Research and development expenses were \$133.9 million for the nine months ended September 30, 2023, compared to \$194.9 million for the nine months ended September 30, 2022. The net decrease of \$61.0 million was primarily attributable to the following:

- \$34.2 million of decreased manufacturing costs primarily driven by 2022 manufacturing commitments; a decrease in research and development production costs in 2023 as well as material production now being included in inventory and cost of product revenue;

- \$23.3 million of decreased net employee compensation, benefit, and other headcount-related expenses, including a decrease of \$8.8 million in stock-based compensation expense, driven by related expenses now being included in inventory and cost of product revenue;
- \$6.5 million of decreased information technology and facility related costs driven by decreased information technology spending, related expenses now being included in inventory and cost of product revenue as well as the impact of lease changes; and
- \$3.3 million of decreased license and milestone payment costs.

These decreased costs were partially offset by the following:

- \$4.5 million of increased costs related to clinical trials; and
- \$0.9 million of increased costs related to consultants.

Restructuring expenses. The decrease in restructuring expenses is primarily related to the costs associated with our decision to reduce our workforce by 30% during the second and third quarters of 2022.

Gain from sale of priority review voucher, net. The increase in gain from sale of priority review voucher, net was related to the sale of a priority review voucher in the first quarter of 2023.

Interest income, net. The increase in interest income, net was primarily related to higher interest income earned on investments and dividends related to our operating account.

Other income (expense), net. The increase in other income (expense), net was primarily related to the rental income from the 50 Binney sublease starting in April 2022 and CAM rental income from the sublease in 2023.

Liquidity and Capital Resources

As of September 30, 2023, we had cash, cash equivalents and marketable securities of approximately \$174.3 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 September 30, 2023, our funds are primarily held in U.S. government agency securities and treasuries, corporate bonds, and money market accounts.

We have incurred losses and cumulative negative cash flows from operations since our inception in April 1992, and as of September 30, 2023, we had an accumulated deficit of \$4.11 billion. We expect our research and development expenses to decrease in conjunction with an increase in commercial activities and selling, general and administrative expense due to the approvals of ZYNTEGLO and SKYSONA and the performance of commercial readiness activities for lovo-cel in anticipation of potential approval.

Based on our current business plan, management has concluded that there is substantial doubt regarding our ability to continue as a going concern, and we anticipate our cash, cash equivalents, and marketable securities as of September 30, 2023, including anticipated cash flows from operations, will be sufficient to fund our operations into second quarter of 2024. We have based this estimate on assumptions of revenues and operating costs that may prove to be wrong. Our cash runway estimate does not include use of our restricted cash of \$53.0 million, which is currently unavailable for use, and we believe at least \$45.4 million of this restricted cash is unlikely to be released in the near term. Furthermore, pursuant to the terms of certain agreements we have in place, we could be required to further increase our restricted cash due, in part, to recent concerns related to the stability of the banking sector, which would consequently reduce the amount of cash available to fund our operations. However, we have based this estimate on assumptions of revenues and operating costs that may prove to be wrong. Our future net product revenues will depend upon the size of the markets, our ability to obtain regulatory approval of lovo-cel for SCD, our ability to timely scale our manufacturing capabilities to meet market demand, our ability to achieve sufficient market acceptance, reimbursement from third-party payers, adequate market share in those markets and the performance of drug product subject to outcome-based programs. As a result, we could deplete our capital resources sooner than we currently expect. If, for any reason, our revenues or our expenses differ materially from our assumptions or we utilize our cash more quickly than anticipated, or if we are unable to obtain funding on a timely basis we may be required to revise our business plan and strategy, which may result in bluebird significantly curtailing, delaying or discontinuing one or more of our research or development programs or the commercialization of any products or may result in bluebird 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.

We have funded our operations principally from the sale of common stock in public offerings and the sale of the two PRVs. The following is a summary of recent financing transactions:

- In the first quarter of 2023, we sold our second PRV for aggregate net proceeds of \$92.9 million.
- In the first quarter of 2023, we sold 23.0 million shares of common stock (inclusive of shares sold pursuant to an option to the underwriters in connection with the offering) in an underwritten public offering at a price of \$6.00 per share for aggregate net proceeds of \$130.5 million.
- In August 2023, we entered into an Open Market Sales Agreement (the "Sales Agreement") with Jefferies LLC ("Jefferies") to sell shares of our common stock up to \$125.0 million, from time to time, through an "at the market" equity offering program under which Jefferies will act as sales agent. As of September 30, 2023, we have made no sales pursuant to the Sales Agreement.
- In October 2023, we entered into an advance agreement to sell a third PRV, if granted in connection with the potential approval of lovo-cel, for \$103.0 million. Closing of the transaction remains subject to the approval of lovo-cel and receipt of a PRV, as well as customary closing conditions.

Sources of Liquidity

Cash Flows

The following table summarizes our cash flow activity:

	For the nine months ended September 30,	
	2023	2022
	(in thousands)	
Net cash used in operating activities	\$ (221,209)	\$ (296,680)
Net cash provided by investing activities	151,164	147,211
Net cash provided by financing activities	129,969	54,368
Net (decrease) increase in cash, cash equivalents and restricted cash	<u>\$ 59,924</u>	<u>\$ (95,101)</u>

Operating Activities. The \$75.5 million decrease in cash used in operating activities for the nine months ended September 30, 2023 compared to the nine months ended September 30, 2022 was primarily due to the decrease in net loss during this period of \$175.4 million, offset by adjustments for non-cash items, including a gain from the sale of priority review voucher of \$92.9 million in the first quarter of 2023.

Investing Activities. The \$4.0 million increase in cash provided by investing activities for the nine months ended September 30, 2023 compared to the nine months ended September 30, 2022 was primarily due to a decrease in proceeds from sales of marketable securities of \$24.4 million, a decrease in proceeds from maturities of marketable securities of \$25.6 million and an increase in cash used to purchase marketable securities of \$43.3 million, partially offset by an increase in proceeds from sale of priority review voucher of \$92.9 million during the nine months ended September 30, 2023 compared to the nine months ended September 30, 2022.

Financing Activities. The \$75.6 million increase in cash provided by financing activities for the nine months ended September 30, 2023 compared to the nine months ended September 30, 2022 was primarily due to the increase in proceeds from the secondary public offering, net of paid offering costs of \$75.7 million during the nine months ended September 30, 2023.

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 2022 Annual Report on Form 10-K.

Item 3. Quantitative and Qualitative Disclosures About Market Risks

We are exposed to market risk related to changes in interest rates. As of September 30, 2023 and December 31, 2022, we had cash, cash equivalents and marketable securities of \$174.3 million and \$181.7 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 September 30, 2023, the net fair value of our interest-sensitive marketable securities would have resulted in a hypothetical decline of approximately \$0.0 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 September 30, 2023, 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. The outcome of these proceedings and claims cannot be predicted with certainty. We believe 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 senior 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 October 21, 2021, San Rocco Therapeutics, LLC, formerly known as 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. Patent Nos. 7,541,179 and 8,058,061. The term of U.S. Patent No. 8,058,061 already expired on November 25, 2022, and U.S. Patent No. 7,541,179 will expire on May 13, 2024. The allegations relate to our use of the BB305 lentiviral vector, including in connection with 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 ("SRT"). 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 argued warranted complete dismissal of the action as a matter of law, regardless of the merits of SRT's underlying infringement claims. 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 February 7, 2023, the Arbitrator issued a final award finding in favor of SRT on both threshold issues, thereby enabling SRT to pursue its claims for alleged infringement. On March 1, 2023, the parties jointly stipulated, subject to the approval of the United States District Court for the District of Delaware, to lift the stay. The Court lifted the stay on March 2, 2023, and on March 31, 2023 we filed our answer to SRT's complaint with counterclaims asserting that we do not infringe the patents-in-suit and that the patents-in-suit are invalid. Also, on April 24, 2023, the Patent Trial & Appeal Board of the U.S. PTO granted institution of our two petitions for inter partes review, which are seeking to invalidate various claims of the patents-in-suit. On May 25, 2023, the Court entered a scheduling order that the parties agreed on, which scheduled a five-day jury trial to begin on April 21, 2025. We plan to vigorously defend against SRT's claims including by seeking a declaration from the Court that SRT's action is an exceptional case within the meaning of 35 U.S.C. § 285, and by seeking costs, attorney fees, and other relief to which we may be justly entitled.

On April 27, 2023, SRT filed another complaint against us (as well as against Mr. Nick Leschly, Mr. Mitchell Finer, Mr. Philip Reilly, Third Rock Ventures LLC, and 2Seventy Bio, Inc.) in the United States District Court for the District of Massachusetts. This complaint alleges civil violations of the Federal Racketeer Influenced and Corrupt Organizations Act, violations of Mass. Gen. Laws ch. 93A, § 11, and fraudulent inducement of SRT into a release provision in a November 2020 confidential settlement agreement we executed with, *inter alia*, SRT. The allegations relate to our use of the BB305 lentiviral vector, including in connection with the beti-cel program, and SRT seeks declaratory relief and money damages. On July 3, 2023, we (in conjunction with the other defendants) moved to dismiss all claims with prejudice brought by SRT in its Complaint for failure to state a claim upon which relief may be granted. On August 7, 2023, SRT filed an amended complaint, adding Craig Thompson as a defendant, and adding additional claims of alleged antitrust violations under federal and state law. The case is now captioned San Rocco Therapeutics, LLC v. Nick Leschly, Mitchell Finer, Philip Reilly, Craig Thompson, Third Rock Ventures LLC, bluebird bio, Inc. and 2Seventy Bio, Inc., C.A. No. 1:23-cv-10919-ADB. On September 18, 2023, we (in conjunction with the non-Thompson defendants), moved to dismiss with prejudice once again. SRT filed an opposition to that motion on October 12, 2023. On October 24, 2023, we filed a motion for leave to file a reply brief, which was granted on October 30, 2023. We plan to vigorously defend against SRT's claims in this action, which we believe have no merit whatsoever.

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 2022 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 significant losses since our inception in 1992. As of September 30, 2023, we had an accumulated deficit of \$4.11 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, absent new initiatives, we expect to directionally decrease as we focus on bringing our therapies to patients in the commercial setting. To date, we have financed our operations primarily through the sale of equity securities and priority review vouchers, and, to a lesser extent, through collaboration agreements and grants from governmental agencies and charitable foundations. We did not generate material revenues from the sale of ZYNTEGLO in the European Union and only recently launched ZYNTEGLO and SKYSONA in the U.S. Our future revenues will depend upon the size of any markets in which our products and product candidates 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. We anticipate that our expenses will increase substantially if and as we:

- continue to invest in lovo-cel as we prepare for the potential regulatory approval for our accepted BLA;
- grow our capabilities to support our commercialization efforts for ZYNTEGLO, SKYSONA and lovo-cel, if approved, including continuing to establish a sales, marketing and distribution infrastructure in the United States;
- obtain, build and expand manufacturing capacity, including capacity at third-party manufacturers;
- attract and retain skilled personnel;
- initiate additional research, preclinical, clinical or other programs as we seek to identify and validate additional product candidates;
- acquire or in-license other product candidates and technologies;
- maintain, protect and expand our intellectual property portfolio; and
- experience any delays or encounter issues with any of the above.

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 commercial programs, product development efforts or other operations.

Developing and commercializing gene therapy products is expensive, and we do not expect to generate meaningful product revenues in the foreseeable future. Based on our current business plan as of the date hereof, there is substantial doubt regarding our ability to continue as a going concern. See Part I, Item 2 “Management’s Discussion and Analysis of Financial Condition and Results of Operations—Liquidity and Capital Resources” of this Quarterly Report on Form 10-Q for a discussion of our expected cash runway. Our cash runway estimate does not include use of our restricted cash of \$53.0 million, which is currently unavailable for use, and we believe at least \$45.4 million of this restricted cash is unlikely to be released in the near term. Furthermore, pursuant to the terms of certain agreements we have in place, we could be required to further increase our restricted cash due, in part, to recent concerns related to the stability of the banking sector, which would consequently reduce the amount of cash available to fund our operations. Accordingly, we will need to raise additional funding in order to execute on our current business plans and strategy, including prior to becoming profitable.

