

**UNITED STATES
SECURITIES AND EXCHANGE COMMISSION**
Washington, D.C. 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, 2022

or

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

For the transition period from _____ to _____
Commission File Number: 001-37378

ATYR PHARMA, INC.

(Exact name of registrant as specified in its charter)

Delaware
(State or other jurisdiction
of incorporation or organization)

3545 John Hopkins Court, Suite #250, San Diego, CA
(Address of principal executive offices)

(858) 731-8389

(Registrant's telephone number, including area code)

20-3435077
(I.R.S. Employer
Identification No.)

92121
(Zip Code)

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

<u>Title of each class</u>	<u>Trading Symbol(s)</u>	<u>Name of each exchange on which registered</u>
Common Stock, par value \$0.001 per share	LIFE	The Nasdaq Capital Market

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 8, 2022, there were 29,009,382 shares of the registrant's common stock, par value \$0.001 per share, outstanding.

ATYR PHARMA, INC.
FORM 10-Q
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PART I. FINANCIAL INFORMATION

Item 1. Financial Statements

aTyr Pharma, Inc.

Condensed Consolidated Balance Sheets
(in thousands, except share and per share data)

	September 30, 2022 (unaudited)	December 31, 2021
Assets		
Current assets:		
Cash and cash equivalents	\$ 18,359	\$ 2,336
Available-for-sale investments	59,015	105,575
Other receivables	873	435
Prepaid expenses	6,386	5,223
Total current assets	84,633	113,569
Restricted cash	2,239	—
Property and equipment, net	1,275	543
Operating lease, right-of-use assets	6,971	1,267
Financing lease, right-of-use assets	768	—
Other assets	169	158
Total assets	<u>\$ 96,055</u>	<u>\$ 115,537</u>
Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable	\$ 3,129	\$ 1,031
Accrued expenses	7,269	4,002
Current portion of operating lease liability	657	980
Current portion of financing lease liability	158	—
Total current liabilities	11,213	6,013
Long-term operating lease liability, net of current portion	7,218	398
Long-term financing lease liability, net of current portion	618	—
Commitments and contingencies (Note 4)		
Stockholders' equity:		
Preferred stock, \$0.001 par value per share; 5,000,000 undesignated authorized shares as of September 30, 2022 (unaudited) and December 31, 2021; no shares issued or outstanding as of September 30, 2022 (unaudited) and December 31, 2021	—	—
Common stock, \$0.001 par value per share; 85,000,000 and 42,500,000 authorized shares as of September 30, 2022 (unaudited) and December 31, 2021, respectively; issued and outstanding shares – 29,009,382 and 27,793,035 as of September 30, 2022 (unaudited) and December 31, 2021, respectively	29	28
Additional paid-in capital	487,937	481,832
Accumulated other comprehensive loss	(669)	(263)
Accumulated deficit	(410,113)	(372,296)
Total aTyr Pharma, Inc. stockholders' equity	77,184	109,301
Noncontrolling interest in Pangu BioPharma Limited	(178)	(175)
Total stockholders' equity	77,006	109,126
Total liabilities and stockholders' equity	<u>\$ 96,055</u>	<u>\$ 115,537</u>

See accompanying notes.

aTyr Pharma, Inc.

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

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2022	2021	2022	2021
	(unaudited)			
Operating expenses:				
Research and development	\$ 9,867	\$ 5,138	\$ 27,898	\$ 17,309
General and administrative	3,625	2,590	10,556	8,066
Total operating expenses	13,492	7,728	38,454	25,375
Loss from operations	(13,492)	(7,728)	(38,454)	(25,375)
Total other income (expense), net	247	59	634	159
Consolidated net loss	(13,245)	(7,669)	(37,820)	(25,216)
Net loss attributable to noncontrolling interest in Pangu BioPharma Limited	1	2	3	7
Net loss attributable to aTyr Pharma, Inc.	\$ (13,244)	\$ (7,667)	\$ (37,817)	\$ (25,209)
Net loss per share, basic and diluted	\$ (0.46)	\$ (0.42)	\$ (1.34)	\$ (1.56)
Shares used in computing net loss per share, basic and diluted	28,663,047	18,159,231	28,184,698	16,145,351

See accompanying notes.

aTyr Pharma, Inc.

Condensed Consolidated Statements of Comprehensive Loss
(in thousands)

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2022	2021	2022	2021
	(unaudited)			
Consolidated net loss	\$ (13,245)	\$ (7,669)	\$ (37,820)	\$ (25,216)
Other comprehensive loss:				
Change in unrealized gain (loss) on available-for-sale investments, net of tax	141	(8)	(406)	(26)
Comprehensive loss	(13,104)	(7,677)	(38,226)	(25,242)
Comprehensive loss attributable to noncontrolling interest in Pangu BioPharma Limited	1	2	3	7
Comprehensive loss attributable to aTyr Pharma, Inc. common stockholders	\$ (13,103)	\$ (7,675)	\$ (38,223)	\$ (25,235)

See accompanying notes.

aTyr Pharma, Inc.
Condensed Consolidated Statements of Stockholders' Equity
(in thousands, except share data)

	Three and Nine Months Ended September 30, 2022 (unaudited)						Total Stockholders' Equity
	Common Stock		Additio nal Paid-In Capital	Other Comprehen sive Gain/(Loss)	Accumul ated Deficit	Noncontrol ling Interest	
	Shares	Amount					
Balance as of December 31, 2021	27,793,035	\$ 28	\$ 481,832	\$ (263)	\$ (372,296)	\$ (175)	\$ 109,126
Issuance of common stock upon release of restricted stock units	2,500	—	—	—	—	—	—
Issuance of common stock upon exercise of stock options	259	—	1	—	—	—	1
Issuance of common stock from at-the-market offerings, net of offering costs	260,455	—	1,480	—	—	—	1,480
Stock-based compensation	—	—	417	—	—	—	417
Net unrealized loss on investments, net of tax	—	—	—	(496)	—	—	(496)
Net loss	—	—	—	—	(12,153)	(1)	(12,154)
Balance as of March 31, 2022	28,056,249	28	483,730	(759)	(384,449)	(176)	98,374
Issuance of common stock pursuant to employee stock purchase plan	1,958	—	5	—	—	—	5
Issuance of common stock from at-the-market offerings, net of offering costs	69,251	—	34	—	—	—	34
Stock-based compensation	—	—	517	—	—	—	517
Net unrealized loss on investments, net of tax	—	—	—	(51)	—	—	(51)
Net loss	—	—	—	—	(12,420)	(1)	(12,421)
Balance as of June 30, 2022	28,127,458	28	484,286	(810)	(396,869)	(177)	86,458
Issuance of common stock from at-the-market offerings, net of offering costs	881,924	1	3,036	—	—	—	3,037
Stock-based compensation	—	—	615	—	—	—	615
Net unrealized gain on investments, net of tax	—	—	—	141	—	—	141
Net loss	—	—	—	—	(13,244)	(1)	(13,245)
Balance as of September 30, 2022	29,009,382	\$ 29	\$ 487,937	\$ (669)	\$ (410,113)	\$ (178)	\$ 77,006

	Three and Nine Months Ended September 30, 2021 (unaudited)						Total Stockholders' Equity
	Common Stock		Additio nal Paid-In Capital	Other Comprehen sive Gain/(Loss)	Accumul ated Deficit	Noncontrol ling Interest	
	Shares	Amount					
Balance as of December 31, 2020	11,018,954	\$ 11	\$ 370,210	\$ (43)	\$ (338,528)	\$ (166)	\$ 31,484
Issuance of common stock upon release of restricted stock units	4,177	—	—	—	—	—	—
Issuance of common stock from at-the-market offerings, net of offering costs	1,988,254	2	9,619	—	—	—	9,621
Issuance of common stock from committed purchase agreement, net of offering costs	3,000,000	3	15,233	—	—	—	15,236
Stock-based compensation	—	—	360	—	—	—	360
Net unrealized loss on investments, net of tax	—	—	—	(14)	—	—	(14)
Net loss	—	—	—	—	(7,151)	(4)	(7,155)
Balance as of March 31, 2021	16,011,385	16	395,422	(57)	(345,679)	(170)	49,532
Issuance of common stock upon exercise of stock options	553	—	1	—	—	—	1
Issuance of common stock pursuant to employee stock purchase plan	1,602	—	5	—	—	—	5
Issuance of common stock from at-the-market offerings, net of offering costs	293,830	—	1,265	—	—	—	1,265
Stock-based compensation	—	—	398	—	—	—	398
Net unrealized loss on investments, net of tax	—	—	—	(4)	—	—	(4)
Net loss	—	—	—	—	(10,391)	(1)	(10,392)
Balance as of June 30, 2021	16,307,370	16	397,091	(61)	(356,070)	(171)	40,805
Issuance of common stock upon exercise of stock options	9,620	—	58	—	—	—	58
Issuance of common stock from at-the-market offerings, net of offering costs	692,437	1	3,183	—	—	—	3,184
Issuance of common stock from underwritten follow-on offering, net of offering costs	10,781,250	11	80,616	—	—	—	80,627

Stock-based compensation	—	—	442	—	—	—	442
Net unrealized loss on investments, net of tax	—	—	—	(8)	—	—	(8)
Net loss	—	—	—	—	(7,667)	(2)	(7,669)
	<u>27,790,</u>		<u>481,3</u>		<u>(363,73</u>		
Balance as of September 30, 2021	<u>677</u>	<u>\$ 28</u>	<u>\$ 90</u>	<u>\$ (69)</u>	<u>\$ 7)</u>	<u>\$ (173)</u>	<u>\$ 117,439</u>

See accompanying notes.

Condensed Consolidated Statements of Cash Flows
(in thousands)

	Nine Months Ended September 30,	
	2022	2021
	(unaudited)	
Cash flows from operating activities:		
Consolidated net loss	\$ (37,820)	\$ (25,216)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	193	367
Stock-based compensation	1,549	1,200
Amortization of premium of available-for-sale investment securities	565	143
Amortization of right-of-use assets	805	617
Gain on disposal of property and equipment	(95)	—
Changes in operating assets and liabilities:		
Other receivables	70	1,910
Prepaid expenses and other assets	(1,174)	(3,244)
Accounts payable and accrued expenses	4,878	(133)
Operating lease liability	(488)	(633)
Net cash used in operating activities	(31,517)	(24,989)
Cash flows from investing activities:		
Purchases of property and equipment	(522)	(174)
Purchases of available-for-sale investment securities	(17,124)	(68,811)
Maturities of available-for-sale investment securities	62,713	26,767
Proceeds from sale of property and equipment	179	—
Net cash provided by (used in) investing activities	45,246	(42,218)
Cash flows from financing activities:		
Proceeds from issuance of common stock through option exercises	1	59
Proceeds from issuance of common stock through employee stock purchase plan	5	5
Proceeds from issuance of common stock from at-the-market offerings, net of offering costs	4,551	14,070
Proceeds from issuance of common stock from committed purchase agreement, net of offering costs	—	15,236
Proceeds from issuance of common stock from underwritten follow-on offering, net of offering costs	—	80,627
Principal paid on finance lease liabilities	(24)	—
Net cash provided by financing activities	4,533	109,997
Net change in cash, cash equivalents and restricted cash	18,262	42,790
Cash, cash equivalents and restricted cash at beginning of period	2,336	16,952
Cash, cash equivalents and restricted cash at the end of period	\$ 20,598	\$ 59,742
Cash and cash equivalents at the end of period	\$ 18,359	\$ 59,742
Restricted cash at the end of period	2,239	—
Cash, cash equivalents and restricted cash at the end of period	\$ 20,598	\$ 59,742
Supplemental schedule of noncash investing and financing activities:		
Purchases of property and equipment in accounts payable	\$ 487	\$ —
Right-of-use assets obtained in exchange for lease obligation	\$ 800	\$ —

See accompanying notes.

**Notes to Condensed Consolidated Financial Statements
(Unaudited)**

1. Organization, Business, Basis of Presentation and Summary of Significant Accounting Policies

Organization and Business

aTyr Pharma, Inc. (we, us, and our) was incorporated in the State of Delaware on September 8, 2005. We are a biotherapeutics company engaged in the discovery and development of first-in-class medicines from our proprietary tRNA synthetase platform.

Principles of Consolidation

Our condensed consolidated financial statements include our accounts and our 98% majority-owned subsidiary in Hong Kong, Pangu BioPharma Limited (Pangu BioPharma). All intercompany transactions and balances are eliminated in consolidation.

Unaudited Interim Financial Information

The accompanying interim unaudited condensed consolidated financial statements have been prepared in accordance with United States generally accepted accounting principles (U.S. GAAP) and follow the requirements of the U.S. Securities and Exchange Commission (SEC) for interim reporting. As permitted under those rules, certain footnotes or other financial information that are normally required by U.S. GAAP can be condensed or omitted. In our opinion, the interim unaudited condensed consolidated financial statements have been prepared on the same basis as the audited consolidated financial statements and include all adjustments, which include only normal recurring adjustments, necessary for the fair presentation of our financial position and our results of operations and cash flows for the periods presented. These statements do not include all disclosures required by U.S. GAAP and should be read in conjunction with our audited consolidated financial statements and accompanying notes contained in our Annual Report on Form 10-K for the fiscal year ended December 31, 2021, as filed with the SEC on March 15, 2022. The results of the interim periods are not necessarily indicative of the results expected for the full fiscal year or any other interim period or any future year or period.

Risks and Uncertainties

The impact of the ongoing COVID-19 pandemic has been and will likely continue to be extensive in many aspects of society, which has resulted in and will likely continue to result in significant disruptions to the global economy, as well as businesses and capital markets around the world. Impacts to our business have included delayed enrollment of our now completed Phase 1b/2a clinical trial in patients with pulmonary sarcoidosis and the discontinuation of some patients in that trial, temporary closures of portions of our facilities and those of our licensees and collaborators, disruptions or restrictions on our employee's ability to travel and delays in certain research and development activities. Other potential impacts to our business include, but are not limited to, disruptions to or delays in planned clinical trials, third-party manufacturing supply and other operations, inflation, the potential diversion of healthcare resources away from the conduct of clinical trials to focus on pandemic concerns, interruptions or delays in the operations of the U.S. Food and Drug Administration or other regulatory authorities, and our ability to raise capital and conduct business development activities.

In addition to the ongoing COVID-19 pandemic, global economic and business activities continue to face widespread macroeconomic uncertainties, including labor shortages, inflation and monetary supply shifts, recession risks and potential disruptions from the Russia-Ukraine conflict, which has resulted in volatility in the U.S. and global financial markets and which has led to, and may continue to lead to, additional disruptions to trade, commerce, pricing stability, credit availability and supply chain continuity globally. It is uncertain what the long-term impact of the ongoing Ukraine-Russia conflict may have on our business and we continue to actively monitor the impact of these macroeconomic factors on our results of operations, financial condition and cash flows. The extent of the impact of these factors on our operational and financial performance, including our ability to execute our business strategies and initiatives in the expected timeframe, will depend on future developments, which are uncertain and cannot be predicted; however, any continued or renewed disruption resulting from these factors could negatively impact our business.

Liquidity and Financial Condition

We have incurred net losses in each year since our inception in 2005, including a consolidated net loss of \$13.2 million and \$37.8 million for the three and nine months ended September 30, 2022, respectively. As of September 30, 2022, we had an accumulated deficit of \$410.1 million. We believe that our existing cash, cash equivalents, restricted cash and available-for-sale investments of \$79.6 million as of September 30, 2022 will be sufficient to meet our material cash requirements from known contractual and other obligations for a period of at least one year from the filing date of this Quarterly Report on Form 10-Q.

We do not expect to generate any revenues from product sales unless and until we successfully complete development and obtain regulatory approval for one or more of our product candidates, which we expect will take a number of years at a minimum. If we obtain regulatory approval for any of our product candidates, we expect to incur significant commercialization expenses related to product sales, marketing, manufacturing and distribution. Accordingly, we will need to raise substantial additional capital to fund our operations.

The amount and timing of our future funding requirements will depend on many factors, including the pace and results of our preclinical and clinical development efforts and the timing and nature of the regulatory approval process for our product candidates. We anticipate that we will seek to fund our operations through equity offerings, grant funding, collaborations, strategic partnerships and/or licensing arrangements, and when we are closer to commercialization of our product candidates potentially through debt financings. However, we may be unable to raise additional capital or enter into such arrangements when needed on favorable terms or at all. Our failure to raise capital or enter into such arrangements when needed would have a negative impact on our financial condition and ability to develop our product candidates.

Restricted Cash

As of September 30, 2022, restricted cash consisted of approximately \$2.2 million, which was held as a security deposit in conjunction with our new facility lease and financing leases as discussed further below in Note 4 – Commitments and Contingencies.

Use of Estimates

Our unaudited condensed consolidated financial statements are prepared in accordance with U.S. GAAP. The preparation of our unaudited condensed consolidated financial statements requires us to make estimates and assumptions that impact the reported amounts of assets, liabilities and expenses and the disclosure for these items in our unaudited condensed consolidated financial statements and accompanying notes. The most significant estimates in our unaudited condensed consolidated financial statements relate to clinical trial and research and development expenses. Although these estimates are based on our knowledge of current events and actions we may undertake in the future, actual results may ultimately differ materially from these estimates and assumptions.

Leases

We determine if an arrangement is a lease at inception. Short-term leases with an initial term of 12 months or less are not recorded on our balance sheet. For long-term leases with an initial term of greater than 12 months, we recognize a right-of-use asset (ROU) and a lease liability based on the present value of future lease payments using an estimated rate of interest that we would pay to borrow equivalent funds on a collateralized basis at the lease commencement date. We determine the lease term at the commencement date by considering whether renewal options and termination options are reasonably assured of exercise. Rent expense for operating leases is recognized on a straight-line basis over the lease term and is included in operating expenses in our unaudited condensed consolidated statements of operations. For financing leases, interest expense and amortization of the ROU is included in operating expenses in our unaudited condensed consolidated statements of operations and variable lease payments are recorded as incurred.

If a lease is modified, the modified contract is evaluated to determine whether it is or contains a lease. If a lease continues to exist, the lease modification is determined to be a separate contract when the modification grants the lessee an additional ROU that is not included in the original lease and the lease payments increase commensurate with the standalone price for the additional ROU. A lease modification that results in a separate contract will be accounted for in the same manner as a new lease. For a modification that is not a separate contract, we reassess the lease classification using the modified terms and conditions and the facts and circumstances as of the effective date of the modification and recognize the amount of the remeasurement of the lease liability for the modified lease as an adjustment to the corresponding lease ROU asset.

Our ROU assets consist of the Lease (as defined below) and the non-cancelable operating lease for our existing office and laboratory space and financing leases for various research and development and information technology equipment.

We do not separate lease and non-lease components of our long-term leases.

Revenue Recognition

We evaluate our agreements under Accounting Standard Codification (ASC) Topic 606, *Revenue from Contracts with Customers* (Topic 606) and ASC Topic 808, *Collaborative Arrangements*. We recognize revenue when we transfer promised goods or services to customers in an amount that reflects the consideration to which we expect to be entitled in exchange for those goods or services. In determining the appropriate amount of revenue to be recognized as we fulfill our obligations under our agreement, we perform the following steps: (i) identification of the promised goods or services in the contract; (ii) determination of whether the promised goods or services are performance obligations including whether they are distinct in the context of the contract; (iii) measurement of the transaction price, including the constraint on variable consideration; (iv) allocation of the transaction price to the performance obligations; and (v) recognition of revenue when (or as) we satisfy each performance obligation. As part of the accounting for these arrangements, we must develop assumptions that require judgment to determine the stand-alone selling price for each performance obligation identified in the contract. We use key assumptions to determine the stand-alone selling price, which may include forecasted revenues, development timelines, reimbursement rates for personnel costs, discount rates and probabilities of technical and regulatory success.

We recognize revenue in one of two ways, over time or at a point in time. We recognize revenue over time when we are executing on our performance obligation over time and our partner receives benefit over time. For example, we recognize revenue over time when we provide research and development services. We recognize revenue at a point in time when we transfer control of a distinct performance obligation to our partner. For example, if a license to our intellectual property is determined to be distinct from the other performance obligations identified in the arrangement, we recognize revenues from non-refundable, up-front fees allocated to the license when the license is transferred to the licensee and the licensee is able to use and benefit from the license.

Net Loss Per Share

Basic net loss per share is calculated by dividing the net loss by the weighted-average number of common shares outstanding for the period. Diluted net loss per share is calculated by dividing the net loss by the weighted-average number of common stock equivalents outstanding for the period determined using the treasury-stock method. Dilutive common stock equivalents are comprised of warrants for common stock, options and restricted stock units outstanding under our stock option plan and estimated shares to be purchased under our employee stock purchase plan. For all periods presented, there is no difference in the number of shares used to calculate basic and diluted shares outstanding, as the assumed exercise or settlement of stock options, restricted stock units, and warrants, or the conversion of preferred stock are anti-dilutive.

Potentially dilutive securities not considered for the calculation of diluted net loss per share are as follows (in common stock equivalents):

	Nine Months Ended September 30,	
	2022	2021
Common stock warrants	13,760	13,760
Common stock options and restricted stock units	3,082,068	1,279,036
Employee stock purchase plan	19,062	1,780
Total	<u>3,114,890</u>	<u>1,294,576</u>

Recent Accounting Pronouncements

In June 2016, the Financial Accounting Standards Board issued Accounting Standards Update (ASU) No. 2016-13, *Financial Instruments – Credit Losses* (Topic 326), to provide financial statement users with more decision-useful information about the expected credit losses on financial instruments and other commitments to extend credit held by a reporting entity at each reporting date. To achieve this objective, the amendments in Topic 326 replace the incurred loss impairment methodology in current U.S. GAAP with a methodology that reflects expected credit losses and requires consideration of a broader range of reasonable and supportable information to inform credit loss estimates. Topic 326 is effective for fiscal years beginning after December 15, 2022, including interim periods within those fiscal years for smaller reporting companies. We do not expect the adoption of the amendments in Topic 326 to have a material effect on our condensed consolidated financial position or results of operations when such amendment is effective.

2. Fair Value Measurements

The carrying amounts of cash equivalents, prepaid and other assets, accounts payable and accrued liabilities are considered to be representative of their respective fair values because of the short-term nature of those instruments. Investment securities are recorded at fair value.

The accounting guidance defines fair value, establishes a consistent framework for measuring fair value and expands disclosure for each major asset and liability category measured at fair value on either a recurring or nonrecurring basis. Fair value is defined as an exit price, representing the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants. As such, fair value is a market-based measurement that should be determined based on assumptions that market participants would use in pricing an asset or liability. As a basis for considering such assumptions, the accounting guidance establishes a three-tier fair value hierarchy, which prioritizes the inputs used in measuring fair value as follows:

Level 1: Observable inputs such as quoted prices in active markets.

Level 2: Inputs, other than the quoted prices in active markets that are observable either directly or indirectly.

Level 3: Unobservable inputs in which there is little or no market data, which require the reporting entity to develop its own assumptions.

Financial assets measured at fair value on a recurring basis consist of investment securities. Investment securities are recorded at fair value, defined as the exit price in the principal market in which we would transact, representing the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants. Level 2 securities are valued using quoted market prices for similar instruments, non-binding market prices that are corroborated by observable market data, or discounted

cash flow techniques and include our investments in commercial paper, corporate debt securities and asset-backed securities. We have no financial liabilities measured at fair value on a recurring basis. None of our non-financial assets and liabilities are recorded at fair value on a non-recurring basis. No transfers between levels have occurred during the periods presented.

Assets measured at fair value on a recurring basis are as follows (in thousands):

	Total	Fair Value Measurements Using		
		Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
As of September 30, 2022				
Assets:				
Current:				
Cash equivalents	\$ 17,513	\$ 17,513	\$ —	\$ —
Available-for-sale investments:				
Commercial paper	15,792	—	15,792	—
Corporate debt securities	34,434	—	34,434	—
Municipal bonds	8,789	—	8,789	—
Total available-for-sale investments	59,015	—	59,015	—
Total assets measured at fair value	\$ 76,528	\$ 17,513	\$ 59,015	\$ —

	Total	Fair Value Measurements Using		
		Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
As of December 31, 2021				
Assets:				
Current:				
Cash equivalents	\$ 2,052	\$ 2,052	\$ —	\$ —
Available-for-sale investments:				
Commercial paper	36,921	—	36,921	—
Corporate debt securities	55,713	—	55,713	—
Municipal bonds	12,941	—	12,941	—
Total available-for-sale investments	105,575	—	105,575	—
Total assets measured at fair value	\$ 107,627	\$ 2,052	\$ 105,575	\$ —

As of September 30, 2022 and December 31, 2021, available-for-sale investments are detailed as follows (in thousands):

	Contractual Maturity	September 30, 2022			
		Gross Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Market Value
Available-for-sale investments:					
Commercial paper	Within 1 year	\$ 15,871	\$ —	\$ (79)	\$ 15,792
Corporate debt securities	1 to 2 years	34,921	—	(487)	34,434
Municipal bonds	Within 1 year	8,842	—	(53)	8,789
		\$ 59,634	\$ —	\$ (619)	\$ 59,015

December 31, 2021

	Contractual Maturity	Gross Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Market Value
Available-for-sale investments:					
Commercial paper	Within 1 year	\$ 36,956	\$ —	\$ (35)	\$ 36,921
Corporate debt securities	1 to 2 years	55,859	—	(146)	55,713
Municipal bonds	1 to 2 years	12,973	—	(32)	12,941
		<u>\$ 105,788</u>	<u>\$ —</u>	<u>\$ (213)</u>	<u>\$ 105,575</u>

At each reporting date, we perform an evaluation of impairment to determine if any unrealized losses are other-than-temporary. Factors considered in determining whether a loss is other-than-temporary include the length of time and extent to which fair value has been less than the cost basis, the financial condition of the issuer, and our intent and ability to hold the investment until recovery of its amortized cost basis. We intend, and have the ability, to hold our investments in unrealized loss positions, if any, until their amortized cost basis has been recovered.