Our efforts to raise additional funding may divert our management from their day-to-day activities, which may adversely affect our ability to develop and commercialize our products. 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, traditional debt or other debt-like arrangements, 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.

Moreover, as a result of recent volatile market conditions, the cost and availability of capital has been and may continue to be adversely affected. Concern about the stability of the banking sector has generally led many lenders and institutional investors to reduce, and in some cases, cease to provide credit to businesses and consumers. Continued turbulence in the U.S. market and economy may adversely affect our liquidity and financial condition, including our ability to access the capital markets to meet liquidity needs. In addition, we maintain the majority of our cash and cash equivalents in accounts with major financial institutions, and our deposits at these institutions exceed insured limits. Market conditions can impact the viability of these institutions. In the event of failure of any of the financial institutions where we maintain our cash and cash equivalents, there can be no assurance that we would be able to access uninsured funds in a timely manner or at all. Any inability to access or delay in accessing these funds could adversely affect our business and financial position.

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 the commercialization of any current or future products 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.

**** Among other potential adverse events, insertional oncogenesis is a significant risk of gene therapies using viral vectors that can integrate into the genome. Any such adverse events may require us to halt or delay further clinical development of our product candidates or to suspend or cease commercialization following marketing approval, and the commercial potential of our products and product candidates may be materially and negatively impacted.***

Adverse events or other undesirable side effects caused by our products or product candidates could cause us or regulatory authorities to interrupt, delay or halt clinical trials and could result in a more restrictive label or the delay, denial or withdrawal of regulatory approval by the FDA or other comparable foreign regulatory authorities. 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 could cause cancer in the patient, known as insertional oncogenesis. For instance, five patients with CALD treated with eli-cel (now SKYSONA) in our clinical studies have been diagnosed with myelodysplastic syndrome (“MDS”), likely mediated by Lenti-D LVV insertion. SKYSONA’s label includes a boxed warning for the known risk of hematologic malignancy and, accordingly, we expect additional cases to arise over time. We continue to closely monitor potential cases of hematologic malignancy in patients treated with SKYSONA and we are communicating regularly with treating physicians and regulatory authorities. We cannot make assurances that additional patients treated with SKYSONA, ZYNTEGLO or lovo-cel in the clinical or commercial setting will not be diagnosed with MDS, leukemia or lymphoma.

Moreover, in December 2021, the FDA placed the lovo-cel clinical development program under a partial clinical hold for patients under the age of 18. The hold related to a case of persistent anemia in an adolescent patient with two α -globin gene deletions ($-\alpha 3.7/-\alpha 3.7$), also known as alpha-thalassemia trait, who was treated with lovo-cel. In December 2022, the FDA lifted its partial clinical hold for patients under the age of 18 in studies evaluating lovo-cel for SCD. Notwithstanding the lifting of this partial clinical hold, additional adverse events or new data or analyses regarding previously reported events may indicate significant safety issues, and the FDA could potentially impose or reimpose a clinical hold in the future on studies evaluating lovo-cel. Moreover, laboratory results following gene therapy can be difficult to interpret, resulting in different or changing diagnoses by treating physicians. For instance, on January 31, 2023, we received a physician diagnosis of MDS in a patient treated with lovo-cel, in response to lab results obtained through routine monitoring of the same adolescent patient with two α -globin gene deletions subject to the partial clinical hold noted above. Consistent with established safety protocols, the information was reviewed by an independent Data Monitoring Committee which concluded that available evidence did not support a diagnosis of MDS and additional data would be needed to confirm such diagnosis, and that lovo-cel clinical studies should continue. Test results received since the investigator’s initial report (including integration site analysis) demonstrated no evidence of insertional oncogenesis and the patient continues to be clinically stable and is not undergoing treatment for an MDS diagnosis. Study investigators and the FDA have been informed and we will continue to monitor additional analyses as further test results are received. We maintain dialogue with the FDA and, from time to time, as required by regulations or requested by the FDA, update the FDA on additional adverse events or new data or analyses regarding previously reported events.

Furthermore, treatment with our products and product candidates involves chemotherapy or myeloablative treatments, which can cause side effects or adverse events that may impact the perception of the potential benefits of our products and product candidates. For instance, MDS leading to acute myeloid leukemia is a known risk of certain myeloablative regimens. Accordingly, it is possible that the events of MDS and acute myeloid leukemia previously reported in our HGB-206 clinical study of lovo-cel in SCD were caused by underlying SCD, transplant procedure, and stress on the bone marrow following drug product infusion in connection with the lovo-cel treatment. Additionally, the procedures associated with the administration or collection of cells for ZYNTEGLO, SKYSONA, or lovo-cel, 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.

Moreover, patients treated with our therapies, including lovo-cel, have exhibited persistent oligoclonality, which we define as two consecutive instances of (i) any LVV insertion site observed at $\geq 10\%$ relative frequency, or (ii) two or more insertion sites observed at $\geq 5\%$ relative frequency, as measured by integration site analysis. Based on our clinical protocols, we increase 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 criterion used by the FDA to evaluate the safety of gene therapies over time.

Additionally, there is 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 LVVs possess characteristics that may pose high risks of delayed adverse events.

If any such adverse events occur, including insertional oncogenesis, 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 our approved products in the manner we expect, or at all. 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 of our approved products. If any of these were to occur, the commercial potential of our programs may be materially and negatively impacted.

Although ZYNTEGLO and SKYSONA have been approved by the FDA, serious safety events may result in an approved product being removed from the market or its market opportunity being significantly reduced. For instance, it is possible that as we commercialize our products or test our product candidates in larger, longer and more extensive clinical trials, or as use of these products and product candidates (if approved) becomes more widespread, illnesses, injuries, discomforts and other adverse events that were observed in previous trials, as well as conditions that did not occur or went undetected in previous trials, will be reported by patients. Many times, side effects (that may or may not be related to our products or product candidates) are only detectable after investigational products are tested in large-scale clinical trials or, in some cases, after they are made available to patients on a commercial scale following approval. Other patients receiving our products and product candidates may develop cancers, including leukemia, lymphoma, or MDS in the future, which may negatively impact the commercial prospects of our products and product candidates. We or others may later identify undesirable side effects or adverse events caused by such products, or side effects or adverse events could accumulate over time, and a number of potentially significant negative consequences could result, including but not limited to:

- regulatory authorities may suspend, limit or withdraw approvals of such product, or seek an injunction against its manufacture or distribution;
- regulatory authorities may require additional warnings on the label, including “boxed” warnings, or issue safety alerts, “Dear Healthcare Provider” or “Dear Doctor” letters, press releases or other communications containing warnings or other safety information about the product;
- we may be required to change the way the product is administered or conduct additional clinical trials or post-marketing studies;
- we may be required to create a risk evaluation and mitigation strategy, or REMS which could include elements to assure safe use, or a medication guide outlining the risks of such side effects for distribution to patients;

- we may be subject to fines, injunctions or the imposition of criminal penalties;
- patients and/or treating physicians could perceive the risk of undesirable side effects or adverse events caused by the product to exceed its potential benefit and choose not to use the product;
- we could choose to remove such product from the market;
- we could be sued and held liable for harm caused to patients; and
- our reputation may suffer.

Any of these events could impair our ability to develop or commercialize our products and product candidates, and their commercial potential may be materially and negatively impacted.

****We rely on complex, single-source supply chains for SKYSONA, ZYNTEGLO, and lovo-cel, respectively. The manufacture, testing 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, or timing needed to support our clinical programs and commercialization.***

We rely on third parties to manufacture the LVV and the drug product for ZYNTEGLO and SKYSONA, our two commercial products, and for our clinical trials, including the ongoing phase 3 clinical study evaluating the efficacy and safety of lovo-cel in the treatment of patients with SCD. We continue to advance plans to make additional investment in manufacturing to expand capacity and, to date, we have secured additional commercial-scale manufacturing capacity in order to meet our near-term sales forecasts for ZYNTEGLO and SKYSONA; however, any plans to expand our manufacturing capacity beyond our current levels are subject to FDA approval, which we have not yet obtained. 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, or if we fail to receive regulatory approval for the expansion of our manufacturing capacity in a timely manner, we may be unable to execute on our 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, quality assurance testing, operator error, scarcity of qualified manufacturing and quality control testing personnel, shortages of any production raw materials as well as compliance with strictly enforced federal, state and foreign regulations. Further, the transition from clinical to commercial manufacturing is complex and has resulted in, and may continue to result in, lower operational success rates due to, among other things, tighter specifications and higher regulatory standards associated with commercial products. 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 requires a lengthy technology transfer process and regulatory review and approval, which often takes significant time 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 SKYSONA, ZYNTEGLO, 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, including due to reduced operational success rates as a result of the transition to commercial manufacturing, the development and commercialization of our products and product candidates may be materially harmed, result in delays in our plans or increased capital expenditures.

In addition, we currently have only one drug product supplier for ZYNTEGLO and SKYSONA and one drug product supplier anticipated for commercial distribution for lovo-cel and, accordingly, 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 SKYSONA, ZYNTEGLO, 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 control the process for acquisition of all key materials and shortages may occur for reasons beyond our control.

Additionally, since the hematopoietic stem cells ("HSCs") used as starting material for our drug products have a limited window of stability following procurement from a patient, we have initially established transduction facilities in areas that we believe can adequately service patients from regions where we are commercializing SKYSONA, ZYNTEGLO, and where we anticipate commercializing lovo-cel, if and when approved. However, we cannot ensure that such facilities will enable us to produce and deliver drug product in a timely manner; any issues with production and delivery of drug product could have a material adverse effect on our successful commercialization of our product and product candidates. Moreover, establishing additional facilities in appropriate regions may be financially impractical or impeded by technical, quality, or regulatory issues related to these new sites and we may also run into technical or scientific issues related to transfer of our transduction process or other developmental issues that we may be unable to resolve in a timely manner or with available funds.

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, in our lovo-cel program, we are seeking 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 drug product manufactured in a commercial, rather than a clinical, manufacturing facility. Such transitions require regulatory review and approval including reaching agreement with the FDA on an acceptable comparability data package. The FDA may require us to conduct additional clinical studies, collect additional data, develop additional assays, or modify product specifications relating to such comparability analysis prior to approving our BLA for lovo-cel, which may delay or prevent our plans for commercialization. Any such requests or delays may have a material adverse effect on our forecasted timelines for approval of lovo-cel and may require substantial additional funds.

We are evaluating plans to transition our drug product manufacturing process for lovo-cel, if approval is obtained, to utilize cryopreserved apheresis patient starting material in order to expand the potential reach of our therapy and to provide manufacturing flexibility. Such changes to our drug manufacturing process will similarly require comparability and process validation data to support such transition and, therefore, may not be approved in a timely manner, if at all.

We cannot predict when or if we will obtain marketing approval to commercialize lovo-cel, and the marketing approval of our product candidates may ultimately be for more narrow indications than we expect. If lovo-cel or other 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.

The 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 are limited data concerning long-term safety and efficacy following treatment with our products and product candidates. These data, or other positive data, may not continue to 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 marketed products or 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 or may require the inclusion of limitations or warnings that may be different from those of our competitors. 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, such as using lovo-cel for treatment for children with sickle cell disease ages 12 and older, our business may suffer, including as a result of our inability to close the announced sale of a priority review voucher we may be eligible to receive should lovo-cel be approved for patients with sickle cell disease ages 12 and older.

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, comparability and/or quality perspective, to support the approval of the BLA. The BLA submission for lovo-cel is based on clinical data from Group C of our ongoing HGB-206 clinical study, which is our registrational Phase 1/2 clinical trial of lovo-cel in three treatment cohorts, and supporting data from our ongoing HGB-210 clinical study, which is our Phase 3 clinical trial of lovo-cel in pediatric and adult participants, and has been accepted for filing by the FDA and granted priority review, with a PDUFA goal date of December 20, 2023. However, the FDA may determine that lovo-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 lovo-cel for the treatment of patients with SCD, if ever.

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

Risks related to commercialization

We have limited experience as a commercial company and the marketing and sale of ZYNTEGLO, SKYSONA and of 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 as we have only recently launched ZYNTEGLO and SKYSONA in the U.S., our first two commercial products marketed in the U.S. 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 lovo-cel in the United States;
- sustain adequate pricing and reimbursement for ZYNTEGLO and SKYSONA, across all U.S. payer segments, and obtain pricing and reimbursement for lovo-cel across payers in the U.S., when and if approved;
- 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 ZYNTEGLO, SKYSONA, and lovo-cel, when and if approved;
- manage our manufacturing capabilities and supply chain operations in the coordination and delivery of drug product to patients at qualified treatment centers;
- manage our spending as we seek marketing approvals, and engage in commercialization efforts; and
- initiate, develop and maintain successful strategic alliances.

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

The commercial success of ZYNTEGLO, SKYSONA and of 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 ZYNTEGLO, SKYSONA, and of 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 ZYNTEGLO, SKYSONA, and lovo-cel, in particular, as medically useful, cost-effective, and safe. ZYNTEGLO, SKYSONA, and lovo-cel, which we may bring to the market if approved, 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 ZYNTEGLO, SKYSONA, and of lovo-cel, if and when approved, will depend on a number of factors, including:

- the potential and perceived efficacy and potential advantages over alternative treatments, including over direct competitors in the gene therapy space;

- the prevalence and severity of any side effects, including any limitations or warnings contained in a product's approved labeling; for instance, the SKYSONA product label includes a boxed warning for the risk of hematologic malignancy;
- the prevalence and severity of any side effects resulting from the chemotherapy and myeloablative treatments associated with the procedure by which our products are administered, including the possible prejudicial effects that chemotherapy can have on fertility;
- relative convenience and ease of administration;
- given the complexity of manufacturing product and the reduced operational success rates in connection with the transition to commercial manufacturing, the perception or possibility that issues may continue to arise in the supply of product which could delay treatment;
- 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 products;
- publicity concerning our products, or competing products and treatments;
- sufficient insurance coverage or reimbursement;
- the possible occurrence of adverse clinical findings or decreased effectiveness of a product or product candidate over time identified during continued monitoring and evaluation of patients; and
- the mix of private and governmental payers coverage, particularly if the percentage of patients receiving reimbursement from state Medicaid is high since such process can be slower to reimburse.

Even if a product displays a favorable efficacy and safety profile in clinical studies, market acceptance of the product will not be known until some period after it is launched. Our efforts to educate the medical community and payers on the benefits of our products may require significant resources and may never be successful. For instance, following marketing approval of ZYNTEGLO in the European Union, we did not reach agreement with payers on an acceptable price for reimbursement in our priority markets in Europe, and as a result we are no longer seeking to commercialize our products and 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 ZYNTEGLO, SKYSONA, or lovo-cel, to be unsuccessful or less successful than anticipated.

Our ability to successfully commercialize our products or product candidates, if approved, including our ability to achieve their widespread market acceptance, is critical to the success of our business.

We dedicate a substantial amount of our resources to the commercialization of ZYNTEGLO and SKYSONA. Our ability to generate revenue in the near-term will depend almost entirely on our ability to execute on our commercialization plans and the level of market adoption for, and the continued use of, ZYNTEGLO and SKYSONA and, if approved, lovo-cel, by physicians, hospitals, patients, and/or healthcare payers, including government payers, consumers, managed care organizations, and specialty pharmacies. If we are not successful in commercializing our products, including achieving and maintaining an adequate level of market adoption, our profitability and our future business prospects will be adversely impacted.

Future expansion of commercial opportunity is dependent upon lifecycle management and access to complementary therapies. Our efforts to reduce cost of goods through efficiencies of scale or new technologies, such as improved mobilization, may not be successful and/or we may not have access to the complementary technologies we need to succeed, which could impact the level of future profitability. For instance, improvements in conditioning regimens (which could increase the patient population who has access to our products), may not be successfully developed and approved, and if they are, we may not have access to those improvements which, in most instances, are technology owned by third parties. Additionally, the future opportunity to market our therapies in geographies outside the U.S. through partnership or our internal efforts may not materialize.

If the market opportunities for our product candidates 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 product candidates, 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 product candidates may be limited or may not be amenable to treatment with our product candidates. For instance, in our lovo-cel and SKYSONA 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 products and product candidates 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 product candidates and our ability to achieve and maintain profitability and, as a consequence, our business may suffer.

We have limited sales and distribution experience and limited capabilities for marketing and market access. Although we have invested and expect to continue to invest significant financial and management resources, if we are unable to establish and maintain these commercial capabilities and infrastructure, or to enter into agreements with third parties to market and sell our 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 ZYNTEGLO, SKYSONA, 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 further 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 ZYNTEGLO, SKYSONA, 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, if at all. 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.

We may encounter challenges with engaging or coordinating with qualified treatment centers needed for the ongoing commercialization of ZYNTEGLO and SKYSONA and the potential commercialization of lovo-cel.

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 our transduction 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. For instance, we have currently signed agreements with 29 such treatment centers and our corporate strategy is to contract with at least 40 such centers by the end of 2023; however, our ability to reach this goal depends on many factors beyond our control, including, for example, the availability of contracting staff at the

centers, and as a result we may experience delays. Any delay or failure to meet these goals may limit patient access to our therapies and, accordingly, have a material adverse effect on our commercial forecasts and business.

Furthermore, 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. Additionally, delays with infusion at the qualified treatment centers, due to, for instance, the patient's schedule or health condition or such center's capacity, or due to the need for multiple cell collections, could result in a patient becoming medically ineligible for our treatment, the drug product becoming unusable and loss of medical coverage, which would have a material adverse effect on commercial sales.

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 transduction 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.

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 products to offer lifetime therapeutic benefit in a single administration, we face unique and additional challenges in obtaining adequate coverage and reimbursement for our products. 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 healthcare, and especially expensive medicines, such as gene therapy products. Sales of our products will depend substantially on the extent to which the price(s) set for our products will be covered 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 payers will be willing to reimburse providers at the company-established list price or that reimbursement levels that payers will be willing to pay will be acceptable to us. Moreover, given that our therapies are likely to be administered in the inpatient care setting, it will be important that our products are either reimbursed as a separate item from the underlying services incurred during the patient's hospitalization or that, if reimbursement for our therapies is "bundled" with reimbursement for the hospital stay, the list price of our therapy is used in setting the bundled payment rate. Notably, neither "separate reimbursement" nor bundled payment that appropriately accounts for the invoice cost of the therapy is guaranteed by all payers. Accordingly, the estimation of potential revenues will be complex and it is difficult to predict what payers 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.

In the U.S., regional Medicare Administrative Contractors ("MACs") are responsible for making a determination with regard to whether a new therapy meets the federal standard of "reasonable and necessary" such that it is covered and reimbursed by Medicare. For the Medicaid program, each State Medicaid Agency is responsible for establishing coverage criteria, billing policies, and reimbursement rates for FDA-approved drugs. Reimbursement methodologies in Medicare and Medicaid can vary based on the type of therapeutic agent and setting of care, and for Medicaid, the reimbursement methodologies also vary by state. There is uncertainty with this process both in terms of the timing of the decision making process and the coverage decision itself, and we anticipate significant exposure to the Medicaid program given the potential patient population for our products and product candidates. Our exposure to the Medicare program is anticipated to be much more limited given that only a small percentage of our patient population may be Medicare eligible (i.e., a small percentage of patients may be dually eligible for Medicare and Medicaid, in which case Medicare serves as the primary payer and Medicaid as the secondary payer for any service not otherwise covered by Medicare).

Moreover, increasing efforts by governmental and third-party payers to cap or reduce healthcare costs may cause such payers 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 ZYNTEGLO, SKYSONA, or for lovo-cel following marketing approval, if and when obtained. We expect to experience pricing pressures in connection with the sale of our products due to greater scrutiny on list prices and total prescription drug spending across all payer channels as well additional legislative changes at the state and federal level. Net prices for drugs may be reduced by mandatory discounts or rebates required by government or private payers. As a result, increasingly high barriers are being erected to the entry of new products, often in the form of limiting the patient population for whom a new therapy is deemed "medically necessary." Even if coverage is provided, the amount payers are willing to reimburse may not be a sufficient return on our investment.

Furthermore, because a provider is responsible for costs associated not just with obtaining our medicines but also with the underlying hospital stay in which the administration of our therapies occur, the pricing and reimbursement dynamics that impact patient access are not entirely within our control as providers and payers negotiate separately for the cost of the associated items and services, decisions in which we cannot and do not play a role. These services include the collection of HSCs from the patient, followed by chemotherapy and myeloablative treatments, and inpatient hospital stay following drug product infusion. If our customers are unable to obtain adequate levels of reimbursement, our ability to successfully market and sell our products will be adversely affected.

We have entered into and continue to engage with payers across all channels around outcomes-based contracts for ZYNTEGLO. In the event that a payer opts for the outcomes-based contract, we will need to reserve a certain portion of revenue from each sale to account for the potential that a rebate will be owed if the patient fails to meet the pre-established outcome metric over a one- or two-year evaluation period following drug product administration. These contracts also may result in the timing of revenue recognition not corresponding to the timing of cash collection. Despite our efforts to engage with CMS and work with experts to ensure all of our payer contracting efforts comply with relevant federal and state regulations, including government price reporting obligations, given the complexity of these arrangements, we may not be able to satisfy the compliance requirements, which may result in significant fines and liability.

Collectively, these factors could affect our ability to successfully commercialize our 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

Clinical drug development involves a lengthy and expensive process, with an uncertain outcome. We may incur additional costs or experience delays in completing, or ultimately be unable to complete, the development and commercialization of lovo-cel or other potential product candidates.

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 of lovo-cel or any other product candidate include:

- inability to generate sufficient preclinical, toxicology, or other in vivo or in vitro data to support the initiation or continuation of clinical trials;
- delays or failure in obtaining regulatory authorization to commence a trial;
- delays in reaching agreement on acceptable terms with prospective contract research organizations (“CROs”), and clinical trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and clinical trial sites;
- delays in identifying, recruiting and training suitable clinical investigators;
- delays in obtaining required IRB or ethics committee approvals at each clinical trial site;
- delays in manufacturing, testing, releasing, validating or importing/exporting sufficient stable quantities of our product candidates for use in clinical trials or the inability to do any of the foregoing;
- insufficient or inadequate supply or quality of product candidates or other materials necessary for use in clinical trials, or delays in sufficiently developing, characterizing or controlling a manufacturing process suitable for clinical trials;

- imposition of a clinical hold by regulatory agencies, including after review of an IND or amendment or equivalent foreign application or amendment, as a result of a new safety finding that presents unreasonable risk to clinical trial participants or after an inspection of our clinical study operations or study sites or due to unforeseen safety issues;
- failure by our CROs, other third parties or us to adhere to clinical trial protocols or failure to perform in accordance with the FDA's or any other regulatory authority's good clinical practice requirements ("GCPs") or applicable regulatory guidelines in other countries;
- occurrence of adverse events associated with the product candidate that are viewed to outweigh its potential benefits, or occurrence of adverse events in trial of the same class of agents conducted by other companies, particularly due to the fact that we are required to follow patients in our clinical studies for an extended period of time (up to 15 years);
- changes to the clinical trial protocols;
- clinical sites deviating from trial protocol or dropping out of a trial;
- changes in the standard of care on which a clinical development plan was based, which may require new or additional trials;
- selection of clinical endpoints that require prolonged periods of observation or analyses of resulting data;
- the cost of clinical trials of our product candidates being greater than we anticipate;
- clinical trials of our product candidates producing negative or inconclusive results, which may result in our deciding, or regulators requiring us, to conduct additional clinical trials or abandon development of such product candidates;
- transfer of manufacturing processes to larger-scale facilities operated by a contract manufacturing organization ("CMO") and delays or failure by our CMOs or us to make any necessary changes to such manufacturing process (please see "Risk Factors—Changes in our manufacturing processes may cause delays in our clinical development and commercialization plans" of this Quarterly Report on Form 10-Q for further information); or
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols.