As of September 30, 2022, all available-for-sale investments had a variety of effective maturity dates of less than two years. As of September 30, 2022, all available-for-sale investments were in gross unrealized loss positions of which 7 of 26 available-for-sale investments with a market value of \$13.4 million were at a loss position greater than 12 months.

3. License and Other Agreements

Kyorin Pharmaceutical Co., Ltd.

In January 2020, we entered into a collaboration and license agreement (Kyorin Agreement) with Kyorin Pharmaceutical Co., Ltd. (Kyorin) for the development and commercialization of efzofitmod for interstitial lung disease (ILD) in Japan. Under the Kyorin Agreement, Kyorin received an exclusive right to develop and commercialize efzofitmod in Japan for all forms of ILD. Kyorin is obligated to fund all research, development, regulatory, marketing and commercialization activities in Japan. In 2020, Kyorin completed a Phase 1 clinical trial of efzofitmod (known as KRP-R120 in Japan). The Phase 1 clinical trial, which was conducted and funded by Kyorin, was a placebo-controlled study to evaluate the safety, pharmacokinetics and immunogenicity of efzofitmod in 32 healthy Japanese male volunteers. Efzofitmod was observed to be generally well-tolerated with no drug-related serious adverse events and pharmacokinetics findings were consistent with previous studies of efzofitmod. We received an \$8.0 million upfront payment in January 2020 and a \$2.0 million milestone payment in January 2021 following completion of enrollment in the Phase 1 clinical trial. Kyorin has joined our Phase 3 clinical trial of efzofitmod in pulmonary sarcoidosis patients (EFZO-FIT™ study), and all study activity in Japan will be funded by Kyorin. We are eligible to receive up to an additional \$165.0 million in the aggregate upon achievement of certain development, regulatory and sales milestones, as well as tiered royalties ranging from the mid-single digits to mid-teens on net sales in Japan.

Either party may terminate the Kyorin Agreement in the event that the other party breaches the agreement and fails to cure the breach, becomes insolvent or challenges certain of the intellectual property rights licensed under the agreement.

We assessed our license and collaboration with Kyorin in accordance with Topic 606 and concluded that Kyorin is a customer. We identified the following performance obligations under the Kyorin Agreement: 1) the license of efzofitmod for ILD in Japan; and 2) free clinical trial material for Kyorin's Phase 1 clinical trial. The \$8.0 million upfront payment received from Kyorin is non-refundable and non-creditable and is considered fixed consideration. We determined that the relative stand-alone selling price was \$7.9 million when the license was delivered to Kyorin in January 2020. We determined that the relative standalone selling price was \$0.1 million for the free clinical trial material delivered to Kyorin in June 2020, using the "expected cost plus a margin" approach. In December 2020, Kyorin completed the last subject visit in its Phase 1 clinical trial of efzofitmod. This achievement triggered a \$2.0 million milestone payment which we recognized as license and collaboration revenue in December 2020. We received the \$2.0 million from Kyorin in January 2021.

During the three and nine months ended September 30, 2022 and 2021, there were no activities that triggered additional license and collaboration agreement revenue under the Kyorin Agreement.

The remaining milestones and royalty payments under the Kyorin Agreement are variable consideration. Since milestone payments are binary in nature, we will use the "most-likely" method to evaluate whether the milestones should be included as revenue. We will constrain these amounts until the milestone is probable of being achieved. The royalties are dependent on future sales by Kyorin which are at the full discretion of Kyorin. Accordingly, we constrain these amounts until the future sales have occurred.

In March 2020, our subsidiary, Pangu BioPharma, together with the Hong Kong University of Science and Technology (HKUST) was awarded a grant of approximately \$750,000 to build a high-throughput platform for the development of bi-specific antibodies. The project is being funded by the Hong Kong government's Innovation and Technology Commission (ITC) under the Partnership Research Program (PRP). The PRP aims to support research and development projects undertaken by companies in collaboration with local universities and public research institutions. The ITC funded approximately 50% of the total estimated project cost and we contributed the remaining 50%. The research grant agreement between Pangu BioPharma, HKUST and the Government of the Hong Kong Special Administration Region became effective April 1, 2020. In May 2021, we announced that Pangu BioPharma and HKUST achieved certain milestones for the first year of the project. The project was completed as of September 30, 2022.

All the contributions provided by the ITC are paid to HKUST and we record expenses under this grant award when incurred. Expenses for the three months ended September 30, 2022 and 2021 were \$27,000 and \$0.1 million, respectively. Expenses for the nine months ended September 30, 2022 and 2021 were \$0.1 million and \$0.3 million, respectively.

4. Commitments and Contingencies

Operating Leases

We have a non-cancelable facility lease that is subject to base lease payments, which escalate over the term of the lease, additional charges for common area maintenance and other costs. In July 2018, we entered into a lease amendment that reduced the space we lease from 24,494 square feet to 20,508 square feet and extended the lease term to May 2023. With the lease amendment, we do not have an option to extend the lease.

In May 2022, we entered into a lease (the Lease) with San Diego Creekside, LLC (Landlord), as lessor, pursuant to which we agreed to lease from Landlord approximately 23,696 rentable square feet (subject to increase pursuant to the terms of the Lease) of office and laboratory space. The term of the lease (the Lease Term) will commence upon the earlier of April 1, 2023 or the completion of certain leasehold improvements to the Premises (as defined in the Lease), but not sooner than March 1, 2023 (the Lease Commencement Date) and continue for 124 months from the Lease Commencement Date. We also have one option to extend the Lease Term for five years. Base rent during such extension period would be at the fair market rent for the Premises. Under the terms of the Lease, the base rent during the first 12 months of the Lease Term will be \$5.75 per square foot of rentable area per month, subject to certain upward adjustments of approximately 3.0% annually. We are entitled to an allowance of \$5.5 million for tenant improvements, including an option to utilize an additional allowance of up to \$0.6 million, which, if used by us, would be repaid by us as additional monthly base rent, amortized at eight percent (8.0%) per annum during the Lease Term. We provided a \$0.7 million security deposit in the form of a letter of credit which is included in restricted cash as of September 30, 2022.

Future minimum payments under the Lease and the non-cancelable operating lease for our existing office and laboratory space and reconciliation to the operating lease liability as of September 30, 2022 were as follows (in thousands):

	Operating Lease
2022	\$ 270
2023	1,085
2024	1,675
2025	1,726
2026	1,777
2027 and thereafter	12,933
Less: Amount representing interest	(7,019)
Present value of lease payments	12,447
Less: Current portion of operating lease liability	(657)
Less: Tenant improvement allowance not yet received	(4,572)
Long-term operating lease liability, net of current portion	<u>\$ 7,218</u>

For each of the three months ended September 30, 2022 and 2021, we recorded an operating lease cost of \$0.3 million and \$0.2 million, respectively. For each of the nine months ended September 30, 2022 and 2021, we recorded an operating lease cost of \$0.8 million and \$0.7 million, respectively. As of September 30, 2022, the weighted-average remaining lease term was 10.4 years and the weighted-average discount rate was 8.8%.

Financing Leases

In April 2022, we entered into a master financing lease agreement to lease various research and development and information technology equipment over a 48-month term. Future minimum payments under the non-cancelable financing lease and reconciliation to the financing lease liability as of September 30, 2022 were as follows (in thousands):

	Financing Lease
2022	\$ 52
2023	208
2024	208
2025	208
2026	223
Less: Amount representing interest	(123)
Present value of lease payments	776
Less: Current portion of financing lease liability	(158)
Long-term financing lease liability, net of current portion	<u>\$ 618</u>

As of September 30, 2022, the weighted-average remaining lease term was 3.8 years and the weighted-average discount rate was 7.2%. We provided a \$1.5 million deposit to be held as collateral for the leased equipment, and this deposit is included in restricted cash as of September 30, 2022.

5. Stockholders' Equity

Underwritten Follow-On Public Offerings

In September 2021, we completed an underwritten follow-on public offering of 10,781,250 shares of our common stock, including the full exercise of the underwriters' option to purchase additional shares, at a price to the public of \$8.00 per share. The total net proceeds from the offering were approximately \$80.6 million after deducting underwriting discounts, commissions and offering expenses payable by us.

At the Market Offering Programs

In March 2021, we entered into a Capital on DemandTM Sales Agreement with JonesTrading Institutional Services LLC (JonesTrading) for an at-the-market offering program (the Prior ATM Offering Program), pursuant to which we were entitled to sell from time to time, at our option, up to an aggregate of \$25.0 million of shares of our common stock through JonesTrading, as sales agent or principal. JonesTrading was entitled to a commission at a fixed rate of up to 3.0% of the gross proceeds. During 2021, we sold an aggregate of 986,267 shares of common stock at a weighted-average price of \$4.75 per share for net proceeds of \$4.4 million under the Prior ATM Offering Program. During the nine months ended September 30, 2022, we sold an aggregate of 260,455 shares of common stock at a weighted-average price of \$6.07 per share for net proceeds of approximately \$1.5 million under the Prior ATM Offering Program. In April 2022, we terminated the Prior ATM Offering Program.

In April 2022, we entered into an Open Market Sale AgreementSM with Jefferies LLC (Jefferies) implementing an "at-the-market" offering program (the ATM Offering Program), pursuant to which we may offer and sell, from time to time and at our option, up to an aggregate of \$65.0 million of shares of our common stock through Jefferies, acting as sales agent. Jefferies is entitled to a fixed commission rate of up to 3.0% of the gross sales proceeds of shares sold under the ATM Offering Program. During the nine months ended September 30, 2022, we sold an aggregate of 951,175 shares of common stock at a weighted-average price of \$3.55 per share for net proceeds of approximately \$3.1 million under the ATM Offering Program.

Purchase Agreement

In September 2020, we entered into a common stock purchase agreement (the Purchase Agreement) with Aspire Capital Fund, LLC (Aspire Capital), which provides that, upon the terms and subject to the conditions and limitations set forth therein, Aspire Capital is committed to purchase up to an aggregate of \$20.0 million of shares of our common stock at our request from time to time during the 30 month term of the Purchase Agreement. Concurrently with entering into the Purchase Agreement, we also entered into a registration rights agreement with Aspire Capital, in which we agreed to file one or more registration statements, as permissible and necessary to register under the Securities Act of 1933, as amended, for the resale of the shares of our common stock that have been and may be issued to Aspire Capital under the Purchase Agreement. During the nine months ended September 30, 2021, we sold an aggregate of 3,000,000 shares of common stock at a weighted-average price of \$5.09 per share for net proceeds of \$15.2 million under the Purchase Agreement. During the nine months ended September 30, 2022, there were no issuances or sales under the Purchase Agreement.

Inducement Grants

In March 2022, we adopted and our board of directors approved our 2022 Inducement Plan (our Inducement Plan). Awards granted under our Inducement Plan are in accordance with Nasdaq Listing Rule 5635(c)(4). A total of 300,000 shares of our common stock were initially reserved for the issuance under our Inducement Plan.

The maximum term of options granted under our Inducement Plan is ten years. Each option vests over a period of four years, with 25% of the shares vesting on the one-year anniversary of the applicable vesting commencement date and the remaining 75% vesting in equal monthly installments over three years, subject to continuous employment.

During the nine months ended September 30, 2022, we granted nonstatutory stock options under our Inducement Plan to purchase an aggregate of 192,400 shares of our common stock, with a weighted-average exercise price of \$4.04 per share as inducement awards to new employees.

Common Stock Reserved for Future Issuance

Common stock reserved for future issuance was as follows:

	<u>September 30, 2022</u>
Common stock warrants	13,760
Common stock options and restricted stock units	3,082,068
Shares available under the 2015 equity incentive plan	948,519
Shares available under the 2022 inducement plan	107,600
Shares available under the employee stock purchase plan	819,975
	<u>4,971,922</u>

The following table summarizes our stock option activity under all equity incentive plans for the nine months ended September 30, 2022:

	<u>Number of Outstanding Stock Options</u>	<u>Weighted- Average Exercise Price</u>
Outstanding as of December 31, 2021	1,412,550	\$ 12.01
Granted	1,573,844	\$ 3.44
Exercises	(259)	\$ 3.77
Canceled/forfeited/expired	(25,505)	\$ 12.27
Outstanding as of September 30, 2022	<u>2,960,630</u>	<u>\$ 7.45</u>

The assumptions used in the Black-Scholes option pricing model to determine the fair value of the employee stock option grants were as follows:

	<u>Three Months Ended September 30,</u>		<u>Nine Months Ended September 30,</u>	
	<u>2022</u>	<u>2021</u>	<u>2022</u>	<u>2021</u>
Expected term (in years)	5.98 – 6.06	5.98 – 6.06	5.98 – 6.08	5.50 – 6.08
Risk-free interest rate	2.7%-2.9%	0.8% – 1.1%	1.7% – 3.0%	0.6% – 1.1%
Expected volatility	84.5% – 84.6%	86.3% – 86.9%	84.5% – 86.5%	86.3% – 104.8%
Expected dividend yield	0.0%	0.0%	0.0%	0.0%

The following table summarizes our restricted stock unit activity under all equity incentive plans for the nine months ended September 30, 2022:

	<u>Number of Outstanding Restricted Stock Units</u>	<u>Weighted-Average Grant Date Fair Value</u>
Balance as of December 31, 2021	7,500	\$ 4.08
Granted	116,438	\$ 5.13
Released	(2,500)	\$ 4.13
Balance as of September 30, 2022	<u>121,438</u>	<u>\$ 5.09</u>

Stock-based Compensation

The allocation of stock-based compensation for all options and restricted stock units and stock issued pursuant to our employee stock purchase plan is as follows (in thousands):

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2022	2021	2022	2021
Research and development	\$ 150	\$ 70	\$ 388	\$ 198
General and administrative	465	372	1,161	1,002
Total stock-based compensation expense	<u>\$ 615</u>	<u>\$ 442</u>	<u>\$ 1,549</u>	<u>\$ 1,200</u>

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

The following discussion and analysis should be read in conjunction with our unaudited condensed consolidated financial statements and accompanying notes included in this Quarterly Report on Form 10-Q (Quarterly Report), our audited consolidated financial statements and accompanying notes thereto for the fiscal year ended December 31, 2021 and the related Management's Discussion and Analysis of Financial Condition and Results of Operations, which are contained in our Annual Report on Form 10-K for the fiscal year ended December 31, 2021, as filed with the Securities and Exchange Commission (SEC), on March 15, 2022 (our 2021 Annual Report).

This Quarterly Report contains "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933, as amended, (the Securities Act), and Section 21E of the Securities Exchange Act of 1934, as amended (the Exchange Act). Such forward looking statements, which represent our intent, belief or current expectations, involve risks and uncertainties and other factors that could cause actual results and the timing of certain events to differ materially from future results expressed or implied by such forward-looking statements. In some cases, you can identify forward-looking statements by terms such as "may," "will," "expect," "anticipate," "estimate," "intend," "plan," "predict," "potential," "believe," "should" or the negative or plural of these words and similar expressions. Factors that could cause or contribute to differences in results include, but are not limited to those set forth under "Risk Factors" under Part II, Item 1A, and elsewhere in this Quarterly Report. Except as required by law we undertake no obligation to update these forward-looking statements to reflect events or circumstances after the date of this Quarterly Report or to reflect actual outcomes.

Overview

We are a biotherapeutics company engaged in the discovery and development of first-in-class medicines from our proprietary tRNA synthetase platform. We have concentrated our research and development efforts on a newly discovered area of biology, the extracellular functionality and signaling pathways of tRNA synthetases. Built on more than a decade of foundational science on extracellular tRNA synthetase biology and its effect on immune responses, we have built a global intellectual property estate directed to a potential pipeline of protein compositions derived from 20 tRNA synthetase genes and their extracellular targets, such as neuropilin-2 (NRP2).

Efzofitimod

Our primary focus is efzofitimod, a clinical-stage product candidate which binds to the NRP2 extracellular target and is designed to downregulate immune engagement in fibrotic lung disease. We are developing efzofitimod as a potential disease-modifying therapy for patients with fibrotic lung diseases with high unmet medical need. This includes interstitial lung disease (ILD), a group of rare immune-mediated disorders that cause progressive fibrosis of the lung. In January 2022, the U.S. Food and Drug Administration (FDA) granted efzofitimod an orphan drug designation for the treatment of sarcoidosis and in April 2022, for the treatment of systemic sclerosis (also known as scleroderma). In August 2022, the FDA granted efzofitimod fast track designation for the treatment of pulmonary sarcoidosis, and in September 2022, the FDA granted efzofitimod a second fast track designation for the treatment of scleroderma associated ILD.

In December 2018, we designed a Phase 1b/2a multiple-ascending dose, double-blind, placebo-controlled clinical trial in patients with pulmonary sarcoidosis, a major form of ILD, to evaluate the safety, tolerability, immunogenicity and steroid-sparing effect of efzofitimod, and conduct other exploratory assessments of efficacy, such as lung function. In September 2021, we announced positive results and clinical proof-of-concept from the Phase 1b/2a clinical trial in 37 patients with pulmonary sarcoidosis. Efzofitimod was well-tolerated at all doses administered with no serious drug-related adverse events or signal of immunogenicity. Additionally, the study demonstrated consistent dose response for efzofitimod on key efficacy endpoints and improvements compared to placebo, including measures of steroid reduction, lung function, pulmonary sarcoidosis symptom measures and inflammatory biomarkers. Based on the results of this study, we met with the FDA in February and have had continued correspondence to discuss these data and our plans for subsequent clinical development and path to registration for efzofitimod for the treatment of pulmonary sarcoidosis. In addition, based

on the results of the Phase 1b/2a clinical trial, we believe efzofitimid has further potential applications in the treatment of other ILD, such as chronic hypersensitivity pneumonitis and connective tissue disease related ILD, including scleroderma-associated ILD.

During the third quarter of 2022, we initiated a global pivotal Phase 3 randomized, double-blind, placebo-controlled clinical trial to evaluate the efficacy and safety of efzofitimid in patients with pulmonary sarcoidosis (the EFZO-FIT™ study). The EFZO-FIT™ study is a 52-week study consisting of three parallel cohorts randomized equally to either 3.0 mg/kg or 5.0 mg/kg of efzofitimid or placebo dosed intravenously once a month for a total of 12 doses. The study is currently enrolling and intends to enroll 264 subjects with pulmonary sarcoidosis at multiple centers in the United States, Europe and Japan. The trial design incorporates a forced steroid taper. The primary endpoint of the study is steroid reduction. Secondary endpoints include measures of lung function and sarcoidosis symptoms. In September 2022, we dosed the first patient in this study.

In January 2020, we entered into a collaboration and license agreement (Kyorin Agreement) with Kyorin Pharmaceutical Co., Ltd. (Kyorin) for the development and commercialization of efzofitimid for the treatment of ILD in Japan. Under the Kyorin Agreement, Kyorin received an exclusive right to develop and commercialize efzofitimid in Japan for all forms of ILD, and is obligated to fund all research, development, regulatory, marketing and commercialization activities in Japan. In September 2020, Kyorin began dosing patients in a Phase 1 clinical trial of efzofitimid (known as KRP-R120 in Japan) and completed the last subject visit in December 2020. The Phase 1 clinical trial, which was conducted and funded by Kyorin, was a placebo-controlled clinical trial to evaluate the safety, pharmacokinetics (PK) and immunogenicity of efzofitimid in 32 healthy Japanese male volunteers. Efzofitimid was observed to be generally well-tolerated with no drug-related serious adverse events, and PK findings were consistent with previous studies of efzofitimid. We received an \$8.0 million upfront payment in January 2020 and a \$2.0 million milestone payment in January 2021 following completion of enrollment in the Phase 1 clinical trial. Kyorin has joined the EFZO-FIT™ study, and all study activity in Japan will be funded by Kyorin. We are eligible to receive up to an additional \$165.0 million in the aggregate upon achievement of certain development, regulatory and sales milestones, as well as tiered royalties ranging from the mid-single digits to mid-teens on net sales in Japan.

Discovery Pipeline

In parallel with our clinical development of efzofitimid, we have been advancing our discovery pipeline of tRNA synthetases and NRP2 antibodies.

In February 2021, we announced two new programs from our discovery pipeline of tRNA synthetases. These programs will investigate the functionality of selected fragments of Alanyl-tRNA synthetase (AARS) and Aspartyl-tRNA synthetase (DARS) in immunology, fibrosis and cancer. We are also advancing our preclinical pipeline of tRNA synthetases and NRP2 targeting candidates through internal research efforts, industry and academic collaborations. In June 2022, we announced that the target receptor of the fragment AARS-1 was identified as fibroblast growth factor receptor 4, indicating that AARS-1 may have therapeutic potential in fibrosis, inflammation and cancer.

In October 2022, we entered into a research collaboration with Dualsystems Biotech AG (Dualsystems), a company specializing in custom proteomics, aimed at accelerating drug discovery and generating new therapeutics based on our extensive intellectual property portfolio. Under the collaboration, which is exclusive with respect to tRNA related molecules, Dualsystems will utilize their proprietary receptor screening technology and research expertise to attempt to identify and validate 10 new target receptors for tRNA synthetases by 2025.

We have also advanced our preclinical pipeline of NRP2 targeting antibody candidates through internal research efforts, industry and academic collaborations. ATYR2810 is our product candidate in oncology from our NRP2 antibody program. ATYR2810 is a fully humanized monoclonal antibody that is designed to selectively and functionally block the interaction between NRP2 and vascular endothelial growth factor (VEGF). NRP2 is a pleiotropic cell surface receptor that is highly expressed on certain tumors and increased NRP2 expression is associated with worse outcomes in many cancers, such as overall survival, metastasis and resistance to targeted therapies. VEGF is a validated mediator of tumor growth and plays a role in immune evasion in the tumor microenvironment. The role of NRP2 and VEGF signaling in the tumor microenvironment and its importance in the progression of certain aggressive cancers is becoming increasingly validated. ATYR2810 is in preclinical development for the potential treatment of certain aggressive cancers where NRP2 is implicated. Due to current market conditions, we intend to focus our resources on prioritizing our efzofitimid program. Therefore, we have made the strategic decision not to use internal resources to initiate a Phase 1 study of ATYR2810 this year. We intend to pursue alternative non-dilutive avenues, including academic collaborations, to advance this program.

In March 2020, our subsidiary, Pangu BioPharma Limited (Pangu BioPharma), together with the Hong Kong University of Science and Technology (HKUST) was awarded a grant of approximately \$750,000 to build a high-throughput platform for the development of bi-specific antibodies. The project is being funded by the Hong Kong government's Innovation and Technology Commission (ITC) under the Partnership Research Program (PRP). The PRP aims to support research and development projects undertaken by companies in collaboration with local universities and public research institutions. The ITC funded approximately 50% of the total estimated project cost, and we contributed the remaining 50%. In May 2021, we announced that Pangu BioPharma and HKUST achieved certain milestones for the first year of the project. The project was completed as of September 30, 2022.

Impact of the COVID-19 Pandemic and Other Geopolitical and Macroeconomic Conditions

The impacts of the ongoing COVID-19 pandemic on our business have included the delay in enrollment of our now completed Phase 1b/2a clinical trial in patients with pulmonary sarcoidosis and the discontinuation of some patients in that trial, temporary closures of portions of our facilities and those of our licensees and collaborators, disruptions or restrictions on our employees' ability to travel and delays in certain research and development activities. Other potential impacts to our business include, but are not limited to, disruptions to or delays in other clinical trials, third-party manufacturing supply and other operations, the potential diversion of healthcare resources away from the conduct of clinical trials to focus on pandemic concerns, interruptions or delays in the operations of the FDA or other regulatory authorities, and our ability to raise capital and conduct business development activities.