Clinical trials must be conducted in accordance with the FDA and other applicable regulatory authorities' legal requirements, regulations or guidelines, and are subject to oversight by these governmental agencies and ethics committees or IRBs at the medical institutions where the clinical trials are conducted.

Further, conducting clinical trials in foreign countries, as we may do for our product candidates, presents additional risks that may delay completion of our clinical trials. These risks include the failure of enrolled patients in foreign countries to adhere to clinical protocol as a result of differences in healthcare services or cultural customs, managing additional administrative burdens associated with foreign regulatory schemes, as well as political and economic risks relevant to such foreign countries.

Moreover, principal investigators for our clinical trials may serve as scientific advisors or consultants to us from time to time and receive compensation in connection with such services. Under certain circumstances, we may be required to report some of these relationships to the FDA or comparable foreign regulatory authorities. The FDA or comparable foreign regulatory authority may conclude that a financial relationship between us and a principal investigator has created a conflict of interest or otherwise affected interpretation of the study. The FDA or comparable foreign regulatory authority may therefore question the integrity of the data generated at the applicable clinical trial site and the utility of the clinical trial itself may be jeopardized. This could result in a delay in approval, or rejection, of our marketing applications by the FDA or comparable foreign regulatory authority, as the case may be, and may ultimately lead to the denial of marketing approval of one or more of our product candidates.

Delays in the completion of any clinical trial of our product candidates will increase our costs, slow down our product candidate development and approval process and delay or potentially jeopardize our ability to commence product sales and generate product revenue. In addition, many of the factors that cause, or lead to, a delay in the commencement or completion of clinical trials may also ultimately lead to the denial of regulatory approval of our product candidates. Any delays to our clinical

trials that occur as a result could shorten any period during which we may have the exclusive right to commercialize our product candidates and our competitors may be able to bring products to market before we do, and the commercial viability of our product candidates could be significantly reduced. Any of these occurrences may harm our business, financial condition and prospects significantly.

We depend on enrollment of patients in our clinical trials for our product candidates. If we experience delays or difficulties enrolling in our clinical trials, our research and development efforts and business, financial condition, and results of operations could be materially adversely affected.

Successful and timely completion of clinical trials, including additional trials which the FDA may require we complete prior to or as part of approval of our product and product candidates, will require that we enroll a sufficient number of patient candidates. These trials and other trials we conduct may be subject to delays for a variety of reasons, including as a result of patient enrollment taking longer than anticipated, patient withdrawal or adverse events. These types of developments could cause us to delay the trial or halt further development.

Our clinical trials will compete with other clinical trials that are in the same therapeutic areas as our product candidates, and this competition reduces the number and types of patients available to us, as some patients who might have opted to enroll in our trials may instead opt to enroll in a trial being conducted by one of our competitors. Because the number of qualified clinical investigators and clinical trial sites is limited, we expect to conduct some of our clinical trials at the same clinical trial sites that some of our competitors use, which will reduce the number of patients who are available for our clinical trials at such clinical trial sites. In addition, there may be limited patient pools from which to draw for clinical studies. In addition to the rarity of some diseases, the eligibility criteria of our clinical studies will further limit the pool of available study participants as we will require that patients have specific characteristics that we can measure or to assure their disease is either severe enough or not too advanced to include them in a study.

Patient enrollment depends on many factors, including:

- the size and nature of the patient population;
- the severity of the disease under investigation;
- eligibility criteria for the trial;
- the proximity of patients to clinical sites;
- the design of the clinical protocol;
- the ability to obtain and maintain patient consents;
- the ability to recruit clinical trial investigators with the appropriate competencies and experience;
- the risk that patients enrolled in clinical trials will drop out of the trials before the administration of our product candidates or trial completion;
- the availability of competing clinical trials;
- the availability of new drugs approved for the indication the clinical trial is investigating; and
- clinicians' and patients' perceptions as to the potential advantages of the drug being studied in relation to other available therapies.

These factors may make it difficult for us to enroll enough patients to complete our clinical trials in a timely and cost-effective manner. Delays in the completion of any clinical trial of our product candidates will increase our costs, slow down our product candidate development and approval process and delay or potentially jeopardize our ability to commence product sales and generate revenue. In addition, some of the factors that cause, or lead to, a delay in the commencement or completion of clinical trials may also ultimately lead to the denial of regulatory approval of our product candidates.

Data from our clinical trials that we announce or publish from time to time may change as more patient data become available either through long-term patient follow-up and/or as such data is audited and verified, which could result in material changes to clinical and safety profiles for our products.

From time to time, we may disclose data from our preclinical studies and clinical trials. Such data from clinical trials that we may complete are subject to the risk that one or more of the clinical outcomes may materially change as patient enrollment continues and more patient data become available or as patients from our clinical trials continue other treatments for their disease. In addition, the clinical trials evaluating our products and product candidates generally require that we continue to monitor and evaluate safety and efficacy in patients over an extended period of time following treatment, including for up to fifteen years for some studies, which may result in the safety or efficacy profile to change over time. Changes in the efficacy and safety profile of our product or product candidates over time could significantly harm our business prospects including resulting in volatility in the price of our common stock.

Additionally, from time to time, we may publicly disclose preliminary or top-line data from our preclinical studies and clinical trials, which are based on a preliminary analysis of then-available data, and the results and related findings and conclusions are subject to change following a more comprehensive review of the data related to the particular study or trial. We also make assumptions, estimations, calculations and conclusions as part of our analyses of data, and we may not have received or had the opportunity to fully and carefully evaluate all data. As a result, the top-line or preliminary results that we report may differ from future results of the same studies, or different conclusions or considerations may qualify such results, once additional data have been received and fully evaluated. Top-line data also remain subject to audit and verification procedures that may result in the final data being materially different from the preliminary data we previously published. As a result, top-line data should be viewed with caution until the final data are available.

Further, others, including regulatory agencies, may not accept or agree with our assumptions, estimates, calculations, conclusions or analyses or may interpret or weigh the importance of data differently, which could impact the value of the particular program, the approvability or commercialization of the particular product candidate or product and our Company in general. In addition, the information we choose to publicly disclose regarding a particular study or clinical trial is based on what is typically extensive information, and you or others may not agree with what we determine is material or otherwise appropriate information to include in our disclosure. If others, including regulatory authorities, disagree with the conclusions reached with respect to such information and assessments, our ability to obtain approval for, and commercialize, our product candidates may be harmed, which could harm our business, operating results, prospects or financial condition.

Even if we have received or will receive accelerated approval from the FDA, if our confirmatory trials do not verify clinical benefit, or if we do not comply with rigorous post-marketing requirements, the FDA may seek to withdraw any accelerated approval we have obtained.

In September 2022, SKYSONA received accelerated approval from the FDA, and we may in the future receive accelerated approval for our one or more of our product candidates. Under the accelerated approval program, the FDA may grant accelerated approval to a product candidate designed to treat a serious or life-threatening condition that provides meaningful therapeutic benefit over available therapies upon a determination that the product candidate has an effect on a surrogate endpoint or intermediate clinical endpoint that is reasonably likely to predict clinical benefit. The FDA considers a clinical benefit to be a positive therapeutic effect that is clinically meaningful in the context of a given disease, such as irreversible morbidity or mortality. For the purposes of accelerated approval, a surrogate endpoint is a marker, such as a laboratory measurement, radiographic image, physical sign, or other measure that is thought to predict clinical benefit, but is not itself a measure of clinical benefit. An intermediate clinical endpoint is a clinical endpoint that can be measured earlier than an effect on irreversible morbidity or mortality that is reasonably likely to predict an effect on irreversible morbidity or mortality or other clinical benefit.

The accelerated approval pathway may be used in cases in which the advantage of a new drug over available therapy may not be a direct therapeutic advantage, but is a clinically important improvement from a patient and public health perspective. If granted, accelerated approval is usually contingent on the sponsor's agreement to conduct, in a diligent manner, one or more additional confirmatory studies to verify and describe the drug's clinical benefit. If such post-approval studies fail to confirm the drug's clinical benefit or are not completed in a timely manner, the FDA may withdraw its approval of the drug on an expedited basis. For example, we agreed to provide confirmatory long-term clinical data to the FDA as a condition of the SKYSONA accelerated approval, and continued approval for the approved indication will be contingent upon verification of clinical benefit with confirmatory clinical data. Moreover, certain payers, including state Medicaid agencies, may scrutinize therapies that reach the market through accelerated approval, which can lead to delays in broader access after approval and require additional company resources to address any concerns.

In addition, in December 2022, President Biden signed an omnibus appropriations bill to fund the U.S. government through fiscal year 2023. Included in the omnibus bill is the Food and Drug Omnibus Reform Act of 2022, which among other things, introduced reforms intended to expand the FDA's ability to regulate products receiving accelerated approval, including by increasing the FDA's oversight over the conduct of confirmatory trials; however, the ultimate impact of these reforms remains unclear.

A Regenerative Medicine Advanced Therapy designation by the FDA, even if granted for any of our product candidates, may not lead to a faster development or regulatory review or approval process and does not increase the likelihood that our product candidates will receive marketing approval.

We have obtained Regenerative Medicine Advanced Therapy ("RMAT") designation for lovo-cel for the treatment of SCD, and we may seek additional RMAT designations for our product candidates. A biological product candidate is eligible for RMAT designation if: (1) it meets the definition of a regenerative medicine therapy, which the FDA defines as a cell therapy, therapeutic tissue engineering product, human cell and tissue product, or any combination product using such therapies or products, with limited exceptions; (2) the candidate is intended to treat, modify, reverse, or cure a serious disease or condition; and (3) preliminary clinical evidence indicates that the candidate has the potential to address unmet medical needs for such disease or condition. RMAT designation provides potential benefits that include more frequent meetings with FDA to discuss the development plan for the product candidate, and eligibility for rolling review and priority review of BLAs. Product candidates granted RMAT designation may also be eligible for accelerated approval on the basis of a surrogate or intermediate endpoint reasonably likely to predict long-term clinical benefit, or through reliance upon data obtained from a meaningful number of sites, including through expansion to a sufficient number of sites, as appropriate. RMAT-designated product candidates that receive accelerated approval may, as appropriate, be able to fulfill their post-approval requirements through the submission of clinical evidence, clinical studies, patient registries, or other sources of real-world evidence (such as electronic health records); through the collection of larger confirmatory data sets; or via post-approval monitoring of all patients treated with such therapy prior to approval of the therapy.

RMAT designation is within the sole discretion of the FDA. Accordingly, even if we believe one of our product candidates meets the criteria for RMAT designation, the FDA may disagree and instead determine not to make such designation. RMAT designation does not change the standards for product approval, and there is no assurance that such designation or eligibility for such designation will result in expedited review or approval or that the approved indication will not be narrower than the indication covered by the RMAT designation. Additionally, RMAT designation can be revoked if the product candidate fails to meet the qualifications as clinical data continue to emerge.

We have obtained and may seek orphan drug designation for our product candidates, but we may be unable to obtain such designation or to obtain or maintain the benefits associated with orphan drug designation, including market exclusivity, which may cause our product revenue, if any, to be reduced.

We have obtained orphan drug designations for certain diseases or conditions for beti-cel, lovo-cel and eli-cel. Under the Orphan Drug Act, the FDA may designate a biological product as an orphan drug if it is intended to treat a rare disease or condition, defined as a patient population of fewer than 200,000 in the United States, or a patient population greater than 200,000 in the United States where there is no reasonable expectation that the cost of developing the drug will be recovered from sales in the United States. Orphan drug designation must be requested before submitting a BLA. In the United States, orphan drug designation entitles a party to financial incentives such as opportunities for grant funding towards clinical trial costs, tax advantages, waivers from certain pediatric clinical trial requirements, and application fee waivers. After the FDA grants orphan drug designation, the generic identity of the therapeutic agent and its potential orphan use are disclosed publicly by the FDA.

In addition, if a product candidate receives the first FDA approval for the disease or condition for which it has orphan designation, the product is entitled to orphan drug exclusivity, which means the FDA may not approve any other application to market the same drug for the same disease or condition for a period of seven years, except in limited circumstances, such as a showing of clinical superiority over the product with orphan exclusivity or where the manufacturer is unable to assure sufficient product quantity for the orphan patient population. Exclusive marketing rights in the United States may also be unavailable if we or our collaborators seek approval for a disease or condition broader than the orphan designated disease or condition and may be lost if the FDA later determines that the request for designation was materially defective.

Even if we obtain orphan drug designation, we may not be the first to obtain marketing approval for any particular orphan disease or condition due to the uncertainties associated with developing pharmaceutical products. Further, even if we obtain orphan drug exclusivity for a product candidate, that exclusivity may not effectively protect the product from competition

because different drugs can be approved for the same disease condition. Even after an orphan drug is approved, the FDA can subsequently approve the same drug for the same condition if the FDA concludes that the later drug is clinically superior in that it is safer, more effective, or makes a major contribution to patient care. Orphan drug designation neither shortens the development time or regulatory review time of a drug nor gives the drug any advantage in the regulatory review or approval process.

We have obtained a rare pediatric disease designation for lovo-cel for the treatment of SCD and entered into an advance agreement to sell the associated priority review voucher, if granted; however, there is no guarantee that FDA approval will result in issuance of a priority review voucher.

In 2012, Congress authorized the FDA to award priority review vouchers to sponsors of certain rare pediatric disease product applications. This program is designed to encourage development of new drug and biological products for prevention and treatment of certain rare pediatric diseases. Specifically, under this program, a sponsor who receives an approval for a drug or biologic for a “rare pediatric disease” that meets certain criteria may qualify for a voucher that can be redeemed to receive a priority review of a subsequent marketing application for a different product. The sponsor of a rare pediatric disease drug product receiving a priority review voucher may transfer (including by sale) the voucher to another sponsor. The voucher may be further transferred any number of times before the voucher is used, as long as the sponsor making the transfer has not yet submitted the application. The FDA may also revoke any priority review voucher if the rare pediatric disease drug for which the voucher was awarded is not marketed in the U.S. within one year following the date of approval.

We have obtained a rare pediatric disease designation for lovo-cel for the treatment of SCD and in October 2023, we entered into an agreement to sell a priority review voucher, if received, in connection with the potential approval of lovo-cel, for \$103.0 million. However, there is no guarantee that we will be able to obtain a priority review voucher, even if lovo-cel is approved by the FDA. For example, the FDA may determine that a BLA for lovo-cel, even if ultimately approved, does not meet the eligibility criteria for a priority review voucher, such as where the FDA limits approval, if ultimately received, to a patient population over 18 years of age, due to, for instance, insufficient clinical data in the pediatric population. If we do not obtain a priority review voucher in connection with the potential approval of lovo-cel, we will be unable to close the sale, which could have a material adverse effect on our business.

Moreover, Congress included a sunset provision in the statute authorizing the rare pediatric disease priority review voucher program. Under the current statutory sunset provisions, after September 30, 2024, FDA may only award a voucher for an approved rare pediatric disease product application if the sponsor has rare pediatric disease designation for the product candidate, and that designation was granted by September 30, 2024. After September 30, 2026, FDA may not award any rare pediatric disease priority review vouchers.

Our biological products and product candidates may face competition sooner than anticipated.

The Affordable Care Act includes a subtitle called the Biologics Price Competition and Innovation Act of 2009 (“BPCIA”), which created an abbreviated approval pathway for biological products that are biosimilar to or interchangeable with an FDA-licensed reference biological product. Under the BPCIA, an application for a highly similar or “biosimilar” product may not be submitted to the FDA until four years following the date that the reference product was first approved by the FDA. In addition, the approval of a biosimilar product may not be made effective by the FDA until 12 years from the date on which the reference product was first approved. During this 12-year period of exclusivity, another company may still market a competing version of the reference product if the FDA approves a full BLA for the competing product containing the sponsor’s own preclinical data and data from adequate and well-controlled clinical trials to demonstrate the safety, purity and potency of their product. We believe that any of our product candidates approved as a biological product under a BLA should qualify for the 12-year period of exclusivity. However, there is a risk that this exclusivity could be shortened due to congressional action or otherwise, or that the FDA will not consider our product candidates to be reference products for competing products, potentially creating the opportunity for competition sooner than anticipated. Moreover, the extent to which a biosimilar, once approved, will be substituted for any one of our reference products in a way that is similar to traditional generic substitution for non-biological products is not yet clear, and will depend on a number of marketplace and regulatory factors that are still developing.

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 ZYNTEGLO, SKYSONA and lovo-cel.

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. For instance, we are aware that the FDA has accepted BLAs submitted by Vertex Pharmaceuticals for the treatment of beta thalassemia and sickle cell disease. 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 products or product candidates uneconomical or obsolete, and we may not be successful in marketing our product candidates against competitors.

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 complementary technologies such as reduced toxicity conditioning.

The success of our business depends, in part, upon our ability to identify, develop and commercialize products based on our platform technologies. 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. We may be unsuccessful in identifying potential product candidates through research or partnerships, 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 any 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 products and product candidates or adversely affect our ability to conduct our business or obtain and maintain marketing approvals for our products and 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 products and 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 product candidates, 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.

Disruptions at the FDA and other government agencies caused by funding shortages or global health concerns could hinder their ability to hire, retain or deploy key leadership and other personnel, prevent new or modified products from being developed, reviewed, approved or commercialized in a timely manner or at all, which could negatively impact our business.

The ability of the FDA and foreign regulatory authorities to review and approve new products can be affected by a variety of factors, including government budget and funding levels, statutory, regulatory, and policy changes, the FDA's or foreign regulatory authorities' ability to hire and retain key personnel and accept the payment of user fees, and other events that may otherwise affect the FDA's or foreign regulatory authorities' ability to perform routine functions. Average review times at the FDA and foreign regulatory authorities have fluctuated in recent years as a result. In addition, government funding of other government agencies that fund research and development activities is subject to the political process, which is inherently fluid and unpredictable. Disruptions at the FDA may also slow the time necessary for new drugs, medical devices and biologics or modifications to approved drugs and biologics to be reviewed and/or approved by necessary government agencies, which would adversely affect our business. For example, over the last several years, the U.S. government has shut down several times and certain regulatory agencies, such as the FDA, have had to furlough critical FDA employees and stop critical activities.

Separately, in response to the global COVID-19 pandemic, the FDA postponed most inspections of domestic and foreign manufacturing facilities at various points. Even though the FDA has since resumed standard inspection operations of domestic

facilities where feasible, the FDA has continued to monitor and implement changes to its inspectional activities to ensure the safety of its employees and those of the firms it regulates as it adapts to the evolving COVID-19 pandemic, and any resurgence of the virus or emergence of new variants may lead to further inspectional delays. Regulatory authorities outside the United States have adopted similar policy measures in response to the COVID-19 pandemic. If a prolonged government shutdown occurs, or if global health concerns continue to prevent the FDA or other regulatory authorities from conducting their regular inspections, reviews, or other regulatory activities, it could significantly impact the ability of the FDA or other regulatory authorities to timely review and process our regulatory submissions, which could have a material adverse effect on our business.

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 reduces 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, including as a result of insolvency, 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, we will not be able to support commercialization of SKYSONA and ZYNTEGLO and of lovo-cel, if and when 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, including the inability to negotiate favorable terms to increase capacity to meet future forecasted demand;
- 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, including the potential for failed product batches that have resulted, and may in the future result, in delays in treatment of patients;
- 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 products or product candidates. 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, particularly those we anticipate using for the commercial production of lovo-cel (when and if approved) have not produced a commercially-approved product and therefore have not obtained the requisite FDA or other regulatory approvals to do so. Our facilities and quality systems and the facilities and quality systems of some or all of our third-party contractors may be required to successfully complete a pre-approval inspection for compliance with GMPs and other applicable regulations as a condition of marketing approval of our product candidates. In addition, the regulatory authorities may, at any time, audit or inspect a manufacturing facility involved with the preparation of our products or product candidates or the associated quality systems for compliance with the regulations applicable to the activities being conducted. If these facilities do not successfully complete a pre-approval plant inspection, it is possible FDA or other marketing approval of the product candidates may be delayed or prevented.

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.

Further, any plans to expand our manufacturing capacity are subject to the review and approval of regulatory authorities and there is no guarantee that we will receive such approval on the timelines we anticipate. For instance, we have not yet received approval for the planned expansion of our manufacturing capacity for ZYNTEGLO and SKYSONA. Delays in our expansion of manufacturing capacity could affect our ability to meet demand and 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 products or product candidates, cause us to incur higher costs and prevent us from successfully commercializing our products or product candidates. 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 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 rely on contract research organizations ("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 and in accordance with applicable GCPs, GLPs and other 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. Regulatory authorities enforce these GCPs through periodic inspections of trial sponsors, principal investigators and trial sites. We cannot assure you that upon inspection by a given regulatory authority, such regulatory authority will determine that any of our clinical trials complies with GCP regulations. 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 commercialize ZYNTEGLO and SKYSONA and complete the development of, and obtain the regulatory, pricing and reimbursement approvals necessary to commercialize lovo-cel and other potential future product candidates (if and when approved). 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 our approved products;
- launching and commercializing our approved products with a sustainable field-based team and marketing and distribution infrastructure;
- obtaining sufficient pricing and reimbursement for our approved products from private and governmental payers;
- obtaining market acceptance and adoption of our approved products 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 products and product candidates, 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 products and product candidates is subject to outcomes-based arrangements over time, as it is for ZYNTEGLO, 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 will 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. Moreover, our future net product revenues will depend upon the size of the markets in which the products have received approval, the ability to manufacture and deliver drug product to patients, the ability of such products to achieve sufficient market acceptance, reimbursement from third-party payers, adequate market share in those markets and performance of the drug product subject to outcome-based programs. 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 revenues from product sales will be difficult to predict from period to period, given the absence of historical sales data for ZYNTEGLO, SKYSONA, and lovo-cel, if approved.

Further, changes in our operations, such as 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 impact of the ongoing volatility in macro-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 has 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.

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.

As a result of the COVID-19 pandemic, we have experienced and may in the future 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, and the treatment of patients in the commercial context. The COVID-19 pandemic has also 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. Furthermore, certain third parties in our supply chain 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. We cannot reasonably assess or predict at this time any continued negative impact that the COVID-19 pandemic and related effects may have on our business, financial condition, results of operations and cash flows.

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. We do not yet know the full extent of potential delays or impacts on our business, our clinical studies, our research programs, our commercial activities in the United States, healthcare systems or the global economy. For instance, we continue to evaluate any impact of COVID-19 on our QTC network, our supply chain, and any potential future clinical trials.

Our products, whether FDA-approved or investigational, remain subject to regulatory scrutiny.

For any regulatory approvals that we have or may receive, the manufacturing processes, labeling, packaging, distribution, adverse event reporting, storage, advertising, promotion, import, export and recordkeeping for our products and/or product candidates will be subject to extensive and ongoing regulatory requirements. These requirements include submissions of safety and other post-marketing information and reports, registration, as well as ongoing compliance with cGMPs and GCPs for any clinical trials that we may conduct. In addition, manufacturers of drug products and their facilities are subject to continual review and periodic, unannounced inspections by the FDA and other regulatory authorities for compliance with cGMP regulations and standards. Even though we have obtained marketing approval in the U.S. for ZYNTÉGLO and SKYSONA and may obtain regulatory approval in the U.S. for lovo-cel, any regulatory approvals we may receive will require the submission of reports to regulatory authorities and surveillance to monitor the safety and efficacy of the product candidates, and such approvals may contain significant limitations related to use restrictions for specified age groups, warnings, precautions or contraindications, and may include burdensome post-approval study or risk management requirements. For example, the FDA typically advises that patients treated with integrating gene therapy undergo follow-up observations for potential adverse events for a 15-year period. Furthermore, we have agreed to provide confirmatory long-term clinical data to the FDA as a condition of the SKYSONA accelerated approval, and continued approval for the approved indication will be contingent upon verification and description of clinical benefit in a confirmatory trial. If our confirmatory trials fail to adequately verify or describe the anticipated clinical benefit of SKYSONA, or if we fail to conduct such trials in a timely manner, the FDA could withdraw its approval for SKYSONA on an expedited basis.