In February 2022, the U.S. and global financial markets experienced volatility following the invasion of Ukraine by Russia, which has led to disruptions to trade, commerce, pricing stability, credit availability and supply chain continuity globally. In response to the invasion, the United States, United Kingdom and European Union (EU), along with others, imposed significant new sanctions and export controls against Russia, Russian banks and certain Russian individuals and may implement additional sanctions or take further punitive actions in the future. The full economic and social impact of the sanctions imposed on Russia (as well as possible future punitive measures that may be implemented), as well as the counter measures imposed by Russia, in addition to the ongoing Ukraine-Russia conflict, which could conceivably expand into the surrounding region, remains uncertain; however, both the conflict and related sanctions have resulted and could continue to result in disruptions to trade, commerce, pricing stability, credit availability and supply chain continuity in both Europe and globally, and has introduced significant uncertainty into global markets. As a result, our business and results of operations may be adversely affected by the ongoing Ukraine-Russia conflict, particularly to the extent it escalates to involve additional countries, further economic sanctions or wider military conflict.

In addition to the ongoing COVID-19 pandemic and the ongoing Ukraine-Russia conflict, global economic and business activities continue to face widespread macroeconomic uncertainties, including labor shortages, inflation and monetary supply shifts, and recession risks, which has resulted in further volatility in the U.S. and global financial markets and which has led to, and may continue to lead to, additional disruptions to trade, commerce, pricing stability, credit availability and supply chain continuity globally. The ultimate long-term impact of the COVID-19 pandemic, the ongoing Ukraine-Russia conflict and other evolving geopolitical and macroeconomic conditions on our business is uncertain, although we continue to actively monitor the impact of these factors on our results of operations, financial condition and cash flows. The extent of the impact of these factors on our operational and financial performance, including our ability to execute our business strategies and initiatives in the expected timeframe, will depend on future developments, which are uncertain and cannot be predicted; however, any continued or renewed disruption resulting from these factors could negatively impact our business.

Liquidity and Capital Resources

We have incurred losses and negative cash flows from operations since our inception. As of September 30, 2022 and December 31, 2021, we had an accumulated deficit of \$410.1 million and \$372.3 million, respectively, and we expect to continue to incur net losses for the foreseeable future. As of September 30, 2022 and December 31, 2021, we had cash, cash equivalents, restricted cash and available-for-sale investments of \$79.6 million and \$107.9 million, respectively. We believe that our existing cash, cash equivalents, restricted cash and available-for-sale investments as of September 30, 2022 will be sufficient to meet our material cash requirements from known contractual and other obligations for a period of at least one year from the date of this Quarterly Report. We believe we will meet longer-term material cash requirements from known contractual and other obligations through a combination of cash, cash equivalents, restricted cash and available-for-sale investments. In addition to the factors discussed under "Material Cash Requirements," our ability to fund our longer-term operating needs beyond the next 12 months will depend on our ability to raise additional funding through equity or debt offerings, grant funding, collaborations, strategic partnerships and/or licensing arrangements, and other factors, including those discussed in Part II, Item 1A. "Risk Factors—Risks related to our financial condition and need for additional capital—We will need to raise additional capital or enter into strategic partnering relationships to fund our operations."

Sources of Cash

From our inception through September 30, 2022, we have financed our operations primarily through the sale of equity securities and convertible debt, venture debt, term loans and through license and collaboration agreement revenues.

Public Offerings

In September 2021, we completed an underwritten follow-on public offering of 10,781,250 shares of our common stock, including the full exercise of the underwriters' option to purchase additional shares, at a price to the public of \$8.00 per share. The total net proceeds from the offering were approximately \$80.6 million, after deducting underwriting discounts, commissions and offering expenses payable by us.

In February 2020, we completed an underwritten follow-on public offering of 4,235,294 shares of our common stock at a price to the public of \$4.25 per share. In March 2020, the underwriters fully exercised their option to purchase additional shares resulting in the issuance of an additional 635,294 shares of common stock. The total net proceeds from the offering were approximately \$18.8 million, after deducting underwriting discounts, commissions and offering expenses payable by us.

At-the-Market Offering Programs

In April 2022, we entered into an Open Market Sale AgreementSM with Jefferies LLC (Jefferies) implementing an "at-the-market" offering program (the ATM Offering Program), pursuant to which we may offer and sell, from time to time and at our option, up to an aggregate of \$65.0 million of shares of our common stock through Jefferies, acting as sales agent. Jefferies is entitled to a fixed commission rate of up to 3.0% of the gross sales proceeds of shares sold under the ATM Offering Program. During the nine months ended September 30, 2022, we sold an aggregate of 951,175 shares of common stock at a weighted-average price of \$3.55 per share for net proceeds of approximately \$3.1 million under the ATM Offering Program.

In March 2021, we entered into a Capital on DemandTM Sales Agreement with JonesTrading Institutional Services LLC (JonesTrading) for an at-the-market offering program (the Prior ATM Offering Program), pursuant to which we were entitled to sell from time to time, at our option, up to an aggregate of \$25.0 million of shares of our common stock through JonesTrading, as sales agent or principal. JonesTrading was entitled to a commission at a fixed rate of up to 3.0% of the gross proceeds. During 2021, we sold an aggregate of 986,267 shares of common stock at a weighted-average price of \$4.75 per share for net proceeds of \$4.4 million under the Prior ATM Offering Program. During the nine months ended September 30, 2022, we sold an aggregate of 260,455 shares of common stock at a weighted-average price of \$6.07 per share for net proceeds of approximately \$1.5 million under the Prior ATM Offering Program. In April 2022, we terminated the Prior ATM Offering Program.

Purchase Agreement

In September 2020, we entered into a common stock purchase agreement (the Purchase Agreement) with Aspire Capital Fund, LLC (Aspire Capital), which provides that, upon the terms and subject to the conditions and limitations set forth therein, Aspire Capital is committed to purchase up to an aggregate of \$20.0 million of shares of our common stock at our request from time to time during the 30 month term of the Purchase Agreement. Concurrently with entering into the Purchase Agreement, we also entered into a registration rights agreement with Aspire Capital, in which we agreed to file one or more registration statements, as permissible and necessary to register under the Securities Act for the resale of the shares of our common stock that have been and may be issued to Aspire Capital under the Purchase Agreement. During 2021, we sold an aggregate of 3,000,000 shares of common stock at a weighted-average price of \$5.09 per share for net proceeds of \$15.2 million under the Purchase Agreement. During the nine months ended September 30, 2022, there were no issuances or sales under the Purchase Agreement. As of September 30, 2022, \$4.8 million remains available for issuance and sale under the Purchase Agreement.

Kyorin Agreement Milestone Payments

We received an \$8.0 million upfront payment in January 2020 and a \$2.0 million milestone payment in January 2021 following completion of the last subject visit in Kyorin's Phase 1 clinical trial, and we are eligible to receive up to an additional \$165.0 million in the aggregate upon achievement of certain development, regulatory and sales milestones, as well as tiered royalties ranging from the mid-single digits to mid-teens on net sales in Japan. During the three and nine months ended September 30, 2022, there were no activities that triggered additional license and collaboration agreement revenue under the Kyorin Agreement.

HKUST Grant Agreement

In March 2020, Pangu BioPharma, together with the HKUST was awarded a grant of approximately \$750,000 to build a high-throughput platform for the development of bi-specific antibodies. The project is being funded by the ITC under the PRP. The PRP aims to support research and development projects undertaken by companies in collaboration with local universities and public research institutions. The ITC funded approximately 50% of the total estimated project cost, and we contributed the remaining 50%. During the three and nine months ended September 30, 2022, we did not receive any further grants from the ITC or otherwise. The project was completed as of September 30, 2022.

Cash Flows

The following table sets forth a summary of the net cash flow activity for each of the periods indicated (in thousands):

	Nine Months Ended September 30,	
	2022	2021
Net cash provided by (used in):		
Operating activities	\$ (31,517)	\$ (24,989)
Investing activities	45,246	(42,218)
Financing activities	4,533	109,997
Net change in cash, cash equivalents and restricted cash	<u>\$ 18,262</u>	<u>\$ 42,790</u>

Operating activities. Net cash used in operating activities for the nine months ended September 30, 2022 and 2021 was \$(31.5) million and \$(25.0) million, respectively. The increase in net cash used in operating activities resulted primarily from increased research and development expenditure as efzofitmod has advanced and we continued to advance our discovery efforts in our pipeline of tRNA synthetases and NRP2 antibodies.

Investing activities. Net cash provided by (used in) investing activities for the nine months ended September 30, 2022 and 2021 was \$45.2 million and \$(42.2) million, respectively. The fluctuation in net cash provided by (used in) investing activities resulted primarily from the timing differences in investment purchases, sales and maturities, and the fluctuation of our portfolio mix between cash equivalents and investment holdings. The average term to maturity in our investment portfolio is less than two years.

Financing activities. Net cash provided by financing activities for the nine months ended September 30, 2022 consisted primarily of an aggregate of \$4.6 million in proceeds from the issuance and sale of common stock through the ATM Offering Program and Prior ATM Offering Program, net of offering costs. Net cash provided by financing activities for the nine months ended September 30, 2021 consisted primarily of \$80.6 million in net proceeds from the issuance of common stock in an underwritten follow-on public offering, net of offering costs, \$14.1 million of proceeds from the issuance and sale of common stock, net of offering costs, through the Prior ATM Program and an at-the-market offering program with H.C. Wainwright & Co., LLC, which was automatically terminated in March 2021, and \$15.2 million of proceeds from the issuance and sale of common stock through the Purchase Agreement, net of offering costs.

Material Cash Requirements

To date, we have not generated any revenues from product sales. We expect our expenses to increase in connection with our ongoing activities, particularly as we continue to advance efzofitmod in clinical development, including a change in our CRO, manufacturing and technology transfer activities for efzofitmod, continue our research and development activities with respect to other potential therapies based on tRNA synthetase biology and NRP2 biology, and seek marketing approval for product candidates that we may develop. In addition, if we obtain marketing approval for any of our product candidates, we expect to incur significant commercialization expenses related to product sales, marketing, manufacturing and distribution. We currently have no sales or marketing capabilities and would need to expand our organization to support these activities. Accordingly, we will need to obtain substantial additional funding in connection with our continuing operations. Our forecast of the period of time through which our financial resources will be adequate to support our operations is a forward-looking statement that involves risks and uncertainties, and actual results could vary materially.

Our future capital requirements are difficult to forecast and will depend on many factors, including:

- the type, number, scope progress, expansions, results, costs and timing of, our clinical trials and preclinical studies for our product candidates or other potential product candidates or indications which we are pursuing or may choose to pursue in the future, including changes in our CROs;
- the costs, timing and outcome of regulatory review of our product candidates;
- delays of our planned clinical trials of efzofitmod;
- any resulting cost increases as a result of the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict, other geopolitical and macroeconomic conditions, including labor shortages, economic slowdowns, recessions or market corrections, inflation and monetary supply shifts, rising interest rates and tightening of credit markets;
- the number and characteristics of product candidates that we pursue;
- the scope, progress, results and costs of preclinical development, and clinical trials for other product candidates;
- the manufacturing of preclinical study and clinical trial materials, including technology transfers to additional contract development and manufacturing organizations (CDMO);

- our ability to maintain existing and enter into new collaboration and licensing arrangements and the timing of any payments we may receive under such arrangements;
- the costs and timing of preparing, filing and prosecuting patent applications, maintaining and enforcing our intellectual property rights and defending any intellectual property-related claims;
- the costs and timing of future commercialization activities, including product manufacturing, marketing, sales and distribution, for any of our product candidates for which we receive marketing approval; and
- the extent to which we acquire or in-license other products and technologies.

Until such time, if ever, as we can generate substantial product revenues, we expect to finance our cash needs through a combination of equity offerings, grant funding, collaborations, strategic partnerships and/or licensing arrangements, and when we are closer to commercialization of our product candidates potentially through debt financings. To the extent we raise additional capital through the sale of equity, the ownership interest of our stockholders will be diluted, and the terms of these securities may include liquidation or other preferences that adversely affect the rights of our common stockholders. If we raise additional funds through collaborations, strategic partnerships or licensing arrangements with third parties, we may have to relinquish valuable rights to our product candidates, our other technologies, future revenue streams or research programs or grant licenses on terms that may not be favorable to us. The incurrence of additional indebtedness would increase our fixed payment obligations and may require us 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 may be unable to raise additional funds on acceptable terms or at all. If the equity and credit markets deteriorate, it may make any necessary debt or equity financing more difficult, more costly and more dilutive. If we are unable to raise additional funds, we may be required to delay, limit, reduce or terminate our product development or future commercialization efforts or grant rights to develop and market our product candidates even if we would otherwise prefer to develop and market such product candidates ourselves.

As of September 30, 2022, our material cash requirements from known contractual and other obligations consisted primarily of (i) our non-cancelable operating lease for our existing office and laboratory space, (ii) the Lease that we entered into in May 2022, and (iii) our master financing lease agreement that we entered into in April 2022 for various research and development and informational technology equipment.

Our non-cancelable operating lease is subject to base lease payments, which escalate over the term of the lease, additional charges for common area maintenance and other costs. In July 2018, we entered into a lease amendment that reduced the space we lease from 24,494 square feet to 20,508 square feet and extended the lease term to May 2023. With the lease amendment, we do not have an option to extend our non-cancelable operating lease.

In May 2022, we entered into a lease (the Lease) with San Diego Creekside, LLC (Landlord), as lessor, pursuant to which we agreed to lease from Landlord approximately 23,696 rentable square feet (subject to increase pursuant to the terms of the Lease) of office and laboratory space. The term of the lease (the Lease Term) will commence upon the earlier of April 1, 2023 or the completion of certain leasehold improvements to the Premises (as defined in the Lease), but not sooner than March 1, 2023 (the Lease Commencement Date) and continue for 124 months from the Lease Commencement Date. We also have one option to extend the Lease Term for five years. Base rent during such extension period would be at the fair market rent for the Premises. Under the terms of the Lease, the base rent during the first 12 months of the Lease Term will be \$5.75 per square foot of rentable area per month, subject to certain upward adjustments of approximately 3.0% annually. We are entitled to an allowance of \$5.5 million for tenant improvements, including an option to utilize an additional allowance of up to \$0.6 million, which, if used by us, would be repaid by us as additional monthly base rent, amortized at eight percent (8.0%) per annum during the Lease Term. We provided a \$0.7 million security deposit in the form of a letter of credit which is included in restricted cash as of September 30, 2022.

In April 2022, we entered into a financing lease to lease various research and development and information technology equipment over a 48-month term. Financing lease liabilities total \$0.8 million as of September 30, 2022. Additionally, we provided \$1.5 million in cash collateral for the financing lease, and this amount is included in restricted cash as of September 30, 2022.

Except as described above, our material cash requirements from known contractual obligations have not otherwise changed materially since our Annual Report on Form 10-K for the year ended December 31, 2021.

We did not have any off-balance sheet arrangements as of September 30, 2022.

Financial Operations Overview

Organization and Business; Principles of Consolidation

We conduct substantially all of our activities through aTyr Pharma, Inc., a Delaware corporation, at our facility in San Diego, California. aTyr Pharma, Inc. was incorporated in the State of Delaware in September 2005. The condensed consolidated financial statements in this Quarterly Report include our accounts and our 98% majority-owned subsidiary in Hong Kong, Pangu BioPharma as of September 30, 2022. All intercompany transactions and balances are eliminated in consolidation.

Revenue Recognition

In January 2020, we entered into the Kyorin Agreement with Kyorin for the development and commercialization of efzofitimid for ILD in Japan. Under the Kyorin Agreement, Kyorin received an exclusive right to develop and commercialize efzofitimid in Japan for all forms of ILD, and Kyorin is obligated to fund all research, development, regulatory, marketing and commercialization activities in Japan. In September 2020, Kyorin began dosing of its Phase 1 trial of efzofitimid and completed the last subject visit in December 2020. This achievement triggered a \$2.0 million milestone payment, which we received in January 2021. The Phase 1 trial, which was conducted and funded by Kyorin, was a placebo-controlled study to evaluate the safety, PK and immunogenicity of efzofitimid in 32 healthy Japanese male volunteers. Efzofitimid was observed to be generally well-tolerated with no drug-related serious adverse events and PK findings were consistent with previous studies of efzofitimid. We received an \$8.0 million upfront payment and a \$2.0 million milestone payment and we are eligible to receive an additional \$165.0 million in the aggregate upon achievement of certain development, regulatory and sales milestones, as well as tiered royalties ranging from the mid-single digits to mid-teens on net sales in Japan. Kyorin has joined the EFZO-FIT™ study, and all study activity in Japan will be funded by Kyorin.

During the three and nine months ended September 30, 2022 and 2021, there were no activities that triggered additional license and collaboration agreement revenue under the Kyorin Agreement.

Research and Development Expenses

To date, our research and development expenses have related primarily to the development of, and clinical trials for, our product candidates, and to research efforts targeting the potential therapeutic application of other tRNA synthetase-based immuno-modulators and, more recently research efforts related to NRP2 biology. These expenses consist primarily of:

- salaries and employee-related expenses, including stock-based compensation and benefits for personnel in research and product development functions;
- costs associated with conducting our preclinical, development and regulatory activities, including fees paid to third-party professional consultants, service providers and our scientific, therapeutic and clinical advisory board;
- costs to acquire, develop and manufacture preclinical study and clinical trial materials;
- costs incurred under clinical trial agreements with CROs and investigative sites;
- costs for laboratory supplies; and
- allocated facilities, depreciation and other allocable expenses.

Product candidates in later stages of clinical development generally have higher development costs than those in earlier stages of clinical development, primarily due to the increased size and duration of later-stage clinical trials. We expect that the levels of our research and development expenses will continue to increase in future years and will consist primarily of costs related to our clinical development and manufacturing of efzofitimid for patients with pulmonary sarcoidosis, including the costs associated with the change in our CRO and the technology transfer to an additional CDMO of efzofitimid, and other potential therapeutics based on tRNA synthetase biology and NRP2 biology.

We cannot determine with certainty the timing of initiation, the duration or the completion costs of current or future preclinical studies and clinical trials of our product candidates. For instance, as a result of the ongoing COVID-19 pandemic, many clinical trial sites in our completed Phase 1b/2a clinical trial in patients with pulmonary sarcoidosis temporarily suspended dosing of previously-enrolled patients and/or enrollment of new patients and some patients discontinued from the trial.

At this time, due to the inherently unpredictable nature of preclinical and clinical development and given the early stage of our programs, we are unable to estimate with any certainty the costs we will incur or the timelines we will require in the continued development of our product candidates. Clinical and preclinical development timelines, the probability of success and development costs can differ materially from expectations. We anticipate that we will make determinations as to which product candidates to pursue and how much funding to direct to each product candidate on an ongoing basis in response to the results of ongoing and future preclinical studies and clinical trials, regulatory developments and our ongoing assessments as to each product candidate's commercial potential. In addition, we cannot forecast which programs or product candidates may be subject to future collaborations, when such arrangements will be secured, if at all, and to what degree such arrangements would affect our development plans and capital requirements.

General and Administrative Expenses

General and administrative expenses consist primarily of salaries and related costs for employees in executive, finance and administration, corporate development and administrative support functions, including stock-based compensation expenses and benefits. Other significant general and administrative expenses include accounting, legal services, expenses associated with applying for and maintaining patents, cost of insurance, cost of various consultants, occupancy costs, information systems costs and depreciation.

Critical Accounting Estimates

Our management's discussion and analysis of financial condition and results of operations is based on our unaudited condensed consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States. The preparation of these unaudited condensed consolidated financial statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities as of the date of the unaudited condensed consolidated financial statements, as well as the reported expenses during the reporting periods. We monitor and analyze these items for changes in facts and circumstances, and material changes in these estimates could occur in the future. We base our estimates on our historical experience and on various other factors we believe to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying value of assets and liabilities that are not readily apparent from other sources. Changes in estimates are reflected in reported results for the period in which they become known. Actual results may differ materially from these estimates under different assumptions or conditions. Though the impact of the ongoing COVID-19 pandemic, the ongoing Ukraine-Russian conflict and other geopolitical and macroeconomic conditions on our business and operating results presents additional uncertainty, we continue to use the best information available to us in our critical accounting estimates.

We discuss our accounting policies and assumptions that involve a higher degree of judgment and complexity within Note 2 to our audited consolidated financial statements in our 2021 Annual Report. There have been no material changes to our critical accounting policies and estimates as disclosed in our 2021 Annual Report.

Results of Operations

Comparison of the Three Months Ended September 30, 2022 and 2021

The following table summarizes our results of operations for the three months ended September 30, 2022 and 2021 (in thousands):

	Three Months Ended September 30,		Increase/ Decrease
	2022	2021	
Research and development expenses	\$ 9,867	\$ 5,138	\$ 4,729
General and administrative expenses	3,625	2,590	1,035
Other income (expense), net	247	59	188

Research and development expenses. Research and development expenses were \$9.9 million and \$5.1 million for the three months ended September 30, 2022 and 2021, respectively. The increase of \$4.7 million was due primarily to \$3.0 million in start-up costs for the EFZO-FIT™ study, \$0.7 million in increased manufacturing costs for efzofitmod and ATYR2810, an increase of \$0.5 million in preclinical development expenses for ATYR2810 and our discovery programs, and an increase of \$0.4 million in personnel related expenses.

General and administrative expenses. General and administrative expenses were \$3.6 million and \$2.6 million for the three months ended September 30, 2022 and 2021 respectively. The increase of \$1.0 million was due primarily to an increase of \$0.7 million in personnel related expense, and an increase of \$0.2 million in professional fees.

Other income (expense), net. Other income (expense), net was \$0.2 million and \$59,000 for the three months ended September 30, 2022 and 2021, respectively. The increase was primarily a result of interest earned on higher cash, cash equivalents, restricted cash and available-for-sale investments balances, which resulted from an underwritten follow-on offering in September 2021, as well as higher interest rates as of September 30, 2022 compared to the same period in the prior year.

Comparison of the Nine Months Ended September 30, 2022 and 2021

The following table summarizes our results of operations for the nine months ended September 30, 2022 and 2021 (in thousands):

	Nine Months Ended September 30,		Increase / (Decrease)
	2022	2021	
Research and development expenses	27,898	17,309	10,589
General and administrative expenses	10,556	8,066	2,490
Other income (expense), net	634	159	475

Research and development expenses. Research and development expenses were \$27.9 million and \$17.3 million for the nine months ended September 30, 2022 and 2021, respectively. The increase of \$10.6 million was due primarily to \$3.6 million in start-up costs for the EFZO-FIT™ study, \$2.8 million in increased manufacturing costs for efzofitimid and ATYR2810, an increase of \$2.0 million in personnel related expenses, and an increase of \$2.4 million in preclinical development expenses for ATYR2810 and our discovery programs.

General and administrative expenses. General and administrative expenses were \$10.6 million and \$8.1 million for the nine months ended September 30, 2022 and 2021, respectively. The increase of \$2.5 million was due primarily to an increase of \$1.5 million in personnel related expenses, and an increase of \$0.5 million in professional fees.

Other income (expense), net. Other income (expense), net was \$0.6 million and \$0.2 million for the nine months ended September 30, 2022 and 2021, respectively. The increase of \$0.5 million was primarily a result of interest earned on higher cash, cash equivalents, restricted cash and available-for-sale investments balances, which resulted from an underwritten follow-on offering in September 2021 as well as higher interest rates as of September 30, 2022 compared to the same period in the prior year.

Recent Accounting Pronouncements

For discussion of recently issued accounting pronouncements, refer to Part I, Item 1, Notes to Condensed Consolidated Financial Statements (Unaudited) – Note 1 – Recent Accounting Pronouncements of this Quarterly Report.

Item 3. Quantitative and Qualitative Disclosures About Market Risk

Not applicable.

Item 4. Controls and Procedures

We maintain disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act) that are designed to ensure that information required to be disclosed in our reports required by the Exchange Act, is recorded, processed, summarized and reported within the timelines specified in the SEC's rules and forms, and that such information is accumulated and communicated to our management, including our Chief Executive Officer and Chief Financial Officer, as appropriate, to allow timely decisions regarding required disclosure. In designing and evaluating the disclosure controls and procedures, management recognized that any controls and procedures, no matter how well designed and operated, can only provide reasonable assurance of achieving the desired control objectives, and in reaching a reasonable level of assurance, management necessarily was required to apply its judgment in evaluating the cost-benefit relationship of possible controls and procedures.

As required by Rule 13a-15(b) under the Exchange Act, we carried out an evaluation, under the supervision and with the participation of our management, including our Chief Executive Officer and Chief Financial Officer, of the effectiveness of the design and operation of our disclosure controls and procedures as of the end of the quarter covered by this Quarterly Report. Based on the foregoing, our Chief Executive Officer and Chief Financial Officer concluded that our disclosure controls and procedures were effective at the reasonable assurance level as of the end of the quarter covered by this Quarterly Report.