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 clinical programs due to safety concerns arising from our SKYSONA and lovo-cel programs, and we can make no assurance that we will not experience interruptions in any clinical studies, marketing or other commercialization activities in the future, whether due to safety concerns in any approved or investigational 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.

The FDA's and other regulatory authorities' policies may change and additional government regulations may be promulgated that could prevent, limit or delay marketing authorization of any product candidates we develop. We also cannot

predict the likelihood, nature or extent of government regulation that may arise from future legislation or administrative action, either in the United States or abroad. If we are slow or unable to adapt to changes in existing requirements or the adoption of new requirements or policies, or if we are not able to maintain regulatory compliance, we may be subject to enforcement action and we may not achieve or sustain profitability.

The FDA and other regulatory agencies actively enforce the laws and regulations prohibiting the promotion of off-label uses.

The FDA strictly regulates marketing, labeling, advertising and promotion of prescription drugs and biologics. These regulations include standards and restrictions for direct-to-consumer advertising, industry-sponsored scientific and educational activities, promotional activities involving the internet and off-label promotion. Any regulatory approval that the FDA grants is limited to those specific diseases and indications for which a product is deemed to be safe, pure and potent, or effective, by the FDA. For example, the current FDA-approved indication for ZYNTGLO is limited to the treatment of adult and pediatric patients with β -thalassemia who require regular red blood cell transfusions, and the FDA-approved indication for SKYSONA is limited to slow the progression of neurologic dysfunction in boys 4-17 years of age with early, active CALD, which is defined to include to asymptomatic or mildly symptomatic (neurologic function score, NFS \leq 1) boys who have gadolinium enhancement on brain magnetic resonance imaging and Loes scores of 0.5-9.

While physicians in the United States may choose, and are generally permitted, to prescribe drugs for uses that are not described in the product's labeling and for uses that differ from those tested in clinical trials and approved by the regulatory authorities, our ability to manufacture and promote any products will be narrowly limited to those indications that are specifically approved by the FDA. If we are found to have manufactured and promoted such off-label uses, we may become subject to significant liability. The U.S. federal government has levied large civil and criminal fines against companies for alleged improper promotion of off-label use and has enjoined several companies from engaging in off-label promotion. The FDA has also requested that companies enter into consent decrees or permanent injunctions under which specified promotional conduct is changed or curtailed. If we cannot successfully manage the promotion any product candidates, if approved, we could become subject to significant liability, which would materially adversely affect our business and financial condition.

We are subject, directly or indirectly, to federal and state healthcare fraud and abuse laws and, false claims 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. 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, patient services 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.

Actual or perceived failures to comply with applicable data protection, privacy and security laws, regulations, standards and other requirements could adversely affect our business, results of operations, and financial condition.

The global data protection landscape is rapidly evolving, and we are or may become subject to numerous state, federal and foreign laws, requirements and regulations governing the collection, use, disclosure, retention, and security of personal information, such as information that we may collect in connection with clinical trials. Implementation standards and enforcement practices are likely to remain uncertain for the foreseeable future, and we cannot yet determine the impact future laws, regulations, standards, or perception of their requirements may have on our business. This evolution may create uncertainty in our business, affect our ability to operate in certain jurisdictions or to collect, store, transfer use and share personal information, necessitate the acceptance of more onerous obligations in our contracts, result in liability or impose additional costs on us. The cost of compliance with these laws, regulations and standards is high and is likely to increase in the future. Any failure or perceived failure by us to comply with federal, state or foreign laws or regulations, our internal policies and procedures or our contracts governing our processing of personal information could result in negative publicity, government investigations and enforcement actions, claims by third parties and damage to our reputation, any of which could have a material adverse effect on our business, results of operation, and financial condition.

In the U.S., HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act of 2009 ("HITECH") and their implementing regulations (collectively, "HIPAA"), 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. Certain states have also adopted comparable privacy and security laws and regulations, which govern the privacy, processing and protection of health-related and other personal information. For example, California 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 CCPA provides for civil penalties for violations, as well as a private right of action for data breaches that has increased the likelihood of, and risks associated with data breach litigation. Further, the California Privacy Rights Act ("CPRA") generally went into effect on January 1, 2023, and significantly amends the CCPA. It imposes additional data protection obligations on covered businesses, including additional consumer rights processes, limitations on data uses, new audit requirements for higher risk data, and opt outs for certain uses of sensitive data. It also creates a new California data protection agency authorized to issue substantive regulations and could result in increased privacy and information security enforcement. Additional compliance investment and potential business process changes may also be required. Similar laws have passed in Virginia, Colorado, Connecticut and Utah, and have been proposed in other states and at the federal level, reflecting a trend toward more stringent privacy legislation in the United States. The enactment of such laws could have potentially conflicting requirements that would make compliance challenging. In the event that we are subject to or affected by HIPAA, the CCPA, the CPRA or other domestic privacy and data protection laws, any liability from failure to comply with the requirements of these laws could adversely affect our financial condition.

Furthermore, the Federal Trade Commission (FTC) and many state Attorneys General continue to enforce federal and state consumer protection laws against companies for online collection, use, dissemination and security practices that appear to be unfair or deceptive. For example, according to the FTC, failing to take appropriate steps to keep consumers' personal information secure can constitute unfair acts or practices in or affecting commerce in violation of Section 5(a) of the Federal Trade Commission Act. The FTC expects a company's data security measures to be reasonable and appropriate in light of the sensitivity and volume of consumer information it holds, the size and complexity of its business, and the cost of available tools to improve security and reduce vulnerabilities.

We are also or may become subject to rapidly evolving data protection laws, rules and regulations in foreign jurisdictions. For example, in Europe, the European Union General Data Protection Regulation ("GDPR") went into effect in May 2018 and imposes strict requirements for processing the personal data of individuals within the European Economic Area ("EEA"). Companies that must comply with the GDPR face increased compliance obligations and risk, including more robust regulatory

enforcement of data protection requirements and potential fines for noncompliance of up to €20 million or 4% of the annual global revenues of the noncompliant company, whichever is greater. Among other requirements, the GDPR regulates transfers of personal data subject to the GDPR to third countries that have not been found to provide adequate protection to such personal data, including the United States; in July 2020, the Court of Justice of the EU (“CJEU”) limited how organizations could lawfully transfer personal data from the EU/EEA to the United States by invalidating the Privacy Shield for purposes of international transfers and imposing further restrictions on the use of standard contractual clauses (“SCCs”). In March 2022, the US and EU announced a new regulatory regime intended to replace the invalidated regulations; however, this new EU-US Data Privacy Framework has not been implemented beyond an executive order signed by President Biden on October 7, 2022 on Enhancing Safeguards for United States Signals Intelligence Activities. European court and regulatory decisions subsequent to the CJEU decision of July 16, 2020 have taken a restrictive approach to international data transfers. As supervisory authorities issue further guidance on personal data export mechanisms, including circumstances where the SCCs cannot be used, and/or start taking enforcement action, we could suffer additional costs, complaints and/or regulatory investigations or fines, and/or if we are otherwise unable to transfer personal data between and among countries and regions in which we operate, it could affect the manner in which we provide our services, the geographical location or segregation of our relevant systems and operations, and could adversely affect our financial results.

Since the beginning of 2021, after the end of the transition period following the United Kingdom’s departure from the European Union, we are also subject to the United Kingdom data protection regime, which imposes separate but similar obligations to those under the GDPR and comparable penalties, including fines of up to £17.5 million or 4% of a noncompliant company’s global annual revenue for the preceding financial year, whichever is greater. As we continue to expand into other foreign countries and jurisdictions, we may be subject to additional laws and regulations that may affect how we conduct business.

If we fail to comply with reporting and payment obligations under the Medicaid Drug Rebate Program or other governmental pricing programs, we could be subject to additional reimbursement requirements, penalties, sanctions and fines, which could have a material adverse effect on our business, financial condition, results of operations and growth prospects.

We participate in governmental programs that impose extensive drug price reporting and payment obligations on pharmaceutical manufacturers. Medicaid is a joint federal and state program that is administered by the states for low income and disabled beneficiaries. Under the Medicaid Drug Rebate Program (the “MDRP”), as a condition of federal funds being made available for our covered outpatient drugs under Medicaid and certain drugs or biologicals under Medicare Part B, we pay a rebate to state Medicaid programs for each unit of our covered outpatient drugs dispensed to a Medicaid beneficiary and paid for by the state Medicaid program. Medicaid rebates are based on pricing data that we report on a monthly and quarterly basis to CMS, the federal agency that administers the MDRP and Medicare programs. For the MDRP, these data include the Average Manufacturer Price (“AMP”) for each drug and, in the case of innovator products, best price. In connection with Medicare Part B, a pharmaceutical manufacturer must provide CMS with average sales price (“ASP”) information for certain drugs or biologicals on a quarterly basis. ASP is calculated based on a statutorily defined formula, as well as regulations and interpretations of the statute by CMS. If we become aware that our MDRP price reporting submission for a prior period was incorrect or has changed as a result of recalculation of the pricing data, we must resubmit the corrected data for up to three years after those data originally were due. If we fail to provide information timely or are found to have knowingly submitted false information to the government, we may be subject to civil monetary penalties and other sanctions, including termination from the MDRP, in which case payment would not be available for our covered outpatient drugs under Medicaid or, if applicable, Medicare Part B.

Federal law requires that any company that participates in the MDRP also participate in the 340B program in order for federal funds to be available for the manufacturer’s drugs under Medicaid and Medicare Part B. The 340B program is administered by HRSA and imposes a statutorily defined “ceiling price” for pharmaceutical products purchased by defined “covered entities” when administered in the outpatient setting. To date, bluebird’s therapies have been administered in the inpatient setting exclusively and we anticipate that most patients will continue to receive bluebird’s therapies in an inpatient setting. However, in the event that patients are treated in an outpatient setting, we may be required to offer the statutorily defined 340B “ceiling price” for our covered drugs to 340B covered entities for eligible sales. These 340B covered entities include a variety of community health clinics and other entities that receive health services grants from the Public Health Service, as well as hospitals that serve a disproportionate share of low income patients. A drug that is designated for a rare disease or condition by the Secretary of Health and Human Services is not subject to the 340B ceiling price requirement with regard to the following types of covered entities: rural referral centers, sole community hospitals, critical access hospitals, and free standing cancer hospitals. The 340B ceiling price is calculated using a statutory formula, which is based on the AMP and rebate amount for the covered outpatient drug as calculated under the MDRP. In general, products subject to Medicaid price reporting and rebate liability are also subject to the 340B ceiling price calculation and discount requirement. We must report

340B ceiling prices to the Healthcare Resources and Services Administration (HRSA) on a quarterly basis, and HRSA publishes them to 340B covered entities via a closed data portal. HRSA has finalized regulations regarding the calculation of the 340B ceiling price and the imposition of civil monetary penalties on manufacturers that knowingly and intentionally overcharge covered entities for 340B eligible drugs. HRSA has also finalized an administrative dispute resolution process through which 340B covered entities may pursue claims against participating manufacturers for overcharges, and through which manufacturers may pursue claims against 340B covered entities for engaging in unlawful diversion or duplicate discounting of 340B drugs. In addition, legislation may be introduced that, if passed, would further expand the 340B program, such as adding further covered entities or requiring participating manufacturers to agree to provide 340B discounted pricing on drugs used in an inpatient setting.