Changes in Internal Control over Financial Reporting

An evaluation was also performed under the supervision and with the participation of our management, including our Chief Executive Officer and Chief Financial Officer, of any changes to our internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act) during the quarter covered by this Quarterly Report that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting. Our evaluation did not identify any changes in our internal control over financial reporting that occurred during the quarter covered by this Quarterly Report, 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

We are not a party to any material legal proceedings at this time. From time to time, we may be subject to various legal proceedings and claims that arise in the ordinary course of our business activities. Although the results of litigation and claims cannot be predicted with certainty, we do not believe we are party to any claim or litigation the outcome of which, if determined adversely to us, would individually or in the aggregate be reasonably expected to have a material adverse effect on our results of operations or financial condition. Regardless of the outcome, litigation can have an adverse effect on us because of defense and settlement costs, diversion of management resources and other factors.

Item 1A. Risk Factors

Risks Factors Summary

Below is a summary of the principal factors that make an investment in our securities speculative or risky. This summary does not address all of the risks that we face. Additional discussion of the risks summarized in this risk factor summary, and other risks that we face, can be found following this summary and should be carefully considered, together with other information in this Quarterly Report and our other filings with the SEC before making investment decisions regarding our securities.

Investing in our securities involves substantial risk. The risks described under the heading “Risk Factors” immediately following this summary may cause us to not realize the full benefits of our strengths or may cause us to be unable to successfully execute all or part of our strategy. Some of the more significant risks we face include the following:

- We will need to raise additional capital or enter into strategic partnering relationships to fund our operations;
- We are a pre-commercial biotherapeutics company and have incurred significant losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future;
- We may encounter substantial delays and other challenges in our planned clinical trials or we may fail to demonstrate safety and efficacy to the satisfaction of applicable regulatory authorities;
- If we are unable to successfully complete or otherwise advance clinical development, obtain regulatory or marketing approval for, or successfully commercialize our therapeutic product candidates, including efzofitmod and ATYR2810, or experience significant delays in doing so, our business will be materially harmed;
- Our current product candidates and any other product candidates that we may develop from our discovery engine represent novel therapeutic approaches, which may cause significant delays or may not result in any commercially viable drugs;
- Our therapeutic product candidates may cause undesirable side effects or have other properties that could delay or prevent their regulatory approval, limit the commercial profile of an approved label, or result in significant negative consequences following marketing approval, if any;
- We depend on our existing collaborations and may depend on collaborations with additional third parties for the development and commercialization of certain of our product candidates. If our collaborations are not successful, we may not be able to capitalize on the market potential of these product candidates;
- If we are unable to obtain, maintain or protect intellectual property rights related to our product candidates, or if the scope of such intellectual property protection is not sufficiently broad, we may not be able to compete effectively in our markets;
- Our business could continue to be adversely affected by the effects of the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict and other geopolitical and macroeconomic conditions; and

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

Risk Factors

You should carefully consider the following risk factors, as well as the other information in this Quarterly Report and in our other public filings with the SEC. The occurrence of any of these risks could harm our business, financial condition, results of operations and/or growth prospects or cause our actual results to differ materially from those contained in forward-looking statements we have made in this Quarterly Report and those we may make from time to time. You should consider all of the risk factors described in our other public filings when evaluating our business.

Risks related to our financial condition and need for additional capital

We will need to raise additional capital or enter into strategic partnering relationships to fund our operations.

The development of therapeutic product candidates is expensive, and we expect our research and development expenses to fluctuate. As of September 30, 2022, our cash, cash equivalents, restricted cash and available-for-sale investments were approximately \$79.6 million. We believe that our current cash, cash equivalents, restricted cash and available-for-sale investments, will be sufficient to meet our material cash requirements for known contractual and other obligations for a period of at least one year from the date of this Quarterly Report. However, our operating plan may change as a result of many factors currently unknown to us, and we may need to seek additional funds sooner than planned, through equity or debt offerings, grant funding, collaborations, strategic partnerships and/or licensing arrangements. Our future funding requirements are difficult to forecast and will depend on many factors, including but not limited to:

- the type, number, scope progress, expansions, results, costs and timing of, our clinical trials and preclinical studies for our product candidates or other potential product candidates or indications which we are pursuing or may choose to pursue in the future, including any changes in CROs;
- the costs, timing and outcome of regulatory review of our product candidates;
- potential delays of our planned clinical trials of efzofitmod and any resulting cost increases as a result of the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict, and other geopolitical and macroeconomic conditions including labor shortages, economic slowdowns, recessions or market corrections, inflation and monetary supply shifts, rising interest rates and tightening of credit markets;
- the number and characteristics of product candidates that we pursue;
- the scope, progress, results and costs of preclinical development, and clinical trials for other product candidates;
- the manufacturing of preclinical study and clinical trial materials, including technology transfers to additional CDMOs, and any delays in the manufacturing of study drug as a result of the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict, and other geopolitical and macroeconomic conditions including labor shortages, economic slowdowns, recessions or market corrections, inflation, rising interest rates and tightening of credit markets;
- our ability to maintain existing and enter into new collaboration and licensing arrangements and the timing of any payments we may receive under such arrangements;
- the costs and timing of preparing, filing and prosecuting patent applications, maintaining and enforcing our intellectual property rights and defending any intellectual property-related claims;
- the costs and timing of future commercialization activities, including product manufacturing, marketing, sales and distribution, for any of our product candidates for which we receive marketing approval; and
- the extent to which we acquire or in-license other products and technologies.

In any event, we will require additional capital to complete additional clinical trials, including larger, pivotal clinical trials like the EFZO-FIT™ study, to obtain regulatory approval for, and to commercialize, our product candidates.

Raising funds in the current and future economic environment may present additional challenges. Even if we believe we have sufficient funds for our current or future operating plans, we may seek additional capital if market conditions are favorable or if we have specific strategic considerations. If we are unable to obtain funding on a timely basis, we may be required to significantly curtail, delay or discontinue one or more of our research or development programs or the commercialization of any product candidates, or we may be unable to expand our operations, maintain our current organization and employee base or otherwise capitalize on our business opportunities, as desired, which could materially affect our business, financial condition and results of operations.

The terms of any financing may adversely affect the holdings or the rights of our stockholders and the issuance of additional securities 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 cause dilution to all of our stockholders. The incurrence of indebtedness would result in fixed payment obligations and may require us to agree to certain restrictive covenants, such as limitations on our ability to incur 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. As a result of the ongoing COVID-19 pandemic and the ongoing Ukraine-Russia conflict, the global credit and financial markets have experienced volatility and disruptions, including severely diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates, inflation, rising interest rates and uncertainty about economic stability. If the equity and credit markets deteriorate, it may make any necessary debt or equity financing more difficult, more costly and more dilutive. In addition, any fundraising efforts may divert our management from their day-to-day activities, which may adversely affect our ability to develop and commercialize our product candidates.

Additionally, financial markets around the world experienced volatility following the invasion of Ukraine by Russia in February 2022. In response to the invasion, the United States, United Kingdom and EU, along with others, imposed significant new sanctions and export controls against Russia, Russian banks and certain Russian individuals and may implement additional sanctions or take further punitive actions in the future. The full economic and social impact of the sanctions imposed on Russia (as well as possible future punitive measures that may be implemented), as well as the counter measures imposed by Russia, in addition to the ongoing Ukraine-Russian conflict, which could conceivably expand into the surrounding region, remains uncertain; however, both the conflict and related sanctions have resulted and could continue to result in disruptions to trade, commerce, pricing stability, credit availability and/or supply chain continuity in both Europe and globally, and has introduced significant uncertainty into global markets. In particular, the ongoing Ukraine-Russia conflict has contributed to rapidly rising costs of living (driven largely by higher energy prices) in Europe and other advanced economies. Further, a weak or declining economy could strain our suppliers and manufacturers, possibly resulting in additional supply disruption for the production of efzofitimid. As a result, our business and results of operations may be adversely affected by the ongoing Ukraine-Russia, particularly to the extent it escalates to involve additional countries, further economic sanctions or wider military conflict. We are conducting the EFZO-FIT™ study and intend to enroll 264 subjects at multiple centers in United States, Europe and Japan.

In addition to the ongoing COVID-19 pandemic and the ongoing Ukraine-Russia conflict, global economic and business activities continue to face widespread macroeconomic uncertainties, including labor shortages, inflation and monetary supply shifts, and recession risks, which has resulted in further volatility in the U.S. and global financial markets and which has led to, and may continue to lead to, additional disruptions to trade, commerce, pricing stability, credit availability and supply chain continuity globally. The ultimate long-term impact of the COVID-19 pandemic, the ongoing Ukraine-Russia conflict and other evolving macroeconomic conditions on our business is uncertain, although we continue to actively monitor the impact of these factors on our results of operations, financial condition and cash flows. The extent of the impact of these factors on our operational and financial performance, including our ability to execute our business strategies and initiatives in the expected timeframe, will depend on future developments, which are uncertain and cannot be predicted; however, any continued or renewed disruption resulting from these factors could negatively impact our business.

We may decide to enter into additional strategic partnerships, including collaborations with pharmaceutical and biotechnology companies, to enhance and accelerate the development and potential commercialization of our product candidates. We face significant competition in seeking appropriate partners, and the negotiation process is time-consuming and complex. Moreover, we may not be successful in our efforts to establish any new strategic partnership or other collaborative arrangement for any of our product candidates and programs for a variety of reasons, including strategic fit with partners and differences in analysis of commercial value and regulatory risk. We may not be able to negotiate strategic partnerships on a timely basis, on acceptable terms or at all. We are unable to predict when, if ever, we will enter into any new strategic partnership because of the numerous risks and uncertainties associated with establishing strategic partnerships. Even if we are successful in our efforts to establish new strategic partnerships, the terms that we agree upon may not be favorable to us and we may not be able to maintain such strategic partnerships if, for example, we encounter unfavorable results or delays during development or approval of a product candidate or sales of an approved product are lower than expectations.

We are a pre-commercial biotherapeutics company and have incurred significant losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future.

We are a pre-commercial biotherapeutics company, and we have not yet generated any revenues from product sales. We have incurred net losses in each year since our inception in 2005, including consolidated net losses of \$37.8 million for the nine months ended September 30, 2022. As of September 30, 2022 and December 31, 2021, we had an accumulated deficit of \$410.1 million and \$372.3 million, respectively.

We have devoted most of our financial resources to research and development, including our clinical and preclinical development activities. To date, we have financed our operations primarily through the sale of equity securities and convertible debt and through

venture debt, term loans and license and collaboration agreement revenues. The amount of our future net losses will depend, in part, on the rate of our future expenditures and our ability to obtain funding through equity offerings, grant funding, collaborations, strategic partnerships and/or licensing arrangements. We have not completed registrational clinical trials for any product candidate to date and it will be several years, if ever, before we have a product candidate ready for commercialization. Even if we obtain regulatory approval to market a product candidate, our future revenues will depend, in part, upon the size of any markets in which our product candidates have received approval, and our ability to achieve sufficient market acceptance, reimbursement from third-party payors and adequate market share for our product candidates in those markets.

We expect to continue to incur significant expenses and operating losses for the foreseeable future. We anticipate that our expenses will fluctuate in connection with our ongoing activities as we: continue our research and preclinical and clinical development of efzofitmod or any other product candidates that we may develop; obtain clinical trial materials and further develop the manufacturing process for our product candidates; seek regulatory approvals for our product candidates that successfully complete clinical trials; ultimately establish a sales, marketing and distribution infrastructure to commercialize any products for which we may obtain marketing approval; seek to identify and validate additional product candidates; maintain, protect and expand our intellectual property portfolio; acquire or in-license other product candidates and technologies; attract and retain skilled personnel; and create additional infrastructure to support our operations as a public company and our product development and planned future commercialization efforts.

Our revenues, expenses and income or losses 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.

We have never generated any revenue from product sales and may never be profitable.

Our ability to generate revenue and achieve profitability depends on our ability, alone or with strategic collaboration partners, to successfully complete the development of, and obtain the regulatory approvals necessary to commercialize our product candidates. We do not anticipate generating revenues from product sales for the foreseeable future, if ever. Our ability to generate future revenues from product sales depends heavily on our success in:

- completing research, preclinical development and clinical development of our product candidates, potentially with a strategic partner;
- seeking and obtaining regulatory approvals for product candidates for which we complete clinical trials;
- developing a sustainable, scalable, reproducible, and transferable manufacturing process for our product candidates and establishing supply and manufacturing relationships with third parties;
- launching and commercializing product candidates for which we obtain regulatory approval, either by collaborating with a partner or, if launched independently, by establishing a sales force, marketing and distribution infrastructure;
- maintaining, protecting and expanding our intellectual property portfolio;
- obtaining market acceptance of our product candidates as viable treatment options for our target indications;
- identifying and validating new therapeutic product candidates based on tRNA synthetase biology or NRP2 biology, including through our AARS and DARS discovery programs;
- attracting, hiring and retaining qualified personnel; and
- negotiating favorable terms in any licensing, collaboration or other arrangements into which we may enter.

Even if one of our product candidates is approved for commercial sale, we anticipate incurring significant costs associated with commercializing any such approved product candidate. Our expenses could increase beyond expectations if we are required by the FDA or other regulatory agencies, domestic or foreign, to perform clinical trials and other studies in addition to those that we currently anticipate. Even if we are able to generate revenues from the sale of any approved products, we may not become profitable and may need to obtain additional funding to continue operations.

Risks related to the discovery, development and regulation of our product candidates

The FDA has not approved any product candidate for the treatment of patients with pulmonary sarcoidosis, and as such, there is no established FDA regulatory pathway for approval of a drug in that indication. As a result, our EFZO-FIT™ study, even if successful, may not be sufficient to support FDA approval, which would materially and adversely harm our business.

During the third quarter of 2022, we initiated the global pivotal Phase 3 study of efzofitmod in patients with pulmonary sarcoidosis (the EFZO-FIT™ study). To date, the FDA has not approved any product for the treatment of patients with pulmonary

sarcoidosis, and as such, there is no established FDA regulatory pathway for approval of a drug in that indication. The most appropriate efficacy endpoints to demonstrate clinically meaningful treatment effects have not been established. In this instance, without regulatory precedent for established endpoints, the FDA has not endorsed a specific means for measurement of steroid reduction. Therefore, we are measuring steroid reduction in multiple ways in an effort to support an approval. Our rationale for selecting endpoints for the EFZO-FIT™ study is based on the anticipated effects of efzofitmod in pulmonary sarcoidosis consistent with the results of our completed Phase 1b/2a study in patients with pulmonary sarcoidosis. The FDA has highlighted the risk of proceeding with a larger study of longer duration based on our limited Phase 1b/2a data, and our inability to replicate the findings in our Phase 1b/2a study would not support FDA approval and will adversely affect our business, prospects, financial condition and results of operations.

In addition, the FDA has substantial discretion in the approval process and may refuse to accept any application or decide that our data are insufficient for approval and require additional preclinical, clinical or other trials, which would be costly and significantly delay the potential for regulatory approval. In particular, even if we were to receive positive data from the EFZO-FIT™ study, the FDA may determine that the data is not compelling enough for approval. The FDA may also require a panel of experts, referred to as an Advisory Committee, to deliberate on the adequacy of the safety and efficacy data to support approval. The opinion of the Advisory Committee, although not binding, may have a significant impact on our ability to obtain approval of efzofitmod based on the completed clinical trials.

We may encounter substantial delays and other challenges in our planned clinical trials or we may fail to demonstrate safety and efficacy to the satisfaction of applicable regulatory authorities.

Before obtaining marketing approval from regulatory authorities for the sale of our product candidates, we must conduct extensive clinical trials to demonstrate the safety and efficacy of the product candidates in humans. Clinical trials are expensive, time-consuming, often delayed and uncertain as to outcome. We cannot guarantee that future trials we may plan to conduct, will be initiated or conducted as planned or completed on schedule, if at all. We cannot assure you that our product candidates will not be subject to new clinical holds or significant delay in the future. For example, in our completed Phase 1b/2a clinical trial of efzofitmod in patients with pulmonary sarcoidosis, FDG-PET/CT was not evaluable due to incomplete data primarily caused by operational issues related to the ongoing COVID-19 pandemic. Any inability to initiate or complete clinical trials of our product candidates in the United States, as a result of clinical holds or otherwise, would delay our clinical development plans, may require us to incur additional clinical development costs and could impair our ability to obtain U.S. regulatory approval for such product candidates.

A failure of one or more clinical trials can occur at any stage of testing, and our clinical trials may not be successful. Events that may prevent successful or timely completion of clinical development include, but are not limited to:

- our inability to generate sufficient preclinical, toxicology, or other *in vivo* or *in vitro* data to support the initiation of human clinical trials, including trials of certain dosages;
- delays in reaching consensus with regulatory agencies on trial design, including with respect to the endpoints for the EFZO-FIT™ study and prioritization of outcome measurements that would best support the evaluation of efzofitmod's efficacy;
- delays in reaching agreement on acceptable terms with prospective CROs and clinical trial sites, including any delays resulting from changes in CROs;
- delays in obtaining required institutional review board or Ethics Committee approval at each clinical trial site;
- delays in recruiting suitable patients to participate in our clinical trials, or delays that may result if the number of patients required for a clinical trial is larger than we anticipate;
- imposition of a clinical hold by regulatory agencies, which may occur at any time before or during a clinical trial, including after our submission of data to these agencies or an inspection of our clinical trial operations or trial sites;
- failure by our CROs, investigators, other third parties or us to adhere to clinical trial requirements;
- failure to perform in accordance with the FDA's good clinical practices (GCPs) or applicable regulatory requirements in other countries;
- delays in the testing, validation, manufacturing and delivery of our product candidates to the clinical sites;
- delays in having patients complete participation in a trial or return for post-treatment follow-up;
- disagreements with regulators regarding our interpretation of data from preclinical studies or clinical trials;
- occurrence of adverse events associated with a product candidate that are viewed to outweigh its potential benefits; or
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols.

Any delay in or inability to successfully complete preclinical and clinical development (including any delays resulting from any changes in our CRO) could result in additional costs to us and impair our ability to generate revenue. In addition, if we make manufacturing or formulation changes to our product candidates (including our planned technology transfer to another CDMO for bulk drug substance and production capacity changes for efzofitimod), we may need to conduct additional studies to bridge our modified product candidates to earlier versions.

If the results of our future clinical trials are perceived to be negative or inconclusive, or if there are safety concerns or adverse events associated with our product candidates, we may be required to perform additional clinical trials to support approval or be subject to additional post-marketing testing requirements; be delayed in obtaining marketing approval for our product candidates, if at all; obtain approval for indications or patient populations that are not as broad as intended or desired; obtain approval with labeling that includes significant use or distribution restrictions or safety warnings; be subject to changes in the way the product is manufactured or administered; have regulatory authorities withdraw their approval of the product or impose restrictions on its distribution in the form of a modified risk evaluation and mitigation strategy; be subject to litigation; or experience damage to our reputation.

To date, the safety and efficacy of efzofitimod has only been studied in a limited number of humans and ATYR2810 has not been studied in humans at all. Accordingly, efzofitimod, ATYR2810 and any future product candidates could potentially cause unexpected adverse events. In addition, the inclusion of critically ill patients in our clinical trials may result in deaths or other adverse medical events due to the natural progression of the disease.

Further, if patients drop out of any future trials, miss scheduled doses or follow-up visits or otherwise fail to follow trial protocols, or if our trials are otherwise disrupted due to the ongoing COVID-19 pandemic and the ongoing Ukraine-Russia conflict or actions taken to slow its spread, the integrity of data from our trials may be compromised or not accepted by the FDA or other regulatory authorities, which would represent a significant setback for the applicable program. In addition, the ongoing COVID-19 pandemic and the ongoing Ukraine-Russia conflict have impacted clinical trials broadly, including our completed efzofitimod Phase 1b/2a trial in patients with pulmonary sarcoidosis, where many sites stopped enrollment and patients chose not to enroll or continue participating in the trial due to the impact of ongoing COVID-19. While we completed the clinical trial, the availability of results from the Phase 1b/2a clinical trial was delayed to September 2021. We may experience delays in site initiation and patient enrollment, failures to comply with study protocols, delays in the manufacture of study drug for clinical testing and other difficulties in starting or completing our future trials due to the ongoing COVID-19 pandemic, including the emergence of new variants of COVID-19, as well as the ongoing Ukraine-Russia conflict.

Interim, top-line and preliminary data from our clinical trials that we announce or publish from time to time may change as more patient data become available and are subject to audit and verification procedures that could result in material changes in the final data.

From time to time, we may publicly disclose preliminary or top-line data from our clinical studies, 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 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. From time to time, we may also disclose interim data from our clinical studies.

In addition, we may report interim analyses of only certain endpoints rather than all endpoints. Interim data from clinical trials that we may complete are subject to the risk that one or more of the clinical outcomes may materially change as patient enrollment continues and more patient data become available. Adverse differences between preliminary or interim data and final data could significantly harm our business prospects. Further, disclosure of interim data by us or by our competitors could result in volatility in the price of our common stock.

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 a 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, and any information we determine not to disclose may ultimately be deemed significant with respect to future decisions, conclusions, views, activities or otherwise regarding a particular product, product candidate or our business. If the top-line data that we report differ from actual results, or if others, including regulatory authorities, disagree with the conclusions reached, our ability to obtain approval for, and commercialize, our product candidates may be harmed, which could harm our business, operating results, prospects or financial condition.

If we are unable to successfully complete or otherwise advance clinical development, obtain regulatory or marketing approval for, or successfully commercialize our therapeutic product candidates or experience significant delays in doing so, our business will be materially harmed.

To date, we have expended significant time, resources and effort on the discovery and development of product candidates related to the extracellular proteins derived from the histidyl tRNA synthetase (HARS) family and NRP2 biology, including conducting preclinical studies and clinical trials. We have not yet commenced or completed any evaluation of our product candidates in human clinical trials designed to demonstrate efficacy to the satisfaction of the FDA. Before we can market or sell our therapeutic candidates in the United States or foreign jurisdictions, we will need to commence and complete additional clinical trials (including larger, pivotal trials like the EFZO-FIT™ study, which recently commenced), manage clinical and manufacturing activities, obtain necessary regulatory approvals from the FDA in the United States and from similar regulatory authorities in other jurisdictions, obtain adequate clinical and commercial manufacturing supplies, build commercial capabilities, which may include entering into a marketing collaboration with a third party, and in some jurisdictions, obtain reimbursement authorization, among other things. We cannot assure you that we will be able to successfully complete the necessary clinical trials, obtain regulatory approvals, secure an adequate commercial supply for, or otherwise successfully commercialize our therapeutic candidates. If we do not receive regulatory approvals for our product candidates, and even if we do obtain regulatory approvals, we may never generate significant revenues, if any, from commercial sales. If we fail to successfully commercialize our therapeutic candidates, we may be unable to generate sufficient revenues to sustain and grow our company, and our business, prospects, financial condition and results of operations will be adversely affected.

We have encountered and may continue to encounter delays and difficulties enrolling patients in our clinical trials for a variety of reasons, including the limited number of patients who have the diseases for which certain of our product candidates are being studied, which could delay or halt the clinical development of our product candidates.

Identifying and qualifying patients to participate in clinical trials for our product candidates is critical to our success. Certain of the conditions for which we may elect to evaluate our product candidates may be rare diseases with limited patient pools from which to draw for clinical trials.

For example, we are currently conducting the EFZO-FIT™ study in patients with pulmonary sarcoidosis. While estimates of pulmonary sarcoidosis prevalence vary, we estimate that pulmonary sarcoidosis affects an estimated 200,000 patients in the United States. Of that population, however, we estimate that approximately 30% experience progressive disease such that our targeted population is significantly smaller. The eligibility criteria for any of our future clinical trials may further limit the pool of available participants in our trials. For example, if patients have been previously prescribed certain other medications to treat pulmonary sarcoidosis, they may not be eligible to participate in the EFZO-FIT™ study, thus further reducing our patient pool. We may be unable to identify and enroll a sufficient number of patients with the disease in question and who meet the eligibility criteria for, and are willing to participate in, the clinical trials. Once enrolled, patients may decide or be required to discontinue from the clinical trial due to inconvenience, burden of trial requirements, adverse events associated with efzofitmod, limitations required by trial protocols or other reasons.

Our ability to identify, recruit, enroll and maintain a sufficient number of patients, or those with required or desired characteristics to achieve diversity in future clinical trials in a timely manner may also be affected by other factors, including, but not limited to:

- proximity and availability of clinical trial sites for patients;
- severity of the disease under investigation;
- design of the study protocol and the burdens to patients of compliance with our study protocol;
- perceived risks and benefits of the product candidate under study;
- availability of competing therapies and clinical trials for the patient populations and indications under study;
- efforts to facilitate timely enrollment in clinical trials;
- patient referral practices of physicians; and
- ability to monitor patients adequately during and after treatment.