In order to be eligible to have drug products paid for with federal funds under Medicaid and Medicare Part B and purchased by certain federal agencies and grantees, we must also participate in the VA/FSS pricing program. Under the VA/FSS program, we must report the Non-FAMP for our covered drugs to the VA and charge certain federal agencies no more than the Federal Ceiling Price, which is calculated based on Non FAMP using a statutory formula. These four agencies are the VA, the U.S. Department of Defense, the U.S. Coast Guard, and the U.S. Public Health Service (including the Indian Health Service). We must also pay rebates on products purchased by military personnel and dependents through the TRICARE retail pharmacy program. If we fail to provide timely information or are found to have knowingly submitted false information, we may be subject to civil monetary penalties.

Individual states continue to consider and have enacted legislation to limit the growth of healthcare costs, including the cost of prescription drugs and combination products. A number of states have either implemented or are considering implementation of drug price transparency legislation that may prevent or limit our ability to take price increases at certain rates or frequencies. Requirements under such laws include advance notice of planned price increases, reporting price increase amounts and factors considered in taking such increases, wholesale acquisition cost information disclosure to prescribers, purchasers, and state agencies, and new product notice and reporting. Such legislation could limit the price or payment for certain drugs, and states may impose civil monetary penalties or pursue other enforcement mechanisms against manufacturers who fail to comply with drug price transparency requirements. If we are found to have violated state law requirements, we may become subject to penalties or other enforcement mechanisms, which could have a material adverse effect on our business.

Pricing and rebate calculations vary across products and programs, are complex, and are often subject to interpretation by us, governmental or regulatory agencies, and the courts, which can change and evolve over time. Such pricing calculations and reporting, along with any necessary restatements and recalculations, could increase our costs for complying with the laws and regulations governing the MDRP and other governmental programs, and under the MDRP could result in an overage or undercharge in Medicaid rebate liability for past quarters. Price recalculations under the MDRP also may affect the ceiling price at which we are required to offer products under the 340B program. Civil monetary penalties can be applied if we are found to have knowingly submitted any false price or product information to the government, if we fail to submit the required price data on a timely basis, or if we are found to have charged 340B covered entities more than the statutorily mandated ceiling price. CMS could also terminate our Medicaid drug rebate agreement, in which case federal payments may not be available under Medicaid or Medicare Part B, if applicable, for our covered outpatient drugs. Pursuant to the Inflation Reduction Act of 2022 (the “IRA”), the AMP figures we report will also be used to compute rebates under Medicare Part D triggered by price increases that outpace inflation. We cannot assure you that our submissions will not be found to be incomplete or incorrect.

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 products or product candidates harm patients, or is perceived to harm patients even when such harm is unrelated to our products or 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 products for which we have obtained 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 products and product candidates. There is a risk that our products and 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 products; 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 products and 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 products and 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 products and 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 our approved products maintain. 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.

The increasing focus on environmental sustainability and social initiatives could increase our costs, harm our reputation and adversely impact our financial results.

There has been increasing public focus by investors, patients, environmental activists, the media and governmental and nongovernmental organizations on a variety of environmental, social and other sustainability matters. We may experience pressure to make commitments relating to sustainability matters that affect us, including the design and implementation of specific risk mitigation strategic initiatives relating to sustainability. If we are not effective in addressing environmental, social and other sustainability matters affecting our business, or setting and meeting relevant sustainability goals, our reputation and financial results may suffer. In addition, even if we are effective at addressing such concerns, we may experience increased costs as a result of executing upon our sustainability goals that may not be offset by any benefit to our reputation, which could have an adverse impact on our business and financial condition.

In addition, this emphasis on environmental and social matters has resulted in the adoption of new laws and regulations, including new reporting requirements, and may result in the adoption of additional laws and regulations in the future. New reporting requirements may be particularly difficult or expensive to comply with and, if we fail to comply, we may be required to issue financial restatements, suffer harm to our reputation or otherwise have our business be adversely impacted. Such ESG matters may also impact our suppliers or patients, which may adversely impact our business, financial condition and results of operations.

In addition, this emphasis on environmental, social and other sustainability matters has resulted and may result in the adoption of new laws and regulations, including new reporting requirements. If we fail to comply with new laws, regulations or reporting requirements, our reputation and business could be adversely impacted.

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 product candidates, restrict or regulate post-approval activities and affect our ability to profitably sell products for which we have obtained 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.

A primary trend in the U.S. healthcare industry and elsewhere is cost containment. Government authorities and other third party payers have attempted to control costs by limiting coverage and the level of reimbursement for particular medical products and services, implementing reductions in Medicare and other healthcare funding and applying new payment methodologies. For example, in March 2010, the Affordable Care Act ("ACA") was enacted, which, among other things, increased the minimum Medicaid rebates owed by most manufacturers under the Medicaid Drug Rebate Program; introduced 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; extended manufacturer Medicaid rebate obligations to utilization by individuals enrolled in Medicaid managed care plans; established a new Medicare Part D coverage gap discount program; subjected drug manufacturers to new annual fees based on pharmaceutical companies' share of sales to federal healthcare programs; imposed a new federal excise tax on the sale of certain medical devices; created a new Patient Centered Outcomes Research Institute to oversee, identify priorities in, and conduct comparative clinical effectiveness research, along with funding for such research; and established a Center for Medicare Innovation at the CMS to test innovative payment and service delivery models to lower Medicare and Medicaid spending.

Since its enactment, there have been judicial, executive and Congressional challenges to certain aspects of the ACA. On June 17, 2021, the U.S. Supreme Court dismissed the most recent judicial challenge to the ACA brought by several states without specifically ruling on the constitutionality of the ACA. In addition, other legislative changes have been proposed and adopted in the United States since the ACA was enacted. The Budget Control Act of 2011, among other things, led to reductions of Medicare payments to providers, which will remain in effect through 2031 unless additional Congressional action is taken. More recently, in March 2021, President Biden signed into law the American Rescue Plan Act of 2021, which eliminates the statutory cap on the Medicaid drug rebate, currently set at 100% of a drug's AMP, beginning January 1, 2024.

Most significantly, in August 2022, President Biden signed the Inflation Reduction Act of 2022 ("IRA") into law. This statute marks the most significant action by Congress with respect to the pharmaceutical industry since adoption of the ACA in 2010. Among other things, the IRA requires manufacturers of certain drugs to engage in price negotiations with Medicare (beginning in 2026), with prices that can be negotiated subject to a cap; imposes rebates under Medicare Part B and Medicare Part D to penalize price increases that outpace inflation (first due in 2023); and replaces the Part D coverage gap discount program with a new discounting program (beginning in 2025). The IRA permits the Secretary of the Department of Health and Human Services (HHS) to implement many of these provisions through guidance, as opposed to regulation, for the initial years. HHS has and will continue to issue and update guidance as these programs are implemented. On August 29, 2023, HHS announced the list of the first ten drugs that will be subject to price negotiations, although the Medicare drug price negotiation program is currently subject to legal challenges. In addition, in response to the Biden administration's October 2022 executive order, on February 14, 2023, HHS released a report outlining three new models for testing by the Center for Medicare and Medicaid Innovation which will be evaluated on their ability to lower the cost of drugs, promote accessibility, and improve quality of care. It is unclear whether the models will be utilized in any health reform measures in the future.

At the U.S. 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 products and product candidates. Such reforms could have an adverse effect on anticipated revenue from products and 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 information technology 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 activities related to our approved products and have a material adverse effect on our reputation, business, financial condition or results of operations.

Our information technology systems and those of our current or future third-party collaborators, service providers, contractors and consultants may fail and are vulnerable to attack, damage and interruption from computer viruses and malware (e.g. ransomware), malicious code, natural disasters, terrorism, war, telecommunication and electrical failures, hacking, cyberattacks, phishing attacks and other social engineering schemes, employee theft or misuse, human error, fraud, denial or degradation of service attacks, sophisticated nation-state and nation-state-supported actors or unauthorized access or use by persons inside our organizations, or persons with access to systems inside our organization. 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. The prevalent use of mobile devices and unauthorized applications also increases the risk of data security incidents. As a result of the COVID-19 pandemic, and continued hybrid working environment, we may also face increased cybersecurity risks due to our reliance on internet technology and the number of our employees who are working remotely, which may create additional opportunities for cybercriminals to exploit vulnerabilities. Furthermore, because the techniques used to obtain unauthorized access to, or to sabotage, systems change frequently and often are not recognized until launched against a target, we may be unable to anticipate these techniques or implement adequate preventative measures. We may also experience security breaches that may remain undetected for an extended period. Even if identified, we may be unable to adequately investigate or remediate incidents or breaches due to attackers increasingly using tools and techniques that are designed to circumvent controls, to avoid detection, and to remove or obfuscate forensic evidence.

We and certain of our service providers are from time to time subject to cyberattacks and security incidents. While we do not believe that we have experienced any significant system failure, accident or security breach to date, if we were to experience a 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 our products and 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. 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. Further, our insurance coverage may not be sufficient to cover the financial, legal, business or reputational losses that may result from an interruption or breach of our systems.

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 the assignment and assumption of assets and liabilities and 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.

As a result of the separation, we remain contractually liable in connection with certain agreements transferred to 2seventy; for instance, we may be liable in the event of a breach by 2seventy of an assigned lease agreement, which could result in material expenses. Although 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, we cannot guarantee that 2seventy will be able to satisfy its indemnification obligations, including as related to the lease agreement. 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.

If the distribution of shares of 2seventy, 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 of shares of 2seventy was conditioned upon, among other things, our receipt of a private letter ruling from the U.S. Internal Revenue Service (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 U.S. Internal Revenue Code of 1986, as amended (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. This can include events that occur following the distribution such as subsequent public offerings by us or 2seventy or share sales to persons that engaged in negotiations over share purchases prior to the distribution. Subsequent tax opinions have been obtained by us and 2seventy in connection with certain post-distribution sales of 2seventy's shares. The IRS private letter ruling, the opinion of Goodwin Procter LLP and tax opinions related to certain subsequent post-distribution sales of 2seventy shares were based, among other things, on various facts and assumptions, as well as certain representations, statements and undertakings from us and 2seventy (including those relating to the past and future conduct of us and 2seventy) 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 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 at the time of the distribution, 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's distributed common stock in a taxable sale for its fair market value and our stockholders who receive shares of 2seventy 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 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 under Section 355(e) of the Code or an acquisition of 2seventy stock or assets or certain actions by 2seventy, then 2seventy 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 us or 2seventy under Section 355(e) of the

Code and both we and 2seventy are responsible for such failure, liability will be shared according to relative fault. If neither we nor 2seventy 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 products and 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 products and 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 products and 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 products and 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 our products and 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, our current and future products. Several patent applications covering our products and 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 or 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 products and 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. For example, as discussed in Part II, Item 1, "Legal Proceedings", San Rocco Therapeutics, LLC, formerly known as Errant Gene Therapeutics, LLC has alleged that our use of the BB305 lentiviral vector, including in connection with the beti-cel program infringes U.S. Patent Nos. 7,541,179 and 8,058,061, and seeks equitable, injunctive and monetary relief, including royalties, treble damages, attorney fees and costs. 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 products and 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 or 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 or 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 products or 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 attorney's 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 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 products. Because our programs may involve additional technologies 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. For instance, our growth strategy depends in part upon our ability to leverage advancements in complementary technologies such as in reduced toxicity conditioning or in stem cell mobilization. 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 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 products or 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 products, 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 products 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 products and product candidates. 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 products and 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 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, such as the recent volatility and disruption experienced in the global economy and rising interest and inflation rates, 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, either from patients participating in our clinical trials or in connection with sales of our commercial products or other gene therapy products in the market;
- inability to obtain additional funding;
- any adverse development or perceived adverse development with respect to the regulatory authority's review and acceptance of our BLA for lovo-cel;
- failure to successfully manage and sustain the commercial launch of ZYNTEGLO or SKYSONA or of 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 ZYNTEGLO or SKYSONA or for lovo-cel from private and governmental payers;
- failure to obtain market acceptance and adoption of ZYNTEGLO or SKYSONA or of lovo-cel;
- 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 ZYNTEGLO, SKYSONA 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;
- 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;
- global macroeconomic conditions, including as impacted by geopolitical conflicts and war;
- 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, 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 2023 Incentive Award Plan (the "2023 Plan") we are authorized to grant stock options and other equity-based awards to our employees, directors and consultants. The 2023 Plan authorizes the issuance of up to 5.2 million shares. We also 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 under the inducement plan 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 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.