We plan to seek initial marketing approval in the United States. We may not be able to initiate or continue clinical trials if we cannot enroll a sufficient number of eligible patients to participate in the clinical trials required by the FDA or other regulatory agencies. Our ability to successfully initiate, enroll and complete a clinical trial in any foreign country is subject to numerous risks unique to conducting business in foreign countries, including, but not limited to:

- difficulty in establishing or managing relationships with or changes in CROs and physicians;
- different requirements and standards for the conduct of clinical trials;

- our inability to locate qualified local consultants, physicians and partners; and
- the potential burden of complying with a variety of foreign laws, medical standards and regulatory requirements, including the regulation of biotechnology products and treatment.

Additionally, if patients are unwilling to participate in our clinical trials because of negative publicity from adverse events in our clinical trials or in the biotechnology or protein therapeutics industries or for other reasons, including competitive clinical trials for similar patient populations or complications arising from the ongoing Ukraine-Russia conflict, the timeline for recruiting patients, conducting studies and obtaining regulatory approval of potential products may be delayed. These delays could result in increased costs, delays in advancing our product development or termination of our clinical trials altogether. If we have difficulty enrolling and maintaining a sufficient number of patients to conduct our clinical trials as planned for any reason, we may need to delay, limit or terminate clinical trials, any of which would have an adverse effect on our business, prospects, financial condition and results of operations.

Furthermore, clinical trial delays could also shorten any periods during which we may have the exclusive right to commercialize our product candidates or allow our competitors to bring products to market before we do, which could impair our ability to obtain orphan exclusivity and successfully commercialize our product candidates and may have an adverse effect on our business, financial condition and results of operations.

Our current product candidates and any other product candidates that we may develop from our discovery engine represent novel therapeutic approaches, which may cause significant delays or may not result in any commercially viable drugs.

We have concentrated the bulk of our research and development efforts to date on studying extracellular functions of tRNA synthetase biology, a newly discovered area of biology. We have also identified NRP2 as a receptor for efzofitmod and have focused research efforts on NRP2 biology. Our future success is highly dependent on the successful development of product candidates based on these new areas of biology, including efzofitmod, ATYR2810 and additional product candidates arising from proteins derived from tRNA synthetases or targeting the NRP2 receptor or other pathways, including AARS and DARS. Extracellular tRNA synthetase-based biology and NRP2 biology represents a novel approach to drug discovery and development, and to our knowledge, no drugs have been developed using, or based upon, this approach. Despite the successful development of other naturally occurring proteins, such as erythropoietin and insulin, as therapeutics, proteins derived from HARS, AARS or DARS families or targeting the NRP2 receptor and from other tRNA synthetase pathways represent a novel class of protein therapeutics, and our development of these therapeutics is based on our new understanding of human physiology. In particular, the mechanism of action of tRNA synthetases and their role in immunomodulation and tissue regeneration have not been studied extensively, nor has the safety of this class of protein therapeutics been evaluated extensively in humans. The therapeutic product candidates that we elect to develop may not have the physiological functions that we currently ascribe to them, may have limited or no therapeutic applications, or may present safety problems of which we are not yet aware. We cannot be sure that our discovery engine will yield therapeutic product candidates that are safe, effective, approvable by regulatory authorities, manufacturable, scalable, or profitable.

Because our work represents a new therapeutic approach, developing and commercializing our product candidates, including efzofitmod and ATYR2810, subjects us to a number of challenges, including:

- defining indications within our targeted diseases and clinical endpoints within each indication that are appropriate to support regulatory approval, including with respect to the EFZO-FIT™ study and prioritization of outcome measurements that would best support the evaluation of efzofitmod's efficacy;
- obtaining regulatory approval from the FDA and other regulatory authorities that have little or no experience with the development of extracellular tRNA synthetase-based therapeutics;
- educating medical personnel regarding the potential side effect profile of each of our product candidates, such as the potential for the development of antibodies against our purified protein therapeutics;
- developing processes for the safe administration of these product candidates, including long-term follow-up for all patients who receive our product candidates;
- sourcing clinical and, if approved, commercial supplies for the materials used to manufacture and process our product candidates;
- developing a manufacturing process and distribution network that ensures consistent manufacture of our product candidates in compliance with current good manufacturing practices (cGMPs) and related requirements, with a cost of goods that allows for an attractive return on investment;
- obtaining and maintaining third-party coverage and adequate reimbursement of our product candidates;
- establishing sales and marketing capabilities after obtaining any regulatory approval to gain market acceptance; and
- developing therapeutics for diseases or indications beyond those addressed by our current product candidates.

Moreover, public perception of safety issues, including adoption of new therapeutics or novel approaches to treatment, may adversely influence the willingness of subjects to participate in clinical trials, or if approved, of physicians to adopt and prescribe novel therapeutics. Physicians, hospitals and third-party payors often are slow to adopt new products, technologies and treatment practices. Physicians may decide the therapy is too complex or unproven to adopt and may choose not to administer the therapy. Based on these and other factors, healthcare providers and payors may decide that the benefits of any therapeutic candidates for which we receive regulatory approval do not or will not outweigh its costs. Any inability to successfully develop commercially viable drugs would have an adverse impact on our business, prospects, financial condition and results of operations.

Data generated in our preclinical studies and patient sample data relating to the immunomodulatory domain of HARS, including efzofitmod, may not be predictive or indicative of the immunomodulatory activity or therapeutic effects, if any, of our product candidates in patients.

Our scientists discovered the activity of the immunomodulatory domain of HARS, including efzofitmod, using *in vitro* and *in vivo* screening systems designed to test potential immunomodulatory activity in animal models of immune activity or inflammation. Translational medicine, or the application of basic scientific findings to develop therapeutics that promote human health, is subject to a number of inherent risks. In particular, scientific hypotheses formed from preclinical observations may prove to be incorrect, and the data generated in animal models or observed in limited patient populations may be of limited value, and may not be applicable in clinical trials conducted under the controlled conditions required by applicable regulatory requirements and our protocols. For example, we have not extensively studied the activity of efzofitmod in patients with ILD.

Our classification of diseases based on the existence of excessive immune cell activation or lack thereof and our hypothesis that these represent potential indications for our product candidates may not prove to be therapeutically relevant. Accordingly, the conclusions that we have drawn from animal studies and patient sample data regarding the potential immunomodulatory activity of efzofitmod may not be substantiated in other animal models or in clinical trials. Further, based on the discovery of the involvement of NRP2 in the mechanism of action of efzofitmod, we are still expanding our knowledge of the role of the NRP2 pathway in regulating immune responses. Although we were able to establish clinical proof-of-concept for efzofitmod in our Phase 1b/2a clinical trial in patients with pulmonary sarcoidosis, this may not be validated in other clinical trials. Any failure to demonstrate in controlled clinical trials the requisite safety and efficacy of our product candidates will adversely affect our business, prospects, financial condition and results of operations.

We have previously conducted and we or our third party collaborators may conduct additional clinical trials of efzofitmod outside of the United States. The FDA, however, may not accept data from such trials, in which case our development plans will be delayed, which could materially harm our business.

In June 2018, we completed a Phase 1 clinical trial of efzofitmod in healthy subjects in Australia. This randomized, double-blind, placebo-controlled study investigated the safety, tolerability, immunogenicity, and PK of intravenous efzofitmod in 36 healthy volunteers. In addition, we or our third party collaborators may choose to conduct additional clinical trials for efzofitmod in countries outside the United States, subject to applicable regulatory approval. For example, our partner, Kyorin Pharmaceutical Co., Ltd. (Kyorin), conducted an efzofitmod Phase 1 clinical trial in 32 healthy Japanese male volunteers, and we will seek to enroll subjects in the EZFO-FIT™ study in centers in United States, Europe and Japan.

Although the FDA may accept data from clinical trials conducted outside the United States, acceptance of such study data is generally subject to certain conditions. For example, in cases where data from foreign clinical trials are intended to serve as the basis for marketing approval in the United States, the FDA will generally not approve the application on the basis of foreign data alone unless (i) the data are applicable in the U.S. population and U.S. medical practice; and (ii) the trials were performed by clinical investigators of recognized competence and pursuant to GCP regulations. Additionally, the FDA's clinical trial requirements, including sufficient size of patient populations and statistical powering, must be met. In addition, when studies are conducted only at sites outside of the United States, the FDA generally does not provide advance comment on the clinical protocols for the studies, and therefore there is an additional risk that the FDA could determine that the study design or protocol for a non-U.S. clinical trial was inadequate, which would likely require us to conduct additional clinical trials, in which case our development plans will be delayed, which could materially harm our business.

Conducting clinical trials outside the United States also exposes us to additional risks, including risks associated with:

- additional foreign regulatory requirements;
- foreign exchange fluctuations;
- compliance with foreign manufacturing, customs, shipment and storage requirements;
- cultural differences in medical practice and clinical research;
- evolving geopolitical and macroeconomic developments, including the ongoing Ukraine-Russia conflict; and
- diminished protection of intellectual property in some countries.

Further, as a result of the ongoing COVID-19 pandemic, the integrity of data from any clinical trials conducted outside of the United States may not be acceptable to the FDA.

Our therapeutic product candidates may cause undesirable side effects or have other properties that could delay or prevent their regulatory approval, limit the commercial profile of an approved label, or result in significant negative consequences following marketing approval, if any.

Undesirable side effects caused by our product candidates, or safety, tolerability or toxicity issues that may occur in our preclinical studies, clinical trials or in the future, could cause us or regulatory authorities to interrupt, restrict, delay, or halt clinical trials and could result in a more restrictive label or the delay or denial of regulatory approval by the FDA or other comparable foreign authorities.

In our Phase 1b/2 clinical trials for our first clinical trial candidate, ATYR1940 (slightly truncated recombinant HARS protein), completed in 2016 and 2017, we observed low levels of antibodies to ATYR1940 in some subjects in response to the administration of ATYR1940. Although these antibody observations were without associated clinical symptoms, the development of higher levels of such antibodies over a longer course of treatment may ultimately limit efficacy and trigger a negative autoimmune response. In addition, some patients in our Phase 1b/2 clinical trials of ATYR1940 experienced generalized infusion related reactions (IRRs) and discontinued dosing. We established procedural measures, including a decreased concentration and intravenous delivery rate of ATYR1940, in an effort to minimize the occurrence of generalized IRRs and the formation of anti-drug antibodies. After implementation of these procedures, we observed a decreased rate of IRRs in our clinical trials of ATYR1940. We did not observe IRRs in our completed Phase 1b/2a clinical trial of efzofitimod in patients in pulmonary sarcoidosis or in our other efzofitimod clinical trials, but we cannot assure that this will be the case in any future clinical trials. Generalized IRRs and other complications or side effects could harm further development and/or commercialization of our product candidates, including efzofitimod. Additionally, our product candidates are designed to be administered by intravenous injection, which may cause side effects, including acute immune responses and injection site reactions. The risk of adverse immune responses remains a significant concern for protein therapeutics, and we cannot assure that these or other risks will not occur in any of our clinical trials our product candidates. There is also a risk of delayed adverse events as a result of long-term exposure to protein therapeutics that must be administered repeatedly for the management of chronic conditions, such as the development of antibodies, which may occur over time. If any such adverse events occur, which may include the development of a negative autoimmune response from antibodies or the occurrence of IRRs associated with antibodies, further advancement of our clinical trials could be halted or delayed, which would have a material adverse effect on our business, prospects, financial condition and results of operations.

If one or more of our product candidates receives marketing approval, and we or others later identify undesirable side effects or other safety concerns caused by such products, a number of potentially significant negative consequences could result.

Any of these events could prevent us from achieving or maintaining market acceptance of the particular product candidate, if approved, and could significantly harm our business, prospects, financial condition and results of operations.

We may not be successful in our efforts to identify or discover additional product candidates.

A key element of our strategy is to expand applications of efzofitimod to additional immune-mediated diseases, advance the development of ATYR2810 for cancer indications and leverage our discovery engine to identify the therapeutic potential of NRP2 biology and extracellular proteins derived from tRNA synthetases to help identify or discover additional product candidates. A significant portion of the research that we are conducting involves new compounds and drug discovery methods, including our proprietary technology. Our drug discovery activities using our proprietary technology may not be successful in identifying product candidates that are useful in treating diseases. Our research programs may initially show promise in identifying potential product candidates, yet fail to yield product candidates for clinical development for a number of reasons, including:

- the research methodology used may not be successful in identifying appropriate potential product candidates; or
- potential product candidates may, on further study, be shown to have harmful side effects or other characteristics that indicate that they are unlikely to be product candidates that will receive marketing approval and achieve market acceptance.

Research programs to identify new product candidates require substantial technical, financial and human resources. We may choose to focus our efforts and resources on a potential product candidate that ultimately proves to be unsuccessful. If we are unable to identify suitable product candidates for preclinical and clinical development and regulatory approval, we will not be able to generate product revenues, which would have an adverse impact on our business, prospects, financial condition and results of operations.

We may face manufacturing stoppages and other challenges associated with the clinical or commercial manufacture of our product candidates.

All entities involved in the preparation of therapeutics for clinical trials or commercial sale, including our existing CDMOs for our product candidates, are subject to extensive regulation. Components of a finished therapeutic product approved for commercial sale

or use in late-stage clinical trials must be manufactured in accordance with cGMPs. 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 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 CDMOs must supply all necessary documentation in support of a biologics license application (BLA) on a timely basis and must adhere to the FDA's Good Laboratory Practices and cGMP regulations enforced by the FDA through its facilities inspection program. The facilities and quality systems of our CDMOs and other CROs must pass a pre-approval inspection for compliance with applicable regulations as a condition of regulatory approval of our product candidates. If these facilities do not pass a pre-approval plant inspection, FDA approval of the products will not be granted. If global health concerns prevent the FDA or other regulatory authorities from conducting their regular inspections, it could impact the ability of our CDMOs to provide us with product for clinical trials.

The regulatory authorities also may, at any time following approval of a product for sale, audit the facilities in which the product is manufactured. If any such inspection or audit of our facilities or those of our CDMOs and CROs identifies a failure to comply with applicable regulations or if a violation of our product specifications or applicable regulations occurs independently of such an inspection or audit, we or the relevant regulatory authority may require remedial measures that may be costly or time-consuming for us or a third party to implement and that may include the temporary or permanent suspension of a clinical trial 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.

In addition, quarantines, shelter-in-place and similar government orders, or the perception that such orders, shutdowns or other restrictions on the conduct of business operations could occur, related to the ongoing COVID-19 pandemic or other infectious diseases could impact personnel at our CDMOs and CROs, which could disrupt our clinical timelines and have a material adverse effect on our business, prospects, financial condition and results of operations. Additionally, the production of COVID-19 vaccines may disrupt the availability of raw materials and consumables required to manufacture our product candidates, which could result in decreased manufacturing and supply of these product candidates to support our planned clinical trials or regulatory filings.

If we or any of our CDMOs and CROs fail to maintain regulatory compliance, the FDA can impose regulatory sanctions including, among other things, refusal to approve a pending application for a new biologic product, or revocation of a pre-existing approval. Additionally, if supply from one approved manufacturer is interrupted, there could be a significant disruption in clinical or commercial supply. An alternative manufacturer would need to be qualified through a BLA supplement 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.

In addition, the manufacture of our product candidates presents challenges associated with biologics production, including the inherent instability of larger, more complex molecules and the need to ensure uniformity of the drug substance produced in different facilities or across different batches. The process of manufacturing biologics is extremely susceptible to product loss due to contamination, equipment failure or improper installation or operation of equipment, or vendor or operator error. Even minor deviations from normal manufacturing and distribution processes for any of our product candidates could result in reduced production yields, product defects, and other supply disruptions. Furthermore, although tRNA synthetases represent a class of proteins that may share immunomodulatory properties in various physiological pathways, each tRNA synthetase has a different structure and may have unique manufacturing requirements that are not applicable across the entire class. For example, fusion proteins, such as efzofitmod, include an additional antibody domain to improve PK characteristics, and may therefore require a more complex and time-consuming manufacturing process than other tRNA synthetase-based therapeutic candidates. Currently, we are producing our efzofitmod molecule in *E.coli* by expression in inclusion bodies and refolding to recreate the native structure. The manufacturing processes for one of our product candidates may not be readily adaptable to other product candidates that we develop, and we may need to engage multiple third-party manufacturers to produce our product candidates. For example, we recently engaged an additional CDMO to manufacture efzofitmod and will need to complete a technology transfer and validation process before the new CDMO will be able to produce additional bulk drug substance for our clinical trials or otherwise. Any adverse developments affecting manufacturing operations for our product candidates may result in shipment delays, inventory shortages, lot failures, withdrawals or recalls or other interruptions in the supply of our drug substance and drug product which could delay the development of our product candidates. We may also have to write off inventory, incur other charges and expenses for supply of drug product that fails to meet specifications or expires, undertake costly remediation efforts, or seek more costly manufacturing alternatives. Any manufacturing stoppage or delay, or any inability to consistently manufacture adequate supplies of our product candidates for our clinical trials or on a commercial scale will harm our business, prospects, financial condition and results of operations.

Even if we complete the necessary preclinical studies and clinical trials, we cannot predict when or if we will obtain regulatory approval to commercialize a product candidate, and the scope of any approval may be narrower than we expect.

We cannot commercialize a product until the appropriate regulatory authorities have reviewed and approved the product candidate. Even if our product candidates demonstrate safety and efficacy in clinical trials, the regulatory agencies may not complete their review processes in a timely manner, or we may not be able to obtain regulatory approval.

Additional delays may result if an FDA advisory committee or regulatory authority recommends non-approval or restrictions on approval. In addition, we may experience delays or rejections based upon additional government regulation from future legislation or administrative action, or changes in regulatory agency policy during the period of product development, clinical trials and the review process. Regulatory agencies also may approve a product candidate for fewer or more limited indications than requested, may impose restrictions on dosing 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 product candidates.

Although the FDA has granted orphan drug designation to efzofitmod for the treatment of sarcoidosis and systemic sclerosis, we may not receive orphan drug designation for efzofitmod in other jurisdictions or for other indications that we may pursue, or for any other product candidates we may develop under any new applications for orphan drug designation that we may submit, and any orphan drug designations that we have received or may receive may not confer marketing exclusivity or other expected commercial benefits.

The FDA granted orphan drug designation to efzofitmod for the treatment of sarcoidosis and systemic sclerosis (also known as scleroderma). We may apply for orphan drug designation for efzofitmod for other indications and product candidates in the United States. Orphan drug status confers up to ten years of marketing exclusivity in Europe, and up to seven years of marketing exclusivity in the United States, for a particular product in a specified indication. Obtaining an orphan drug designation can be difficult and we cannot assure you that we will be able to obtain orphan drug designation in other jurisdictions or for other indications, or rely on orphan drug or similar designations to exclude other companies from manufacturing or selling products using the same principal mechanisms of action for the same indications that we pursue beyond these timeframes. Furthermore, marketing exclusivity in Europe can be reduced from ten years to six years if the initial designation criteria have significantly changed since the market authorization of the orphan product. Even if we are the first to obtain marketing authorization for an orphan drug indication, there are circumstances under which a competing product may be approved for the same indication during the period of marketing exclusivity, such as if the later product is shown to be clinically superior to the orphan product, or if the later product is deemed a different product than ours. Further, the marketing exclusivity would not prevent competitors from obtaining approval of the same product candidate as ours for indications other than those in which we have been granted orphan drug designation, or for the use of other types of products in the same indications as our orphan product.

A breakthrough therapy or fast track designation by the FDA, including the fast track designation we received for efzofitmod, may not lead to expedited development or regulatory review or approval.

In August 2022, the FDA granted fast track designation to efzofitmod for the treatment of pulmonary sarcoidosis, and in September 2022, the FDA granted fast track designation to efzofitmod for the treatment of scleroderma. We may seek, from time to time, breakthrough therapy or fast track designation for our product candidates. A breakthrough therapy designation is for a product candidate intended to treat a serious or life-threatening condition, and preliminary clinical evidence indicates that the product candidate may demonstrate substantial improvement on a clinically significant endpoint(s) over available therapies. A fast track designation is for a product candidate that treats a serious or life-threatening condition, and preclinical or clinical data demonstrate the potential to address an unmet medical need. The FDA has broad discretion whether or not to grant these designations. Accordingly, even if we believe a particular product candidate is eligible for breakthrough therapy or fast track designation, we cannot assure you that the FDA would decide to grant it. Even if we receive breakthrough therapy or fast track designation, we may not experience a faster development process, review or approval compared to conventional FDA procedures. The FDA may withdraw breakthrough therapy or fast track designation if it believes that the product no longer meets the qualifying criteria. In addition, the breakthrough therapy program is a relatively new program. As a result, we cannot be certain whether any of our product candidates can or will qualify for breakthrough therapy designation. Our business may be harmed if we are unable to avail ourselves of these or any other expedited development and regulatory pathways.

Disruptions at the FDA and other government agencies caused by funding shortages or global health concerns could negatively impact our business.

The ability of the FDA to review and approve proposed clinical trials or new products can be affected by a variety of factors, including government budget and funding levels, statutory, regulatory, and policy changes, the FDA's ability to hire and retain key personnel and accept the payment of user fees, and other events that may otherwise affect the FDA's ability to perform routine functions. Average review times at the agency 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 and other agencies may also slow the time necessary for new product candidates to be reviewed and/or approved

by necessary government agencies, which would adversely affect our business. For example, over the last several years, including for 35 days beginning on December 22, 2018, 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.

Even if we obtain regulatory approval for a product candidate, our products will remain subject to regulatory scrutiny.

Even if we obtain regulatory approval for a product candidate, such product will be subject to ongoing regulatory requirements for manufacturing, labeling, packaging, storage, advertising, promotion, sampling, record-keeping, conduct of post-marketing studies, adverse event reporting and submission of safety, efficacy, and other post-market information, including both federal and state requirements in the United States and requirements of comparable foreign regulatory authorities.

We and our CDMOs will be subject to continual review and inspections to assess compliance with cGMPs and adherence to commitments made in any BLA or marketing authorization application (MAA). Accordingly, we and others with whom we work will need to continue to expend time, money, and effort in all areas of regulatory compliance, including manufacturing, production, and quality control.

Any regulatory approvals that we receive for our product candidates may be subject to limitations on the approved indicated uses for which the product may be marketed or to the conditions of approval, or contain requirements for potentially costly post-marketing testing, including Phase 4 clinical trials, and surveillance to monitor the safety and efficacy of the product candidate. If new safety issues emerge, we may be required to change our labeling. Any new legislation addressing drug safety or efficacy issues could result in delays in product development or commercialization, or increased costs to assure compliance.

We will have to comply with requirements concerning advertising and promotion for our products. Violations, including actual or alleged promotion of our products for unapproved, or off-label, uses are subject to enforcement letters, inquiries and investigations, and civil and criminal sanctions. Any actual or alleged failure to comply with labeling and promotion requirements may have a negative impact on our business. In the United States, engaging in impermissible promotion of our products for off-label uses can also subject us to false claims litigation under federal and state statutes, which can lead to civil and criminal penalties and fines, agreements that would materially restrict the manner in which we promote or distribute our drug products and exclusion from Medicare, Medicaid and other federal and state healthcare programs. These false claims statutes include the federal False Claims Act, which allows any individual to bring a lawsuit against a pharmaceutical company on behalf of the federal government alleging submission of false or fraudulent claims, or causing to present such false or fraudulent claims, for payment by a federal program such as Medicare or Medicaid. If the government prevails in the lawsuit, the individual will share in any fines or settlement funds. If we do not lawfully promote our approved products, we may become subject to such litigation and, if we are not successful in defending against such actions, those actions could compromise our ability to become profitable.

The holder of an approved BLA or MAA must submit new or supplemental applications and obtain approval for certain changes to the approved product, product labeling, or manufacturing process. We could also be asked to conduct post-marketing clinical trials to verify the safety and efficacy of our products in general or in specific patient subsets. If original marketing approval were obtained through an accelerated approval pathway, we could be required to conduct a successful post-marketing clinical trial to confirm clinical benefit for our products. An unsuccessful post-marketing study or failure to complete such a trial could result in the withdrawal of marketing approval.

If 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, or disagrees with the promotion, marketing or labeling of a product, such regulatory agency may impose restrictions on that product or us, including requiring withdrawal of the product from the market. If we fail to comply with applicable regulatory requirements, a regulatory agency or enforcement authority may, among other things:

- issue untitled or warning letters;
- impose civil or criminal penalties;
- suspend or withdraw regulatory approval;
- suspend any of our ongoing clinical trials;
- refuse to approve pending applications or supplements to approved applications submitted by us;
- impose restrictions on our operations, including closing our CDMOs' facilities; or
- seize or detain products, or require or request a product recall.

Any government investigation of alleged violations of law could require us to expend significant time and resources in response, and could generate negative publicity. Any failure to comply with ongoing regulatory requirements may significantly and adversely affect our ability to commercialize and generate revenue from our products. If regulatory sanctions are applied or if regulatory approval is withdrawn, the value of our company and our operating results will be adversely affected.

Risks related to our reliance on third parties

We depend on our existing collaborations and may depend on collaborations with additional third parties for the development and commercialization of certain of our product candidates. If our collaborations are not successful, we may not be able to capitalize on the market potential of these product candidates.

We have entered into, and may continue to enter into, research collaborations for the research and development of specified product candidates. Our sole source of revenue depends upon the performance by these collaborators of their responsibilities under these arrangements. For example, while we are eligible to receive up to an additional \$165.0 million in milestone payments under the Kyorin Agreement, as well as tiered royalties ranging from the mid-single digits to mid-teens on net sales in Japan, whether and when we receive these payments will depend on Kyorin's development and commercialization of efzofitimid in Japan, over which we have limited control. The development efforts of our collaborators are subject to the same risks and uncertainties described above with respect to our independently developed product candidates.

Some collaborators may not succeed in their product development efforts. It is possible that our collaborators may be unable to obtain regulatory approval of our product candidates or successfully market and commercialize any such products for which regulatory approval is obtained. For example, while we received a \$2.0 million milestone payment in January 2021, if Kyorin's operations are limited due to the impacts of the ongoing COVID-19 pandemic in Japan or in other regions where Kyorin operates or relies on third party operations, including as a result of the ongoing Ukraine-Russia conflict, the development of efzofitimid in Japan may be significantly delayed and adversely affected, which may in turn delay or limit our receipt of any additional payments under the Kyorin Agreement. Other collaborators may not devote sufficient time or resources to the programs covered by these arrangements, and we may have limited or no control over the time or resources allocated by these collaborators to these programs. The occurrence of any of these events may cause us to derive little or no revenue from these arrangements, lose opportunities to validate our product candidates, or force us to curtail or cease our development efforts in these areas.

Our collaborators may breach or terminate their agreements with us, including termination without cause at subject to certain prior written notice requirements, and we may be unsuccessful in entering into and maintaining other collaborative arrangements for the development of product candidates. For example, Kyorin has the right to terminate the agreement for any reason upon 90 days advance written notice to us. In addition, if we are unable to maintain existing collaboration arrangements or enter into new ones, our ability to generate licensing, milestone or royalty revenues would be materially impaired.

We rely, and expect to continue to rely, on third parties to conduct some or all aspects of our product manufacturing, protocol development, research and preclinical and clinical testing, and these third parties may not perform satisfactorily.

We currently rely, and expect to continue to rely, on third parties to conduct some or all aspects of product manufacturing, protocol development, research and preclinical and clinical testing with respect to our product candidates. Any of these third parties may terminate their engagements with us at any time. If we need to enter into alternative arrangements, it could delay our product development activities. Our reliance on these third parties for research and development activities reduces our control over these activities but does not relieve us of our responsibility to ensure compliance with all required regulations and study protocols. For example, for any product candidates that we develop and commercialize on our own, we will remain responsible for ensuring that each of our clinical trials is conducted in accordance with the applicable study plan and protocols and GCPs so long as we continue to develop and commercialize on our own.

If these third parties do not successfully carry out their contractual duties, meet expected deadlines or conduct our research and development activities, including clinical trials, in accordance with regulatory requirements or our stated study plans and protocols, we will not be able to complete, or may be delayed in completing, the preclinical studies and clinical trials required to support future BLA submissions and approval of our product candidates.

We rely and intend to rely on third parties to produce preclinical, clinical and commercial supplies of our product candidates.

Other than some internal capacity to support preclinical activities, we do not have, nor do we plan to acquire, the infrastructure or capability internally to manufacture our preclinical and clinical quantities of our product candidates, and we lack the internal resources and capability to manufacture any of our product candidates on a clinical or commercial scale. Reliance on CDMOs and CROs entails risks to which we would not be subject if we manufactured the product candidates ourselves, including:

- the inability to negotiate manufacturing agreements with third parties under commercially reasonable terms;

- reduced control as a result of using third-party CDMOs and CROs for all aspects of manufacturing activities;
- 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 CDMOs, CROs or suppliers caused by conditions unrelated to our business or operations, including the insolvency or bankruptcy of the CDMOs, CROs or suppliers.

Any of these events could lead to clinical trial delays or failure to obtain regulatory approval, or impact our ability to successfully commercialize future products. Some of these events could be the basis for FDA action, including injunction, recall, seizure or total or partial suspension of production.

Additionally, each CDMO may require licenses to manufacture our product candidates or components thereof if the applicable manufacturing processes are not owned by the CDMO or in the public domain, and we may be unable to transfer or sublicense the intellectual property rights we may have with respect to such activities. These factors could cause the delay of clinical development, regulatory submissions, required approvals or commercialization of our product candidates, cause us to incur higher costs and prevent us from commercializing our products successfully.

We previously relied on a single CDMO for process development and scale-up of efzofitimid, including the manufacture of bulk drug substance for our projected needs for initial clinical trials. We have entered into an agreement with another CDMO for the transfer of the process, scale-up and manufacturing of bulk drug substance for future clinical trials. Subject to the satisfactory completion of process validation and other requirements, we may contract with this CDMO for larger scale commercial manufacturing. We currently rely on a single CDMO for process development and scale-up of ATYR2810. We do not have long-term contracts with our CDMOs, and our CDMOs may terminate their agreements with us for a variety of reasons including technical issues or our material breach of our obligations under the applicable agreement. Furthermore, our CDMOs may reallocate resources away from the production of our product candidates if we delay manufacturing under certain circumstances, and the manufacturing facilities in which our product candidates are made could be adversely affected by earthquakes and other natural disasters, labor shortages, power failures, labor shortages, economic slowdowns, rising interest rates, inflation and monetary supply shifts, evolving geopolitical developments, such as the ongoing Ukraine-Russia conflict, and numerous other factors. If our CDMOs fail to meet contractual requirements, and we are unable to secure one or more replacement CDMOs capable of production at a substantially equivalent cost, our clinical development activities may be delayed, or we could lose potential revenue. Manufacturing biologic drugs is complicated and tightly regulated by the FDA and comparable regulatory authorities around the world, and although alternative CDMOs with the necessary manufacturing and regulatory expertise and facilities exist, it could be expensive and take a significant amount of time to arrange for alternative CDMOs, transfer manufacturing procedures to these alternative CDMOs, and demonstrate comparability of material produced by such new CDMOs. New CDMOs of any product would be required to comply with applicable regulatory requirements. These CDMOs may not be able to manufacture our product candidates at costs, or in quantities, or in a timely manner necessary to complete the clinical development of our product candidates or make commercially successful products.

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

We have relied, and expect to continue to rely, on third-party CROs, clinical investigators and clinical trial sites to ensure our clinical trials are conducted properly and on time. While we have and will continue to enter into 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 trials is conducted in accordance with the applicable protocol, legal and regulatory requirements, and scientific standards, and our reliance on the CROs does not relieve us of our regulatory responsibilities.

We and our investigators and CROs are required to comply with GCPs for conducting, recording and reporting the results of clinical trials to assure that the data and reported results are credible and accurate and that the rights, integrity and confidentiality of clinical trial participants are protected. The FDA enforces GCPs through periodic inspections of study sponsors, principal investigators and clinical trial sites. If we or our investigators and CROs fail to comply with applicable GCPs, the clinical data generated in our future clinical trials may be deemed unreliable and the FDA may require us to perform additional unanticipated clinical trials before approving any marketing applications. Upon inspection, the FDA may determine that our clinical trials did not comply with GCPs. In addition, our future clinical trials will require a sufficient number of test subjects to evaluate the safety and effectiveness of our product candidates. Accordingly, if our investigators and CROs fail to comply with these regulations or fail to recruit a sufficient number of patients, we may be required to repeat such clinical trials, which would delay the regulatory approval process.

Our investigators and CROs are not our employees, and we are therefore unable to directly monitor whether or not they devote sufficient time and resources to our clinical and preclinical programs. They may also have relationships with other commercial entities, including our competitors, for whom they may also be conducting clinical trials or other drug development activities that could harm our competitive position. If our investigators or 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 trials may be extended, delayed or terminated, and we may not be able to obtain regulatory approval for, or successfully commercialize our product candidates. For example, we are currently in the process of transitioning CROs for our ongoing EFZO-FIT™ study. As a result, our financial results could be harmed, our costs could increase, our ability to generate revenues could be delayed and the commercial prospects for our product candidates will be adversely affected.

We are in the process of transitioning our CRO to support our ongoing EFZO-FIT™ study. Although we are carefully managing the transition of responsibilities, delays in the transition could occur or the transition could not be successful, which could compromise our ability to meet our desired development timelines, cause the transition to become more costly, and divert management's time and attention, all of which could harm our business, financial condition and prospects.

We are currently in the process of transitioning our CRO to support our ongoing EFZO-FIT™ study. We expect the transition to be completed in the fourth quarter of 2022. Switching CROs involves additional cost and requires management time and focus. In addition, there is a natural transition period when a new CRO commences work. Although we are carefully managing the transition of responsibilities, delays in the transition could occur or the transition could not be successful, which could compromise our ability to meet our desired development timelines, cause the transition to become more costly, and divert management's time and attention, all of which could harm our business, financial condition and prospects. In addition, forces beyond our control, including the impacts of the ongoing COVID-19 pandemic and other geopolitical and macroeconomic conditions, could disrupt the transition, ultimately impacting the new CRO's ability to timely and adequately support the EFZO-FIT™ study.

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.

We rely on third parties to manufacture our product candidates, and we collaborate with both industry and various academic institutions in the development of our discovery engine for therapeutic applications based on tRNA synthetase and NRP2 biology. In connection with these activities, we are required, at times, to 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, prospects, financial condition and results of operations.

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 intellectual property rights to which we are entitled 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, prospects, financial condition and results of operations.

Risks related to our intellectual property

If we are unable to obtain, maintain or protect intellectual property rights related to our product candidates, or if the scope of such intellectual property protection is not sufficiently broad, 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 technologies and product candidates. Our success depends in large part on our and our licensors' abilities to obtain and maintain patent and other intellectual property protection in the United States and in other countries for our proprietary technology and product candidates.

We have sought to protect our proprietary position by filing patent applications in the United States and abroad related to our novel technologies and product candidates that are important to our business. This process is expensive and time consuming, and we may not be able to file and prosecute all necessary or desirable patent applications at a reasonable cost or in a timely manner. It is also possible that we will fail to identify patentable aspects of our research and development output before it is too late to obtain patent protection.

The patentability of inventions, and the validity, enforceability and scope of patents in the biotechnology and pharmaceutical fields involves complex legal and scientific questions and can be uncertain. As a result, patent applications that we own or in-license may not issue as patents with claims that cover our product candidates, or at all, in the United States or in foreign countries for many reasons. For example, there is no assurance that we were the first to invent or the first to file patent applications in respect of the inventions claimed in our patent applications or that our patent applications claim patentable subject matter. We may also be unaware of potentially relevant prior art relating to our patents and patent applications, and this prior art, if any, may be used by third parties as grounds to seek to invalidate a patent or to prevent a patent from issuing from a pending patent application. Even if patents do successfully issue and even if such patents disclose aspects of our product candidates, third parties may challenge their validity, enforceability or scope, which may result in such patents being narrowed or invalidated. Furthermore, even if they are unchallenged, our patents and patent applications may not adequately protect our intellectual property, provide exclusivity for our product candidates or prevent others from designing around our claims. If the breadth or strength of protection provided by the patents and patent applications we hold, license or pursue with respect to our product candidates is threatened, it could threaten our ability to commercialize our product candidates. Further, if we encounter delays in our clinical trials, the period of time during which we could market any of our product candidates under patent protection, if approved, would be reduced. Since patent applications in the United States and most other countries are confidential for a period of time after filing, we cannot be certain that we were the first to file any patent application related to our product candidates. Changes to the patent laws in the United States and other jurisdictions could also diminish the value of our patents and patent applications or narrow the scope of our patent protection. Any of these outcomes could impair our ability to prevent competition from third parties, which may have an adverse effect on our business.

If the patent applications we own or have in-licensed that relate to our programs or product candidates do not issue as patents, if their breadth or strength of protection is threatened, or if they fail to provide exclusivity for our product candidates, it could dissuade companies from collaborating with us to develop product candidates, and threaten our ability to commercialize future products. We cannot offer any assurances about which, if any, patents will issue, the breadth of any such patents 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. In addition, patents have a limited term. In the United States, the natural expiration of a patent is generally 20 years after it is filed. Although various extensions may be available, the life of a patent, and the protection it affords, is limited. Even if a patent does issue for any of our pending patent applications, possible delays in regulatory approvals could mean that the period of time during which we could market a product candidate under patent protection could be reduced from what we generally would expect. 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. Even if patents covering aspects of 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, 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, but it is possible that these security measures could be breached. 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. For example, any of these parties may breach the agreements and disclose our proprietary information, including our trade secrets, and we may not be able to obtain adequate remedies for such breaches. 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 we take to maintain the confidentiality of our trade secrets are inadequate, we may have insufficient recourse against third parties for misappropriating our proprietary information and processes. 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.

If due to the effects on our operations of general political and economic conditions, including the ongoing COVID-19 pandemic, the invasion of Ukraine by Russia, labor shortages, economic slowdowns, recessions or market corrections, inflation and monetary supply shifts, rising interest rates and tightening of credit markets resulting from the pandemic, the conflict or another cause, we are unable to generate new animal, or *in vitro* data, in time to support new, or updated patent application filings, or prior to patent conversion deadlines, it could materially impact the enforceability or scope of those patent filings.

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.

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 preventing third parties from practicing our inventions in countries outside the United States, or from selling or importing products made using our inventions in and into the United States or other jurisdictions.

Claims that our product candidates or the manufacture, sale or use of our future products infringe the patent or other intellectual property rights of third parties could result in costly litigation or could require substantial time and money to resolve, even if litigation is avoided.

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 and inter partes reexamination proceedings before the United States Patent and Trademark Office (USPTO) and corresponding foreign patent offices. Numerous U.S. and foreign issued patents and pending patent applications, which are owned by third parties, exist in the fields in which we are pursuing development candidates. As the biotechnology and pharmaceutical industries expand and more patents are issued, the risk increases that our product candidates may be subject to claims of infringement of the patent rights of third parties.

Third parties may assert that we are employing their proprietary technology without authorization. There may be third-party patents or patent applications with claims to materials, formulations, methods of manufacture or methods for treatment related to the use or manufacture of our product candidates. Because patent applications can take many years to issue, there may be currently pending patent applications which may later result in issued patents that our product candidates may infringe. In addition, third parties may obtain patents in the future and claim that use of our technologies infringes upon these patents. If any third-party patents were held by a court of competent jurisdiction to cover the manufacturing process of any of our product candidates, any molecules formed during the manufacturing process or any final product itself, the holders of any such patents may be able to block our ability to commercialize such product candidate unless we obtained a license under the applicable patents, or until such patents expire.

Similarly, if any third-party patents are held by a court of competent jurisdiction to cover aspects of our formulations, processes for manufacture or methods of use, the holders of any such patents may be able to block our ability to develop and commercialize the applicable product candidate unless we obtain a license or until such patent expires. In either case, such a license may not be available on commercially reasonable terms or at all.

Parties making claims against us may obtain injunctive or other equitable relief, which could effectively block our ability to further develop and commercialize one or more of our product candidates. Defense of these claims, regardless of their merit, would involve substantial litigation expense and would be a substantial diversion of employee resources from our business. In the event of a successful claim of infringement against us, we may have to pay substantial damages, including treble damages and attorneys' fees for willful infringement, pay royalties, redesign our infringing products or obtain one or more licenses from third parties, which may not be able to be obtained on reasonable commercial terms or at all, or require substantial time and monetary expenditure.

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

Patents have a limited lifespan. In the United States, if all maintenance fees are timely paid, the natural expiration of a patent is generally 20 years from its earliest U.S. non-provisional filing date. Various extensions may be available, but 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, we may be open to competition from competitive products, including generics or biosimilars. Given the amount of time required for the development, testing and regulatory review of new product candidates, patents protecting such candidates might expire before or shortly after such candidates are commercialized. As a result, our owned and licensed patent portfolio may not provide us with sufficient rights to exclude others from commercializing products similar or identical to ours.

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

We believe that we have rights to intellectual property, through licenses from third parties and under patents that we own, that is necessary or useful to develop our product candidates. Because our programs may involve additional product candidates that may require the use of proprietary rights held by third parties, the growth of our business will likely depend in part on our ability to acquire, in-license or use these proprietary rights. In addition, our product candidates may require specific formulations to work effectively and efficiently and these rights may be held by others. We may be unable to acquire or in-license any compositions, methods of use, processes or other third-party intellectual property rights from third parties that we identify on reasonable commercial terms or at all. 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.

We sometimes collaborate with U.S. and foreign academic institutions to accelerate our preclinical research or development under written agreements with these institutions. These institutions may provide us with an option to negotiate a license to the institution's rights in technology resulting from the collaboration. Regardless of any 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. If we fail to comply with our obligations under these agreements, or we are subject to a bankruptcy, the licensor may have the right to terminate the license, in which event we would not be able to market products covered by the license.

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

In some cases, patent prosecution of our licensed technology is controlled 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 such intellectual property. In certain cases, we may 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 licensors. 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 license 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 license 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 sublicensees or partners, if any; and

- the priority of invention of patented technology.

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

We may become 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 or otherwise violate our patents, the patents of our licensors or our other intellectual property rights. To counter infringement or unauthorized use, we may be required to file infringement claims, which can be expensive and time-consuming. Any claims that we assert against perceived infringers could also provoke these parties to assert counterclaims against us alleging that we infringe their intellectual property rights. In addition, in an infringement proceeding, a court may decide that a patent of ours or our licensors is not valid, is unenforceable 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. An adverse result in any litigation or defense proceedings could put one or more of our patents at risk of being invalidated or interpreted narrowly and could put our patent applications at risk of not issuing.

Interference or derivation proceedings provoked by third parties or brought by us may be necessary to determine the priority of inventions or other matters of inventorship with respect to our patents or patent applications or those of our licensors. We may also become involved in other proceedings, such as re-examination or opposition proceedings, before the USPTO or its foreign counterparts relating to our intellectual property or the intellectual property rights of others. An unfavorable outcome in any such proceedings could require us to cease using the related technology or to attempt to license rights to it from the prevailing party, or could cause us to lose valuable intellectual property rights. Our business could be harmed if the prevailing party does not offer us a license on commercially reasonable terms, if any license is offered at all. 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. In addition, the uncertainties associated with litigation could have a material adverse effect on our ability to raise the funds necessary to continue our clinical trials, continue our research programs, license necessary technology from third parties, or enter into development partnerships that would help us bring our product candidates to market. We may also become involved in disputes with others regarding the ownership of intellectual property rights. For example, we jointly develop intellectual property with certain parties, and disagreements may therefore arise as to the ownership of the intellectual property developed pursuant to these relationships. If we are unable to resolve these disputes, we could lose valuable intellectual property rights.

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 be subject to claims that former employees, collaborators or other third parties have an ownership interest in our patents or other intellectual property. For example, we may have inventorship disputes arise from conflicting obligations of consultants or others who are involved in developing our product candidates. Litigation may be necessary to defend against these and other claims challenging inventorship or ownership, or we may enter into agreements to clarify the scope of our rights in such intellectual property. 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 or applications will be due to be paid to the USPTO and various governmental patent agencies outside of the United States in several stages over the lifetime of the patents 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 USPTO 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 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.

Issued patents covering our product candidates could be found invalid or unenforceable if challenged in court.

If we or one of our licensors initiated legal proceedings against a third party to enforce a patent covering one of our product candidates, the defendant could counterclaim that the patent covering our product candidate is invalid or unenforceable. In patent litigation in the United States, defendant counterclaims alleging invalidity or unenforceability are commonplace. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including lack of novelty, obviousness 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 USPTO, 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 or unenforceability, we would lose at least part, and perhaps all, of the patent protection on our product candidates. Such a loss of patent protection would have a material adverse effect on our business.

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

As is the case with many 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 therefore obtaining, maintaining and enforcing biotechnology patents is costly, time-consuming and inherently uncertain. In addition, recent legislative and judicial developments in the United States and elsewhere have in some cases removed the protection afforded to patent owners, made patents more difficult to obtain, or increased the uncertainty regarding the ability to obtain, maintain and enforce patents. For example, Congress has recently passed, and the United States is currently implementing, wide-ranging patent reform legislation, and may pass further patent reform legislation in the future. 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. For example, in *Association for Molecular Pathology v. Myriad Genetics, Inc.*, the U.S. Supreme Court held that certain claims to naturally occurring substances are not patentable. Although we do not believe that any of the patents owned or licensed by us will be found invalid based on this decision, we cannot predict how future decisions by the courts, Congress, or the USPTO may impact the value of our patents. 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 generally, once obtained. Depending on decisions and actions by Congress, the federal courts, the USPTO and their respective foreign counterparts, the laws and regulations governing patents could change in unpredictable ways that would weaken our ability to obtain new patents or to maintain and enforce our existing patents and patents that we might obtain in the future.

Patent reform legislation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the validity or defense of our issued patents.

On September 16, 2011, the Leahy-Smith America Invents Act (the Leahy-Smith Act) was signed into law. The Leahy-Smith Act includes a number of significant changes to U.S. patent law, including provisions that affect the way patent applications will be prosecuted and may also affect patent litigation. The USPTO is developing regulations and procedures to govern administration of the Leahy-Smith Act, and many of the substantive changes to patent law associated with the Leahy-Smith Act, and in particular, the first to file provisions, were enacted March 16, 2013. Although it is not clear what, if any, impact the Leahy-Smith Act will have on the operation of our business, the Leahy-Smith Act and its implementation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the enforcement or defense of our issued patents, all of which could have a material adverse effect on our business and financial condition.

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 our business operations

We may use our financial and human resources to pursue a particular business strategy, research program or product candidate and fail to capitalize on strategies, programs or product candidates that may be more profitable or for which there is a greater likelihood of success.

Because we have limited resources, we may forego or delay pursuit of certain strategic opportunities or opportunities with certain programs, product candidates or indications that later prove to have greater commercial potential. We may focus on or pursue one indication over another potential indication and such development efforts may not be successful, which would cause us to delay the clinical development and approval of efzofitimod, ATYR2810 and other product candidates. In addition, our decisions as to which of our discovery programs to advance into preclinical and clinical development could preclude us from advancing others. Our resource allocation decisions may cause us to fail to capitalize on viable commercial products or profitable market opportunities. For example, based on analysis from independent consultants that we have engaged during 2022, we currently estimate that there is a multi-billion dollar market opportunity in interstitial lung diseases, including pulmonary sarcoidosis. Depending on the accuracy of this estimate, we may not be most efficiently allocating resources toward the advancement of efzofitimod versus the advancement of other development efforts. In addition, we may elect to pursue a research, clinical or commercial strategy that ultimately does not yield the results that we desire. Our spending on current and future research and development programs for product candidates may not result in any commercially viable products. If we do not accurately evaluate the commercial potential or target market for a particular product candidate, we may relinquish valuable rights to that product candidate through strategic collaboration, licensing or other royalty arrangements in cases in which it would have been more advantageous for us to retain sole development and commercialization rights to such product candidate, or we may allocate internal resources to a product candidate in a therapeutic area or market in which it would have been more advantageous to enter into a partnering arrangement. Any failure to allocate resources or capitalize on strategies in a successful manner will have an adverse impact on our business.

Our business could continue to be adversely affected by the effects of the ongoing COVID-19 pandemic.

Our business has been adversely affected by the effects of the ongoing COVID-19 pandemic and could continue to be adversely affected in the future. For example, many of our employees began telecommuting during the onset of the ongoing COVID-19 pandemic as states and municipalities announced aggressive actions to reduce the spread of the disease such as “shelter in place” orders, and some employees continue to do so, which has impacted certain of our operations and may continue to do so over the long term. We may experience further limitations on employee resources in the future, including because of sickness of employees or their families. The effects of government actions and our own policies and those of third parties to reduce the spread of COVID-19 have negatively impacted productivity and slowed down or delayed our ongoing and future clinical trials, preclinical studies and research and development activities, and may cause disruptions to our supply chain. In the event that government authorities were to again implement restrictions, including due to the emergence of new variants of COVID-19, our employees who currently are not telecommuting may no longer be able to access our facilities, and our operations may be further limited or curtailed.