We are also a party to litigation and subject to claims incident to the ordinary course of business. For instance, as discussed in Part II, Item 1, "Legal Proceedings", San Rocco Therapeutics, LLC, has filed a complaint against us in the United States District Court for the District of Massachusetts, alleging, among other things, civil violations of the Federal Racketeer Influenced and Corrupt Organizations Act, and antitrust violations under state and federal law and seeking declaratory relief and money damages. Although we believe that these claims have no merit, the outcome of litigation is inherently unpredictable. An adverse result in any litigation could materially harm our financial condition, reputation and business. Regardless of the

outcome, litigation can have an adverse impact on us because of defense costs, diversion of management resources and other factors.

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

Under Sections 382 and 383 of the Code, if a corporation undergoes an “ownership change,” generally defined as a cumulative change of greater than 50% (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 and development tax credits) to offset its post-change income and taxes may be limited. We have completed several financings since our inception, which we believe have resulted in shifts in our equity ownership. We completed a study through December 2020 confirming no ownership changes have occurred since our initial public offering in 2013. We may have experienced ownership changes since December 2020, and we may also experience ownership changes in the future as a result of subsequent shifts in our equity ownership, some of which are outside our control. If finalized, Treasury Regulations currently proposed under Section 382 of the Code may further limit our ability to utilize our pre-change NOLs or other pre-change tax attributes if we undergo a future ownership change. Accordingly, if we earn net taxable income, our ability to use our pre-change NOLs and other pre-change tax attributes 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 and regulations could adversely affect our business, financial condition and results of operations.

New income, sales, use or other tax laws, statutes, rules, regulations or ordinances could be enacted at any time, which could affect the tax treatment of any of our future earnings. Further, existing tax laws, statutes, rules, regulations or ordinances could be interpreted, changed, modified or applied adversely to us. Generally, future changes in applicable tax laws and regulations, or their interpretation and application, potentially with retroactive effect, could have an adverse effect on our business, financial conditions and results of operations. We are unable to predict whether such changes will occur and, if so, the ultimate impact on our business. 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, geopolitical conflicts and war, 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 CROs, 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, Use of Proceeds, and Issuer Purchases of Equity Securities

None

Item 3. Defaults Upon Senior Securities

None

Item 4. Mine Safety Disclosures

None

Item 5. Other Information

- (a) None.
- (b) None.
- (c) Not applicable.

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	Form	Incorporated by Reference		
			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
2.2*	Asset Purchase Agreement, dated as of November 29, 2022, by and between bluebird bio, Inc. and argenx BV	8-K	001-35966	2.1	November 30, 2022
2.3*	Asset Purchase Agreement, dated as of January 5, 2023, by and between bluebird bio, Inc. and Bristol-Myers Squibb Company	8-K	001-35966	2.1	January 6, 2023
3.1	Amended and Restated Certificate of Incorporation of the Registrant	8-K	001-35966	3.1	June 24, 2013
3.2	Certificate of Amendment to the Amended and Restated Certificate of Incorporation of the Registrant	8-K	001-35966	3.1	June 20, 2023
3.3	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†	Second Amendment to Master Manufacturing Services Agreement, dated September 21, 2023, by and between the Registrant and Lonza Houston, Inc.	—	—	—	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.

† Portions of this exhibit (indicated by asterisks) have been omitted in accordance with the rules of the SEC.

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.

Date: November 7, 2023

bluebird bio, Inc.

By: /s/ Andrew Obenshain

Andrew Obenshain

President, Chief Executive Officer and Director

(Principal Executive Officer and Duly Authorized Officer)

Date: November 7, 2023

By: /s/ Christopher Krawtschuk

Christopher Krawtschuk

Chief Financial Officer

(Principal Financial Officer, Principal Accounting Officer and Duly Authorized Officer)

**SECOND AMENDMENT TO MASTER MANUFACTURING SERVICES
AGREEMENT**

This Second Amendment (the “Second Amendment”) is made and entered into effective as of the last date of signature below (the “Second Amendment Effective Date”) and amends that certain Master Manufacturing Services Agreement dated June 3, 2016, as previously amended by the first Amendment dated October 23, 2017, (the “Agreement”), by and between Lonza Houston, Inc., a Delaware corporation having its principal place of business at 14905 Kirby Drive, Houston, TX 77047 (“LONZA”), and bluebird bio, Inc., a Delaware corporation having an office at 455 Grand Union Blvd, Somerville, MA 02145, on behalf of itself and its Affiliates (“CLIENT”) (each of LONZA and CLIENT, a “Party” and, collectively, the “Parties”).

WHEREAS, LONZA and CLIENT are Parties to the Agreement as previously amended; and

WHEREAS, the Parties desire to amend the Agreement further by agreeing to this Second Amendment.

NOW, THEREFORE, in consideration of the above premises and the mutual covenants herein set forth, the Parties hereby agree as follows:

1. **Section 1 – Definitions.** The following definitions are added to Agreement Section 1, “Definitions”:

Business Continuity Plan (“BCP”) means a written strategy for rapidly recovering from a significant disruption to operations due to a Force Majeure Event.

Disaster Recovery Plan (“DRP”) means a written strategy for maintaining or reestablishing vital infrastructure and systems following a natural or human-induced disaster.

2. **Section 3.5 – Duty to Notify.** Agreement Section 3.5, “Duty to Notify”, is deleted and replaced in its entirety with the following:

On or about [***] LONZA will provide CLIENT with a list of estimated dates in the ensuing one (1) year (to the extent known by LONZA as of that time) on which LONZA does not plan to undertake Manufacturing activities, including anticipated Facility or suite shut-downs. LONZA will use commercially reasonable efforts to estimate the start and end dates for any anticipated Facility or suite shutdowns [***]. Should LONZA at any time during the term of this Agreement have reason to believe that it will be unable to meet a delivery date, LONZA will promptly notify CLIENT.

3. **Section 7.1 – Invoices.** Agreement Section 7.1, “Invoices”, is deleted and replaced in its entirety with the following:

7.1 Invoices. Fees and other charges to be paid by CLIENT to LONZA in connection with Services provided hereunder, Slot Fees, Fixed Labor Fees, Raw Materials Fees and milestones shall be included in invoices to CLIENT or as otherwise

directed in the applicable SOW. All invoices are strictly net and payment must be made within [***] without deduction, deferment, set-off, lien or counterclaim of any nature. Each invoice shall be sent to: [***]. CLIENT shall submit all necessary Purchase Orders as may be necessary for its internal payment systems in order to ensure that all invoices properly issued hereunder can be timely paid. In the event CLIENT disputes an invoice submitted by LONZA in good faith, CLIENT shall promptly, but in any event [***] following the date of such invoice, notify LONZA in writing of the disputed amount and the basis for such dispute. CLIENT shall otherwise pay the undisputed portion of such invoice in accordance with the timeframes above. The parties shall endeavor to resolve such dispute as quickly as possible, and upon resolution thereof CLIENT shall promptly pay the amount agreed. If such dispute is not resolved within [***] following the due date of such invoice, either party may submit the dispute to the JSC for resolution. If the JSC does not resolve the dispute within [***] from submission of the dispute to the JSC, then either Party may seek remedies available to that party at law; provided, however, that if any such dispute is not made in good faith by CLIENT, LONZA may suspend the provision of Services hereunder until the dispute is resolved.

4. **Section 7.4 – Raw Materials.** Agreement Section 7.4, “Raw Materials”, is deleted and replaced in its entirety with the following:

7.4 Raw Materials. After the construction period (which as of the Second Amendment Effective Date has concluded), the Raw Materials Fee for each Batch may be invoiced by LONZA [***]; provided, however, [***]. Any media or reagents provided to CLIENT or used by LONZA in the Manufacture or development of the Product shall be provided to CLIENT at LONZA’s market rates.

7.4.1 For purposes of managing Manufacturing lead-times and cost risks, commencing upon the Second Amendment Effective Date, LONZA may purchase, store, and maintain a rolling inventory of Materials sufficient to support [***] (the “Safety Stock”) as set forth and defined in Appendix C. The Safety Stock may be updated by mutual agreement of the Parties (including during joint project team meetings to the extent such agreement is memorialized in writing via applicable meeting minutes or otherwise).

7.4.2 For the purpose of managing lead-time and cost risks, commencing upon the Second Amendment Effective Date, LONZA will maintain and report to CLIENT a [***] inventory position statement showing: [***]. LONZA will not purchase, nor will CLIENT be required to pay for, Materials in excess of the Safety Stock unless otherwise agreed by the Parties in writing (including during joint project team meetings to the extent such agreement is memorialized in writing via applicable meeting minutes or otherwise).

5. **Section 12.6 – Termination by Notice:** The last sentence of Section 12.6 is hereby deleted and replaced in its entirety with: “On or after July 1, 2016, CLIENT may terminate this Agreement by providing written notice of termination not less [***] in advance of the date of termination, and on or after [***] LONZA may terminate this Agreement by providing written notice of termination not less than [***] months in advance of the date of termination”.

6. **Section 12.8.5. – [***]**

7. **Section 15 – Miscellaneous:** Agreement Section 15, “Miscellaneous”, is amended by adding the following new subsection 15.2.1:

15.2.1 Disaster Recovery and Business Continuity. LONZA will maintain a Disaster Recovery Plan (“DRP”) for the portions of its Facility where CLIENT’s suites are located. Further, LONZA will maintain a Business Continuity Plan (“BCP”) that covers critical business processes as determined by the LONZA Facility’s Business Impact Analysis (“BIA”). [***] The DRP and the BCP will be LONZA Confidential Information shall not be shared with CLIENT.

8. **Appendix C – Fee Schedule:** Agreement Appendix C, “Fee Schedule”, is deleted and replaced in its entirety with the form of Appendix C attached to this Second Amendment.
9. All capitalized terms not defined herein shall have the meanings ascribed to them in the Agreement.
10. Except as modified by this Second Amendment, all other terms and provisions of the Agreement, as previously amended, shall remain in full force and effect in accordance with their terms.
11. Entire Agreement. This Second Amendment and the Agreement (as previously amended) supersede all other prior agreements, understandings, representations and warranties, oral or written, between the parties hereto in respect of the subject matter hereof. This Second Amendment may be executed in any number of counterparts, each of which shall be deemed to be an original and all of which together shall constitute one and the same document. Each party acknowledges that an original signature or a copy thereof transmitted by facsimile or by pdf shall constitute an original signature for purposes of this Second Amendment.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

IN WITNESS WHEREOF, the Parties hereto have caused this Amendment to be executed by their respective authorized representatives effective as of the last date below.

bluebird bio, Inc.

By: /s/ Kasra Kasraian
Name: Kasra Kasraian
Title: SVP- Pharmaceutical Development & Technology
Date: 21-Sep-2023

Lonza Houston, Inc.

By: /s/ Alberto Santagostino
Name: Alberto Santagostino
Title: SVP, Head of Cell and Gene Technologies Business Unit
Date: 20-Sep-2023

Appendix C
[***]

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 15d-15(f)) for the registrant and have:
 - (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: November 7, 2023

By: /s/ Andrew Obenshain

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

CERTIFICATIONS

I, Christopher Krawtschuk, 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 15d-15(f)) for the registrant and have:
 - (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: November 7, 2023

By: /s/ Christopher Krawtschuk
Christopher Krawtschuk
Chief Financial Officer
(Principal Financial Officer, Principal Accounting Officer
and Duly Authorized Signer)

**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 September 30, 2023 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: November 7, 2023

By: /s/ Andrew Obenshain
Andrew Obenshain
President, Chief Executive Officer and Director
(Principal Executive Officer and Duly Authorized Signer)

Date: November 7, 2023

By: /s/ Christopher Krawtschuk
Christopher Krawtschuk
Chief Financial Officer
(Principal Financial Officer, Principal Accounting Officer and Duly Authorized Signer)