During the ongoing COVID-19 pandemic, we may experience ongoing disruptions that could severely impact our business, preclinical studies and clinical trials, including:

- delays in receiving approval from local regulatory authorities to initiate future clinical trials;
- delays or difficulties in enrolling and retaining patients in our planned clinical trials, including as a result of the ongoing Ukraine-Russia conflict;
- delays in clinical sites receiving the supplies and materials needed to conduct our clinical trials, including as a result of manufacturing delays and interruptions in global shipping that may affect the transport of clinical trial materials;
- changes in local regulations as part of a response to the ongoing COVID-19 pandemic which may require us to change the ways in which our clinical trials are conducted, which may result in unexpected costs, or to discontinue the clinical trials altogether;
- diversion of healthcare resources away from the conduct of clinical trials, including the diversion of hospitals serving as our clinical trial sites and hospital staff supporting the conduct of our clinical trials;
- interruption of key clinical trial activities, such as clinical trial site monitoring, due to limitations on travel imposed or recommended by federal or state governments, employers and others, or interruption of clinical trial subject visits and study procedures, the occurrence of which could affect the integrity of clinical trial data;
- interruption or delays in the operations of the FDA or other regulatory authorities, which may impact review and approval timelines;
- risk that participants enrolled in future clinical trials will contract COVID-19, or a variant thereof, while the clinical trial is ongoing, which could impact the results of the clinical trial, including by increasing the number of observed adverse events;
- risk that the production of COVID-19 vaccines may disrupt the availability of raw materials and consumables required to manufacture our product candidates, which could result in decreased manufacturing and supply of these product candidates to support our planned clinical trials or regulatory filings;
- refusal of the FDA to accept data from clinical trials in affected geographies; and
- delays or difficulties in completing research required to support our pending patent applications.

These and other disruptions in our operations and the global economy including labor shortages, economic slowdowns, recessions, inflation and monetary supply shifts, rising interest rates and tightening of credit markets caused by the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict or otherwise could negatively impact our business, operating results and financial condition.

Our completed Phase 1b/2a clinical trial in patients with pulmonary sarcoidosis was negatively affected by the ongoing COVID-19 pandemic. In 2020, many clinical trial sites in this clinical trial temporarily suspended dosing of previously-enrolled patients and/or enrollment of new patients and some patients discontinued from the trial. While we completed this clinical trial, the availability of results from this clinical trial was delayed until September 2021.

Additionally, under the terms of the Kyorin Agreement, we rely on Kyorin to fund all research, development, regulatory, marketing and commercialization activities in Japan. If Kyorin's operations are limited due to an outbreak of COVID-19 or another public health emergency in Japan or in other regions where Kyorin operates or relies on third party operations, the development of efzofitimod in Japan may be significantly delayed and adversely affected, which may in turn delay or limit our receipt of any additional payments under the Kyorin Agreement.

Further, we currently rely, and expect to continue to rely, on third parties to conduct some or all aspects of product manufacturing, protocol development, and research and preclinical and clinical testing with respect to our product candidates. While many materials on which we rely may be obtained by more than one supplier, port closures, travel bans and other restrictions resulting from the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict or other adverse macroeconomic or geopolitical events may disrupt our supply chain or limit our ability to obtain sufficient materials to conduct our operations.

As a result of these events and uncertainties, we may need to obtain additional funding through a combination of equity offerings, grant funding, collaborations, strategic partnerships and/or licensing arrangements, and potentially through debt financings, if available on acceptable terms or at all. We may be unable to raise additional funds on acceptable terms or at all. As a result of the ongoing COVID-19 pandemic and actions taken to slow its spread, as well as the ongoing Ukraine-Russia conflict and the evolving foreign policy landscape, the global credit and financial markets have experienced volatility and disruptions, including severely diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates, inflation and uncertainty about economic stability. If the equity and credit markets deteriorate, it may make any necessary debt or equity financing

more difficult, more costly and more dilutive. The impact of the ongoing COVID-19 pandemic on capital markets may affect the availability, amount and type of financing available to us in the future. If we are unable to raise additional funds, we may be required to delay, limit, reduce or terminate our product development or future commercialization efforts or grant rights to develop and market our product candidates even if we would otherwise prefer to develop and market such product candidates ourselves.

COVID-19 and actions taken to reduce its spread continue to rapidly evolve, including the emergence of new variants and additional actions taken in response to their spread. The extent to which the ongoing COVID-19 pandemic may impede the development of our product candidates, reduce the productivity of our employees, disrupt our supply chains, delay our clinical trials, reduce our access to capital or limit our business development activities, will depend on future developments, which are highly uncertain and cannot be predicted with confidence.

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

We are highly dependent on principal members of our executive team, 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 an extreme shortage of skilled personnel in our industry, which is likely to continue. As a result, competition for skilled personnel is very intense and the turnover rate can be high. This competition has become exacerbated by the increase in employee resignations currently taking place throughout the United States as a result of the COVID-19 pandemic, which is commonly referred to as the “great resignation.” We may also experience employee turnover as a result of the ongoing “great resignation.” In response to competition, rising inflation rates and labor shortages, we may need to adjust employee cash compensation, which would affect our operating costs and our margins, or equity compensation, which would affect our outstanding share count and cause dilution to existing stockholders. 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, the available pool of skilled employees may be further reduced if immigration laws change in a manner that increases restrictions on immigration. Further, failure to succeed in preclinical studies or clinical trials may make 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.

We may undertake internal restructuring activities in the future that could result in disruptions to our business or otherwise materially harm our results of operations or financial condition.

From time to time we may undertake internal restructuring activities as we continue to evaluate and attempt to optimize our cost and operating structure in light of developments in our business strategy and long-term operating plans. For example, we implemented a corporate restructuring and program prioritization plan in May 2018 that included a reduction in our workforce. Any such restructuring activities may result in write-offs or other restructuring charges. There can be no assurance that any restructuring activities that we have undertaken or undertake in the future will achieve the cost savings, operating efficiencies or other benefits that we may initially expect. Restructuring activities may also result in a loss of continuity, accumulated knowledge and inefficiency during transitional periods and thereafter. In addition, internal restructurings can require a significant amount of time and focus from management and other employees, which may divert attention from commercial operations. If any internal restructuring activities we have undertaken or undertake in the future fail to achieve some or all of the expected benefits therefrom, our business, results of operations and financial condition could be materially and adversely affected.

We are subject to a variety of risks associated with international operations that could materially adversely affect our business.

We currently conduct research activities through Pangu BioPharma Limited, in collaboration with the Hong Kong University of Science and Technology. Additionally, we have conducted clinical trials in the EU and in Australia and may conduct future clinical trials internationally. Our partner, Kyorin, conducted an efzofitimid Phase 1 clinical trial in healthy volunteers in Japan, and has joined our EFZO-FIT™ study, a global Phase 3 clinical trial designed to enroll 264 subjects at multiple centers in United States, Europe and Japan. If any of our product candidates are approved for commercialization outside of the United States, we expect to either use our own sales organization or selectively enter into agreements with third parties to market our products on a worldwide basis or in more limited geographical regions, as with Kyorin and efzofitimid in Japan. We are, and we expect that we will continue to be, subject to a variety of risks related to international operations, including, but not limited to: different regulatory requirements for approval of drugs and biologics in foreign countries; reduced or uncertain protection for intellectual property; unexpected changes in tariffs, trade barriers and regulatory requirements; economic weakness, including labor shortages, economic slowdowns, recessions, inflation and monetary supply shifts, rising interest rates and tightening of credit markets, or political instability in particular foreign economies and markets, including as a result of the ongoing Ukraine-Russia conflict; compliance with tax, employment, immigration and labor laws for

employees living or traveling abroad; foreign currency fluctuations, which could result in reduced revenues, and other obligations incident to doing business in another country; and the global impacts of the ongoing COVID-19 pandemic.

Any failure to continue our international operations or to commercialize our product candidates outside of the United States may impair our ability to generate revenues and harm our business, prospects and results of operations.

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

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

We face potential product liability, and, if successful claims are brought against us, we may incur substantial liability and costs. If the use of our product candidates harm patients, or is perceived to harm patients even when such harm is unrelated to our product candidates, our regulatory 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 trials and the sale of any products for which we obtain marketing approval exposes us to the risk of product liability claims. Product liability claims might be brought against us by patients, healthcare providers, pharmaceutical companies or others selling or otherwise coming into contact with our products. There is a risk that our product candidates may induce adverse events. If we cannot successfully defend against product liability claims, we could incur substantial liability and costs. In addition, regardless of merit or eventual outcome, product liability claims may result in:

- impairment of our business reputation;
- withdrawal of clinical trial 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 commercialize our product candidates; and
- decreased demand for our product candidates, if approved for commercial sale.

We carry product liability insurance for our clinical trials covering \$10.0 million per occurrence and up to \$10.0 million in the aggregate, subject to certain deductibles and exclusions. Although we believe the amount of our insurance coverage is typical for companies similar to us in our industry, we may not have adequate insurance coverage or be able to maintain insurance coverage at a reasonable cost or in sufficient amounts to protect us against losses due to liability. If and when we obtain marketing approval for product candidates, we intend to expand our insurance coverage to include the sale of commercial products; however, we may be unable to obtain product liability insurance on commercially reasonable terms or in adequate amounts. 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 adversely affect our reputation and, if judgments exceed our insurance coverage, could adversely affect our results of operations and business.

Patients with the diseases targeted by our product candidates are often already in severe and advanced stages of disease and may have both known and unknown significant pre-existing and potentially life-threatening health risks. During the course of treatment, patients may suffer adverse events, including death, for reasons that may be related to our product candidates. Such events could subject us to costly litigation, require us to pay substantial amounts of money to injured patients, delay, negatively impact or end our opportunity to receive or maintain regulatory approval to market our products, 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, the investigation into the circumstance may be time-consuming or inconclusive. These investigations may interrupt our sales efforts, delay our regulatory approval process in other countries, or impact and limit the type of regulatory approvals our product candidates receive or 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.

We are, or may become, subject to stringent and evolving U.S. and foreign laws, regulations, rules, policies, contractual obligations and other obligations related to data privacy and security. Our actual or perceived failure to comply with such obligations could have a material adverse effect on our business and financial condition including, a disruption of clinical trials or commercialization of products; regulatory investigations or actions; litigation; fines and penalties; reputational harm; loss of revenue or profits; and other adverse business consequences.

We collect, receive, store, process, use, generate, transfer, disclose, make accessible, protect and share (Process or Processing) personal information and other sensitive information, including information we or our third party partners (such as CROs and clinical trial sites) collect about patients and healthcare providers in connection with clinical trials necessary to operate our business.

Therefore, we are, or may become, subject to data privacy and security laws, regulations, rules, guidance, and industry standards as well as policies, contractual requirements and other obligations that apply to the Processing of personal data both by us and on our behalf (collectively, Data Protection Requirements). The number and scope of the Data Protection Requirements are changing, subject to differing applications and interpretations, and may be inconsistent between jurisdictions. New Data Protection Requirements may be proposed or enacted. Additionally, given the breadth and evolving nature of Data Protection Requirements, preparing for and complying with these requirements is rigorous, time-intensive and requires significant resources and a review of our technologies, systems and practices, as well as those of any third-party collaborators, service providers, contractors or consultants that Process personal data on our behalf. We may at times fail (or be perceived to have failed) to do so. Moreover, despite our efforts, our personnel or third parties upon whom we rely may fail to comply with such obligations, which could negatively impact our business operations and compliance posture.

Additionally, if we or the third parties upon which we rely fail, or are perceived to have failed, to address or comply with Data Protection Requirements, this could result in government enforcement actions against us that could include investigations, fines, penalties, audits and inspections, additional reporting requirements and/or oversight, temporary or permanent bans on all or some Processing of personal data, orders to destroy or not use personal data, and imprisonment of company officials. Further, individuals or other relevant stakeholders could bring a variety of claims against us for our actual or perceived failure to comply with the Data Protection Requirements. Any of these events could have a material adverse effect on our reputation, business, or financial condition, and could lead to a loss of actual or prospective customers, collaborators or partners; interrupt or stop clinical trials; result in an inability to Process personal data or to operate in certain jurisdictions; limit our ability to develop or commercialize our products; require us to revise or restructure our operations; or otherwise materially adversely affect our operations (each, a Material Adverse Impact). Additionally, given the breadth and evolving nature of Data Protection Requirements, preparing for and complying with these requirements is rigorous, time-intensive and requires significant resources and a review of our technologies, systems and practices, as well as those of any third-party collaborators, service providers, contractors or consultants that Process personal data on our behalf.

In the United States, federal, state and local governments have enacted numerous data privacy and security laws, including data breach notification laws, personal data privacy laws and consumer protection laws (e.g., Section 5 of the Federal Trade Commission Act). For example, the California Consumer Privacy Act (CCPA) requires businesses to provide specific disclosures in privacy notices and honor requests of California residents to exercise certain privacy rights. The CCPA provides for civil penalties of up to \$7,500 per violation and allows private litigants affected by certain data breaches to recover significant statutory damages. Although the CCPA exempts some data processed in the context of clinical trials, the CCPA may increase compliance costs and potential liability with respect to other personal data maintained about California residents. In addition, the California Privacy Rights Act of 2020 (CPRA), effective January 1, 2023, will expand the CCPA's requirements and establish a regulatory agency to implement and enforce the law. Other states, such as Virginia, Colorado, Utah and Connecticut, have also passed comprehensive privacy laws, and similar laws are being considered in several other states. These developments may further complicate compliance efforts, and may increase legal risk and compliance costs for us and the third parties upon whom we rely. In addition, data privacy and security laws have been proposed at the federal, state and local levels in recent years, which could further complicate compliance efforts.

Additionally, our operations may be subject to various federal and state healthcare information privacy laws, including but not limited to the Health Insurance Portability and Accountability Act of 1996 (HIPAA), as amended by the Health Information Technology for Economic and Clinical Health Act of 2009 (HITECH), and their respective implementing regulations, which impose obligations on "covered entities," including certain healthcare providers, health plans, and healthcare clearinghouses, as well as their respective "business associates" and covered subcontractors that create, receive, maintain or transmit individually identifiable health information for or on behalf of a covered entity, with respect to safeguarding the privacy, security and transmission of individually identifiable health information.

In addition, we may become subject to an increasing number of foreign privacy laws, particularly as we begin to sponsor clinical trials in foreign jurisdictions. For example, the EU's General Data Protection Regulation (EU GDPR) regulates the collection and use of personal data in the EU. The EU GDPR covers any business, regardless of its location, that provides goods or services to residents in the EU and, thus, could apply to our activities in EU member states. The EU GDPR imposes strict requirements on controllers and processors of personal data, including special protections for "sensitive information," which includes health and genetic information of individuals residing in the EU. Failure to comply with the requirements of the EU GDPR may result in warning letters, litigation, orders banning the processing of personal data, mandatory audits and financial penalties, including fines of up to 4% of global revenues, or €20,000,000, whichever is greater; or private litigation related to processing of personal data brought by classes of data subjects or consumer protection organizations authorized at law to represent their interests.

Certain jurisdictions have enacted data localization laws and cross-border personal data transfer laws, which could make it more difficult to transfer information across jurisdictions (such as transferring or receiving personal data that originates in the EU or in other foreign jurisdictions). Existing mechanisms that facilitate cross-border personal data transfers may change or be invalidated. For example, absent appropriate safeguards or other circumstances, the EU GDPR generally restricts the transfer of personal data to countries outside of the European Economic Area (EEA) that the European Commission does not consider to provide an adequate level of data privacy and security, such as the United States. The European Commission released a set of "Standard Contractual Clauses" (SCCs) that are designed to be a valid mechanism to facilitate personal data transfers out of the EEA to these jurisdictions. Currently, these SCCs are a valid mechanism to transfer personal data outside of the EEA. Additionally, the SCCs impose additional compliance burdens, such as conducting transfer impact assessments to determine whether additional security measures are necessary to protect the at-issue personal data.

In addition, Switzerland and the United Kingdom similarly restrict personal data transfers outside of those jurisdictions to countries such as the United States that do not provide an adequate level of personal data protection, and certain countries outside Europe (e.g. Russia, China, Brazil) have also passed or are considering laws requiring local data residency or otherwise impeding the transfer of personal data across borders, any of which could increase the cost and complexity of doing business or require us not to conduct business in certain countries. If we cannot implement a valid compliance mechanism for cross-border data transfers, we may face increased exposure to regulatory actions, substantial fines, and injunctions against processing or transferring personal data from Europe or other foreign jurisdictions. The inability to import personal data to the United States could significantly and negatively impact our business operations, including by limiting our ability to conduct clinical trial activities abroad; limiting our ability to collaborate with parties that are subject to such cross-border data transfer or localization laws; or requiring us to increase our personal data processing capabilities and infrastructure in foreign jurisdictions at significant expense.

We may also be bound by contractual obligations related to data privacy and security, and our efforts to comply with such obligations may not be successful. For example, certain privacy laws, such as the EU GDPR and the CCPA, may require our customers to impose specific contractual restrictions on their service providers. We may publish privacy policies, marketing materials and other statements, such as compliance with certain certifications, regarding data privacy and security. If these policies, materials or statements are found to be deficient, lacking in transparency, deceptive, unfair, or misrepresentative of our practices, we may be subject to investigation, enforcement actions by regulators or other adverse consequences.

Unfavorable macroeconomic conditions could adversely affect our business, financial condition or results of operations.

Our results of operations could be adversely affected by general conditions in the global economy and in the global financial markets. For example, the global financial crisis caused volatility and disruptions in the capital and credit markets. In addition, due to general political and economic conditions, including the ongoing COVID-19 pandemic and the ongoing Ukraine-Russia conflict, the global credit and financial markets have recently experienced extreme volatility and disruptions, including diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates, inflation, rising interest rates and uncertainty about economic stability. A severe or prolonged economic downturn, such as the global financial crisis, could result in a variety of risks to our business, including inability to raise additional capital when needed on acceptable terms, if at all. A weak or declining economy could also strain our CDMOs and CROs, possibly resulting in supply disruption. Any of the foregoing could harm our business and we cannot anticipate all of the ways in which the current economic climate and financial market conditions could adversely impact our business.

We or the third parties upon whom we depend may be adversely affected by earthquakes, droughts, floods, fires, hurricanes or other natural disasters and our business continuity and disaster recovery plans may not adequately protect us from a serious disaster.

We are located in San Diego, California and our manufacturing activities are conducted by CDMOs and our clinical trials are conducted at various locations in the United States and abroad. We conducted our Phase I clinical trial for efzofitimod in Australia and we have a subsidiary in Hong Kong. Some of these geographic locations have in the past experienced natural disasters, including severe earthquakes. Earthquakes, droughts, floods, fires, hurricanes, disease epidemics or other natural disasters could severely disrupt our operations, and have a material adverse effect on our business, results of operations, financial condition and prospects. If a natural disaster, power outage or other event occurred that prevented us from using all or a significant portion of our facilities, that damaged

critical infrastructure, such as the manufacturing facilities of our CDMOs and clinical sites utilized by our CROs, or that otherwise disrupted operations, it may be difficult or, in certain cases, impossible for us to continue our business for a substantial period of time. The disaster recovery and business continuity plans we have in place currently are limited and are unlikely to prove adequate in the event of a serious disaster or similar event. We may incur substantial expenses as a result of the limited nature of our disaster recovery and business continuity plans, as well as limits on our insurance coverage, which could have a material adverse effect on our business, prospects, financial condition and results of operations.

Risks related to the commercialization of our product candidates

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

We do not currently have any infrastructure for the sales, marketing and distribution of pharmaceutical products. In order to market our product candidates, if approved by the FDA or any other regulatory body, we must build our sales, marketing, distribution, managerial and other non-technical capabilities or make arrangements with third parties to perform these services. There are risks involved with both establishing our own sales and marketing capabilities and entering into arrangements with third parties to perform these services. For example, recruiting and training a sales force is expensive and time consuming and could delay any product launch. If the commercial launch of a product candidate for which we recruit a sales force and establish marketing capabilities is delayed or does not occur for any reason, we would have prematurely or unnecessarily incurred these commercialization expenses. This may be costly, and our investment would be lost if we cannot retain or reposition our sales and marketing personnel.

If we enter into arrangements or collaborations with third parties to perform sales, marketing and distribution services, our product revenues or the profitability of these product revenues to us are likely to be lower than if we were to market, sell or distribute any medicines that we develop ourselves. In addition, we may not be successful in entering into arrangements with third parties to sell and market our product candidates or may be unable to do so on terms that are favorable to us. We likely will have little control over such third parties, and any of them may fail to devote the necessary resources and attention to sell and market our medicines effectively. If we do not establish sales and marketing capabilities successfully, either on our own or in collaboration with third parties, we will not be successful in commercializing our product candidates.

We rely on third-party manufacturers to produce our product candidates, but we have not entered into agreements with any such manufacturers to support commercialization.

We have not yet secured manufacturing capabilities for commercial quantities of any of our product candidates. Although we intend to rely on third-party manufacturers for commercialization, we have not yet entered into a long-term commercial supply agreement to support full scale commercial production, and we or our CDMOs may be unable to process validation activities necessary to enter into commercial supply agreements or otherwise negotiate agreements with the manufacturers to support our commercialization activities at commercially reasonable terms.

We may run into technical or scientific issues related to development or manufacturing that we may be unable to resolve in a timely manner or with available funds. For example, we recently engaged an additional CDMO to manufacture efzofitmod bulk drug substance and will need to complete a technology transfer and validation process before the new CDMO will be able to produce additional bulk drug substance for our clinical trials or otherwise. The new CDMO has not previously manufactured efzofitmod bulk drug substance, which subjects us to heightened risks that it will experience delays in validating the manufacturing process. If the new CDMO experiences such delays, particularly delays in producing efzofitmod in compliance with cGMP regulations, we could be forced to delay future clinical trials or the submission of regulatory approval applications to the FDA. In addition, due to the fact that all prior cGMP batches of efzofitmod, including those that we intend to use in the EFZO-FIT™ study, have been produced by our existing CDMO, we will be required to complete comparability studies prior to using efzofitmod produced at the new CDMO's facilities in subsequent clinical trials or submitting regulatory approval applications to the FDA. If we are unable to demonstrate such comparability to the satisfaction of the FDA, it may result in delays to future clinical trials or a deficiency in future regulatory applications. If we or our CDMOs are unable to scale the manufacturing process to produce commercial quantities of our product candidates, or our CDMOs do not pass required regulatory pre-approval inspections, our commercialization efforts will be harmed.

In addition, any significant disruption in our relationships with our CDMOs could harm our business. There are a relatively small number of potential manufacturers for our product candidates, and such manufacturers may not be able to supply our drug products at the times we need them or on commercially reasonable terms. Any disruption to our relationship with our current CDMOs and any manufacturers that we contract with in the future will result in delays in our ability to complete the clinical development of, or to commercialize, our product candidates, and may require us to incur additional costs.

We face intense competition and rapid technological change and the possibility that our competitors may develop therapies that are more advanced or effective than ours, which may adversely affect our financial condition and our ability to successfully commercialize our product candidates.

The biotechnology and pharmaceutical industries are intensely competitive and subject to rapid and significant technological change. We have competitors both in the United States and internationally, including major multi-national pharmaceutical companies, biotechnology companies and universities and other research institutions. Although we believe we are the only company engaged in the discovery and development of therapeutics based on novel functions of tRNA synthetases and NRP2 biology, we are aware of other companies that could compete with our product candidates in their target therapeutic indications, such as our lead candidate, efzofitimod for the treatment of pulmonary sarcoidosis and other ILD.

Many of our competitors have substantially greater financial, technical and other resources, such as larger research and development staff and experienced marketing and manufacturing organizations. 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, more convenient or less costly than any product candidate that we may develop, or achieve earlier patent protection, regulatory approval, product commercialization and market penetration than us. Additionally, technologies developed by our competitors may render our potential product candidates uneconomical or obsolete, and we may not be successful in marketing our product candidates against competitors.

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

Even with the requisite approval from the FDA and comparable foreign regulatory authorities, the commercial success of our product candidates will depend in part on the medical community, patients, and third-party payors accepting our product candidates as medically useful, cost-effective, and safe. Any product that we bring to the market may not gain market acceptance by physicians, patients, third-party payors and others in the medical community. If these products do not achieve an adequate level of acceptance, we may not generate significant product revenue and may not become profitable.

Even if a potential product displays a favorable efficacy and safety profile in preclinical studies and clinical trials, market acceptance of the product will not be known until after it is launched. Our efforts to educate the medical community and third-party payors on the benefits of the product candidates may require significant resources and may never be successful. Such efforts to educate the marketplace may require more resources than are required by the conventional technologies marketed by our competitors, and our competitors may have substantially greater resources or brand recognition to effectively market their products. If our product candidates are approved but fail to achieve an adequate level of acceptance by physicians, patients, third-party payors, and others in the medical community, we will not be able to generate sufficient revenue to become or remain profitable.

The insurance coverage and reimbursement status of newly-approved products is uncertain. Failure to obtain or maintain adequate coverage and reimbursement for new or current products could limit our ability to market those products and decrease our ability to generate revenue.

The availability and extent of coverage and adequate reimbursement by third-party payors, including government health administration authorities, private health coverage insurers, managed care organizations and other third-party payors is essential for most patients to be able to afford expensive treatments. Sales of any of our product candidates that receive marketing approval will depend substantially, both in the United States and internationally, on the extent to which the costs of such product candidates will be covered and reimbursed by third-party payors. If reimbursement is not available, or is available only to limited levels, we may not be able to successfully commercialize our product candidates. Even if coverage is provided, the approved reimbursement amount may not be high enough to allow us to establish or maintain pricing sufficient to realize an adequate return on our investment.

There is significant uncertainty related to the insurance coverage and reimbursement of newly approved products. In the United States, the principal decisions about reimbursement for new medicines are typically made by the Centers for Medicare & Medicaid Services (CMS), as CMS decides whether and to what extent a new medicine will be covered and reimbursed under Medicare. Private payors often follow CMS with respect to coverage policy and payment limitations in setting their own reimbursement policies. It is difficult to predict what CMS will decide with respect to reimbursement for fundamentally novel products such as ours, as there is no body of established practices and precedents for these new products. One third-party payor's determination to provide coverage for a product candidate does not assure that other payors will also provide coverage for the product candidate. Further, no uniform policy for coverage and reimbursement exists in the United States, and coverage and reimbursement can differ significantly from payor to payor. As a result, the coverage determination process is often time-consuming and costly. This process will require us to provide scientific and clinical support for the use of our products to each third-party payor separately, with no assurance that coverage and adequate reimbursement will be applied consistently or obtained in the first instance. Reimbursement agencies in Europe may be more conservative than third-party payors in the United States. For example, a number of cancer drugs have been approved for reimbursement in the United States, but have not been approved for reimbursement in certain European countries. There may be significant delays in obtaining reimbursement for newly approved medicines, and our inability to promptly obtain coverage and profitable payment rates

from third-party payors for any approved medicines could have a material adverse effect on our business, prospects, financial condition and results of operations.

Outside the United States, international sales are generally subject to extensive governmental price controls and other market regulations, and we believe the increasing emphasis on cost-containment initiatives in Europe, Canada, and other countries has and will continue to put pressure on the pricing and usage of our product candidates. In many countries, the prices of medical products are subject to varying price control mechanisms as part of national health systems. In general, the prices of medicines under such systems are substantially lower than in the United States. Other countries allow companies to fix their own prices for medicines, but monitor and control company profits. Additional foreign price controls or other changes in pricing regulation could restrict the amount that we are able to charge for our product candidates. Accordingly, in markets outside the United States, the reimbursement for our products may be reduced compared with the United States and may be insufficient to generate commercially reasonable revenues and profits. Net prices for medicines may be reduced by mandatory discounts or rebates required by government healthcare programs or private payors and by any future relaxation of laws that currently restrict imports of medicines from countries where they may be sold at lower prices than in the United States.

Moreover, increasing efforts by governmental and third-party payors, in the United States and abroad, to cap or reduce healthcare costs may cause such organizations to limit both coverage and level of reimbursement for new products and, as a result, they may not cover or provide adequate payment for our product candidates. For example, the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act of 2010 (collectively, the ACA) was passed in March 2010, and substantially changed the way healthcare is financed by both governmental and private insurers, and continues to significantly impact the U.S. pharmaceutical industry. There have been executive, judicial and congressional challenges to certain aspects of the ACA. While Congress has not passed comprehensive repeal legislation, it has enacted laws that modified certain provisions of the ACA such as removing penalties, starting January 1, 2019, for not complying with the ACA's individual mandate to carry health insurance. On June 17, 2021 the U.S. Supreme Court dismissed a challenge on procedural grounds that argued the ACA is unconstitutional in its entirety because the "individual mandate" was repealed by Congress. Further, prior to the U.S. Supreme Court ruling, on January 28, 2021, President Biden issued an executive order that initiated a special enrollment period for purposes of obtaining health insurance coverage through the ACA marketplace, which began on February 15, 2021 and remained open through August 15, 2021. The executive order also instructed certain governmental agencies to review and reconsider their existing policies and rules that limit access to healthcare, including among others, reexamining Medicaid demonstration projects and waiver programs that include work requirements, and policies that create unnecessary barriers to obtaining access to health insurance coverage through Medicaid or the ACA. On August 16, 2022, President Biden signed the Inflation Reduction Act of 2022 (IRA) into law, which among other things, extends enhanced subsidies for individuals purchasing health insurance coverage in ACA marketplaces through plan year 2025. The IRA also eliminates the "donut hole" under the Medicare Part D program beginning in 2025 by significantly lowering the beneficiary maximum out-of-pocket cost through a newly established manufacturer discount program. It is possible that the ACA will be subject to judicial or Congressional challenges in the future. It is unclear how any such challenges and the healthcare reform measures of the Biden administration will impact the ACA and our business.

In addition, there has been heightened governmental scrutiny in the United States of pharmaceutical pricing practices in light of the rising cost of prescription drugs and biologics. Such scrutiny has resulted in several recent presidential executive orders, congressional inquiries and proposed and enacted federal and state legislation designed to, among other things, bring more transparency to product pricing, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for products. For example, in July 2021, the Biden administration released an executive order, "Promoting Competition in the American Economy," with multiple provisions aimed at prescription drugs. In response to Biden's executive order, on September 9, 2021, the U.S. Department of Health and Human Services (HHS) released a Comprehensive Plan for Addressing High Drug Prices that outlines principles for drug pricing reform and sets out a variety of potential legislative policies that Congress could pursue as well as potential administrative actions HHS can take to advance these principles. Further, the IRA, among other things, (1) directs the HHS to negotiate the price of certain single-source drugs and biologics covered under Medicare and (2) imposes rebates under Medicare Part B and Medicare Part D to penalize price increases that outpace inflation. These provisions will take effect progressively starting in fiscal year 2023, although they may be subject to legal challenges. It is currently unclear how the IRA will be implemented but is likely to have a significant impact on the pharmaceutical industry. We expect to experience pricing pressures in connection with the sale of any of our product candidates, due to the trend toward managed healthcare, the increasing influence of health maintenance organizations and additional health reform measures. The downward pressure on healthcare costs in general, particularly prescription drugs and surgical procedures and other treatments, has become very intense. As a result, increasingly high barriers are being erected to the entry of new products.

In addition, drug prices are under significant scrutiny in the markets in which our products may be sold. Drug pricing and other health care costs continues to be subject to intense political and societal pressures which we anticipate will continue and escalate on a global basis. If coverage and reimbursement is available only to limited levels, we may not be able to successfully commercialize our product candidates for which we obtain marketing approval. As a result, we may have difficulty raising capital and our results of operations may be adversely impacted.

Our business operations and current and future relationships with investigators, healthcare professionals, consultants, third-party payors and customers may be subject, directly or indirectly, to federal and state healthcare fraud and abuse laws, false claims laws, transparency laws, health information privacy and security laws and other healthcare laws and regulations. If we are unable to comply, or have not fully complied, with such laws, we could face substantial penalties.

Although we do not currently have any products on the market, our current and future operations may be, directly or indirectly through our prescribers, customers and third-party payors, subject to various federal and state healthcare laws and regulations. The laws that may affect our ability to operate include:

- the federal Anti-Kickback Statute, which prohibits, among other things, persons or entities from knowingly and willfully soliciting, offering, receiving or paying any remuneration (including any kickback, bribe or certain rebates), directly or indirectly, overtly or covertly, in cash or in kind, to induce or reward either the referral of an individual for, or the purchase, lease, order or recommendation of, any good, facility, item or service, for which payment may be made, in whole or in part, under federal and state healthcare programs such as Medicare and Medicaid. A person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;
- the U.S. federal false claims, including the False Claims Act, which can be enforced through whistleblower actions, and civil monetary penalties laws, which, among other things, impose criminal and civil penalties against individuals or entities for knowingly presenting, or causing to be presented, to the U.S. federal government, claims for payment or approval that are false or fraudulent, knowingly making, using or causing to be made or used, a false record or statement material to a false or fraudulent claim, or from knowingly making a false statement to avoid, decrease or conceal an obligation to pay money to the federal government. In addition, the government may assert that a claim including items and services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the False Claims Act;
- HIPAA, which imposes criminal and civil liability for, among other things, knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program, or knowingly and willfully falsifying, concealing or covering up a material fact or making any materially false statement, in connection with the delivery of, or payment for, healthcare benefits, items or services; similar to the U.S. federal Anti-Kickback Statute, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;
- HIPAA, as amended by HITECH, which imposes certain obligations, including mandatory contractual terms, with respect to safeguarding the privacy, security and transmission of individually identifiable health information without appropriate authorization by covered entities, i.e. health plans, healthcare clearinghouses and certain healthcare providers, as well as their business associates and covered subcontractors that perform certain services for or on their behalf involving the use or disclosure of individually identifiable health information;
- the U.S. federal legislation commonly referred to as Physician Payments Sunshine Act, enacted as part of the ACA, and its implementing regulations, which requires certain manufacturers of drugs, devices, biologics and medical supplies that are reimbursable under Medicare, Medicaid or the Children's Health Insurance Program to report annually to the CMS information related to certain payments and other transfers of value to physicians (defined to include doctors, dentists, optometrists, podiatrists and chiropractors), certain other healthcare professionals (such as physician assistants and nurse practitioners), and teaching hospitals, as well as ownership and investment interests held by the physicians described above and their immediate family members; and
- analogous state and foreign laws and regulations.

If our operations are found to be in violation of any of the laws described above or any other governmental laws and regulations that may apply to us, we may be subject to significant penalties, including civil, criminal and administrative penalties, damages, fines, exclusion from government funded healthcare programs, such as Medicare and Medicaid, or similar programs in other countries or jurisdictions, disgorgement, imprisonment, contractual damages, reputational harm, diminished profits, additional reporting requirements and oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of non-compliance with these laws and the delay, reduction, termination or restructuring of our operations.

Risks related to the ownership of our common stock

The market price of our common stock historically has been highly volatile and is likely to continue to be volatile, and you could lose all or part of your investment.

The market price of our common stock has been volatile and could be subject to wide fluctuations in response to various factors, some of which are beyond our control. In addition to the factors discussed in this "Risk Factors" section and elsewhere in this Quarterly Report, these factors include:

- general political and macroeconomic conditions, including the ongoing COVID-19 pandemic, the ongoing Ukraine-Russia conflict, and other geopolitical and macroeconomic conditions including labor shortages, economic slowdowns, recessions,

inflation and monetary supply shifts, rising interest rates and tightening of credit markets, and the resulting impacts on our business operations or financial condition;

- adverse results or delays in preclinical studies or clinical trials;
- manufacturing sufficient quantities of product candidates for use in clinical trials;
- the imposition of a clinical hold on our product candidates or our inability to cause the clinical hold to be lifted;
- any delay in filing an IND or BLA for any of our product candidates and any adverse development or perceived adverse development with respect to the FDA's review of that IND or BLA;
- failure of our strategic partners to perform under our collaborations or early termination of collaborations;
- failure to successfully develop and commercialize our product candidates;
- limited market sizes and pricing for our product candidates;
- failure by us or our licensors to prosecute, maintain or enforce intellectual property rights covering our product candidates and processes;
- changes in laws or regulations applicable to current or future products;
- inability to obtain adequate product supply for our product candidates or the inability to do so at acceptable prices;
- adverse regulatory decisions;
- introduction of new products, services or technologies by our competitors;
- inability to obtain additional capital;
- failure to meet or exceed financial or operational projections we may provide to the public;
- failure to meet or exceed the financial or operational projections of the investment community;
- the perception of the biopharmaceutical industry by the public, politicians, legislatures, regulators and the investment community;
- significant acquisitions, strategic partnerships, joint ventures or capital commitments by us 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;
- if securities or industry analysts issue an adverse or misleading opinion regarding our common stock;
- changes in the market valuations of similar companies;
- changes in the structure of healthcare payment systems;
- sales of our common stock by us or our stockholders in the future;
- a potential additional reverse stock split if we are unable to maintain a stock price above \$1.00 per share of common stock; and
- trading volume of our common stock.

In addition, companies trading in the stock market in general, and on the Nasdaq Capital Market and biotechnology companies in particular, have experienced extreme price and volume fluctuations, and we have in the past experienced volatility that has been unrelated or disproportionate to our operating performance. From January 1, 2020 through November 8, 2022 the closing price of our common stock has ranged between \$2.17 and \$12.48 per share. Broad market and industry factors may negatively affect the market price of our common stock, regardless of our actual operating performance.

Our executive officers, directors, 5% holders and their affiliates currently own a significant percentage of our stock and will be able to exert significant control over matters submitted to stockholders for approval.

As of November 8, 2022, based on the latest information available to us, our executive officers, directors, holders known by us to own 5% of our voting stock and their affiliates own approximately 35.5% of our voting stock. Therefore, our executive officers,

directors, holders known by us to own 5% of our voting stock and their affiliates will have the ability to influence us through their ownership positions and may be able to determine all matters requiring stockholder approval. For example, these stockholders, acting together, may be able to control elections of directors, amendments of our organizational documents, or approval of any merger, sale of assets, or other major corporate transaction. This may prevent or discourage unsolicited acquisition proposals or offers for our common stock that you may believe are in your best interest as one of our stockholders.

Future sales and issuances of equity securities could result in dilution to our stockholders, impose restrictions or limitations on our business and could cause our stock price to fall.

We will need additional capital in the future to continue our planned operations, and we may seek additional funding through a combination of equity offerings, debt, grant funding, collaborations, strategic partnerships and/or licensing arrangements.

In September 2021, we completed an underwritten follow-on public offering of 10,781,250 shares of our common stock, including the full exercise of the underwriters' option to purchase additional shares, at a price to the public of \$8.00 per share. The total net proceeds from the offering were approximately \$80.6 million, after deducting underwriting discounts, commissions and offering expenses payable by us.

In September 2020, we entered into the Purchase Agreement with Aspire Capital, which provides that, upon the terms and subject to the conditions and limitations set forth therein, Aspire Capital is committed to purchase up to an aggregate of \$20.0 million of shares of our common stock at our request from time to time during the 30 month term of the Purchase Agreement. Concurrently with entering into the Purchase Agreement, we also entered into a registration rights agreement with Aspire Capital, in which we agreed to file one or more registration statements, as permissible and necessary to register under the Securities Act, for the resale of the shares of our common stock that have been and may be issued to Aspire Capital under the Purchase Agreement. During 2021, we sold an aggregate of 3,000,000 shares of common stock at a weighted-average price of \$5.09 per share for net proceeds of \$15.2 million under this Purchase Agreement. We may sell the remaining \$4.8 million in the future under the Purchase Agreement. During the nine months ended September 30, 2022, there were no issuances or sales under the Purchase Agreement.

In April 2022, we entered into an Open Market Sale AgreementSM with Jefferies implementing the ATM Offering Program, pursuant to which we may offer and sell, from time to time and at our option, up to an aggregate of \$65.0 million of shares of our common stock through Jefferies, acting as sales agent. Jefferies is entitled to a fixed commission rate of up to 3.0% of the gross sales proceeds of shares sold under the ATM Offering Program. During the nine months ended September 30, 2022, we sold an aggregate of 69,251 shares of common stock at a weighted-average price of \$2.80 per share for gross proceeds of approximately \$0.2 million under the ATM Offering Program.

In March 2021, we entered into a Capital on DemandTM Sales Agreement with JonesTrading to implement the Prior ATM Offering Program, pursuant to which we were entitled to sell from time to time, at our option, up to an aggregate of \$25.0 million of shares of our common stock through JonesTrading, as sales agent or principal. JonesTrading was entitled to a commission at a fixed rate of up to 3.0% of the gross proceeds. During 2021, we sold an aggregate of 986,267 shares of common stock at a weighted-average price of \$4.75 per share for net proceeds of \$4.4 million under the Prior ATM Offering Program. In April 2022, we terminated the Prior ATM Offering Program. During 2022 and prior to the termination in April 2022, we sold an aggregate of 260,455 shares of common stock at a weighted-average price of \$6.07 per share for net proceeds of approximately \$1.5 million under the Prior ATM Offering Program.

These financing activities may have an adverse effect on our stockholders' rights, the market price of our common stock and on our operations, and may require us to relinquish rights to some of our technologies, intellectual property or product candidates, issue additional equity or debt securities, or otherwise agree to terms unfavorable to us.

In addition, sales of a substantial number of shares of our common stock by our existing stockholders in the public market or the perception that these sales might occur, could depress the market price of our common stock and could impair our ability to raise capital through the sale of additional equity securities. Any sales of securities by these stockholders could have a material adverse effect on the trading price of our common stock, even if there is no relationship between such sales and the performance of our business.

We have also registered or plan to register all common stock that we may issue under our employee benefits plans as well as shares of common stock underlying options to purchase shares of our common stock that were granted as inducement grants. As a result, once registered, these shares can be freely sold in the public market upon issuance, subject to restrictions under the securities laws. In addition, our directors and executive officers may establish programmed selling plans under Rule 10b5-1 of the Exchange Act for the purpose of effecting sales of our common stock. If any of these events cause a large number of our shares to be sold in the public market, the sales could reduce the trading price of our common stock and impede our ability to raise future capital.

Our ability to use our net operating losses to offset future taxable income may be subject to certain limitations.

We have incurred substantial losses during our history, we do not expect to become profitable in the near future and we may never achieve profitability. Net operating loss carryforwards (NOLs) that expire unused will be unavailable to offset future income tax liabilities. Under current law, federal net operating losses incurred in tax years beginning after December 31, 2017, may be carried forward indefinitely, but the deductibility of such federal NOLs in tax years beginning after December 31, 2020, is limited to 80% of taxable income.

In addition, under Section 382 of the Internal Revenue Code of 1986, as amended (Code) a corporation that undergoes an “ownership change” (as defined under Section 382 of the Code and applicable Treasury Regulations) is subject to limitations on its ability to utilize its pre-change NOLs to offset post-change taxable income. We have experienced ownership changes in the past, and may experience future ownership changes, under Section 382 of the Code that could affect our ability to utilize our NOLs to offset our income. Furthermore, our ability to utilize NOLs of companies that we may acquire in the future may be subject to limitations. There is also a risk that due to regulatory changes, such as suspensions on the use of NOLs or other unforeseen reasons, portions of our existing NOLs could expire or otherwise be unavailable to reduce future income tax liabilities, including for state tax purposes. For these reasons, we may not be able to utilize a material portion of our NOLs, even if we attain profitability, which could potentially result in increased future tax liability to us and could adversely affect our operating results and financial condition.

We do not intend to pay dividends on our common stock, and therefore 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 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.

In addition, future debt instruments may materially restrict our ability to pay dividends on our common stock. Any future determination related to dividend policy will be made at the discretion of our board of directors and will depend upon, among other factors, our results of operations, financial condition, capital requirements, tax considerations, legal or contractual restrictions, business prospects, the requirements of current or then-existing debt instruments, general economic conditions and other factors our board of directors may deem relevant.

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

Our amended and restated certificate of incorporation, amended and restated bylaws 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 amended and restated bylaws 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 bylaws; 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 bylaws.

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 bylaws 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 bylaws provide that the Court of Chancery of the State of Delaware is the exclusive forum for certain disputes between us and our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers or employees.

Our amended and restated bylaws provide that the Court of Chancery of the State of Delaware will be the sole and exclusive forum for (i) any derivative action or proceeding brought on our behalf, (ii) any action asserting a claim of breach of a fiduciary duty owed by any of our directors, officers or employees to our company or our stockholders, (iii) any action asserting a claim against our company arising pursuant to any provision of the Delaware General Corporation Law or our amended and restated certificate of incorporation or bylaws, or (iv) any action asserting a claim against our company governed by the internal affairs doctrine. This choice of forum provision does not apply to suits brought to enforce a duty or liability created by the Securities Act or the Exchange Act, or any other claim for which the federal courts have exclusive jurisdiction.

This choice of forum provision may limit a stockholder's ability to bring certain claims in a judicial forum that it finds favorable for disputes with us or any of our directors, officers, other employees or stockholders, which may discourage lawsuits with respect to such claims, although our stockholders will not be deemed to have waived our compliance with federal securities laws and the rules and regulations thereunder. If a court were to find this choice of forum provision to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could adversely affect our business and financial condition.

General Risk Factors

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

We are subject to numerous environmental, health and safety laws and regulations, including those governing laboratory procedures and the handling, use, storage, treatment and disposal of hazardous materials and wastes. Our operations involve the use of hazardous and flammable materials, including chemicals and biological materials. Our operations also produce hazardous waste products. We generally contract with third parties for the disposal of these materials and wastes. We cannot eliminate the risk of contamination or injury from these materials. In the event of contamination or injury resulting from our use of hazardous materials, we could be held liable for any resulting damages, and any liability could exceed our resources. We also could incur significant costs associated with civil or criminal fines and penalties.

Although we maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees resulting from the use of hazardous materials or other work-related injuries, this insurance may not provide adequate coverage against potential liabilities. In addition, we may incur substantial costs in order to comply with current or future environmental, health and safety laws and regulations. These current or future laws and regulations may impair our research, development or production efforts. Failure to comply with these laws and regulations also may result in substantial fines, penalties or other sanctions.

If our information technology systems or data, or those maintained on our behalf, are or were compromised, or the security, confidentiality, integrity or availability of our information technology, software, services, networks, communications or data is compromised, limited or fails, this could result in a Material Adverse Impact.

In the ordinary course of our business, we and the third-parties upon which we rely may Process (as defined above) proprietary, confidential and sensitive information, including personal data (including key-coded data, health information and other special categories of personal data), intellectual property, trade secrets, and proprietary business information owned or controlled by ourselves or other third parties (collectively, Sensitive Information).

We utilize information technology systems and networks to process, transmit and store Sensitive Information in connection with our business activities. We may also use third-party service providers and subprocessors to help us operate our business and engage in Processing on our behalf or otherwise share Sensitive Information with our partners or other third parties in conjunction with our business. If we, our service providers, partners or other relevant third parties have experienced or in the future experience any security incident(s) that result in any data loss; deletion or destruction of Sensitive Information; unauthorized access to Sensitive Information; loss, unauthorized acquisition, disclosure or exposure of Sensitive Information; or compromise related to the security, confidentiality, integrity or availability of our (or their) information technology, software, services, communications or data (including Sensitive

Information) (any, a security breach), it may result in a Material Adverse Impact (as defined above). For example, the loss of data from completed clinical trials for our product candidates could result in delays in our regulatory approval efforts and significantly increase our costs. Theft of our Sensitive Information could require substantial expenditures to remedy. If we or the third parties upon which we rely experience a security breach, we could suffer reputational harm or face litigation or adverse regulatory action, fines, other penalties, business interruption, and diversion of funds. As a result, we could experience Material Adverse Impacts.

Cyber-attacks, malicious internet-based activity, online and offline fraud, and other similar activities threaten the confidentiality, integrity and availability of our Sensitive Information and information technology systems, and those of the third parties upon which we rely. Such threats are prevalent, continue to rise, are increasingly difficult to detect and come from a variety of sources, including traditional computer “hackers,” threat actors, “hacktivists,” organized criminal threat actors, personnel (such as through theft or misuse), sophisticated nation states, and nation state supported actors. Some actors now engage and are expected to continue to engage in cyber-attacks, including without limitation nation state actors for geopolitical reasons and in conjunction with military conflicts and defense activities. During times of war and other major conflicts, we and the third parties upon which we rely may be vulnerable to a heightened risk of these attacks, including retaliatory cyber-attacks that could materially disrupt our systems and operations, supply chain, and ability to produce, sell and distribute our goods and services. We and the third parties upon which we rely may be subject to a variety of evolving threats, including but not limited to software bugs; malicious code (such as viruses and worms); denial-of-service attacks (such as credential stuffing); credential harvesting; advanced persistent threat intrusions; natural disasters; terrorism; war; telecommunication and electrical failures; ransomware attacks; phishing attacks; server malfunction; software or hardware failures; supply-chain attacks; loss of data or other computer assets; and other similar issues. Particularly, severe ransomware attacks are becoming increasingly prevalent and can lead to significant interruptions, delays, or outages in our operations, disruption of clinical trials, loss of data (including data related to clinical trials), and other Material Adverse Impacts. To alleviate the financial, operational and reputational impact of a ransomware attack, it may be preferable to make extortion payments, but we may be unwilling or unable to do so (including, for example, if applicable laws or regulations prohibit such payments). Similarly, supply chain attacks have increased in frequency and severity, and we cannot guarantee that third parties and infrastructure in our supply chain have not been compromised or that they do not contain exploitable defects or bugs that could result in a breach of or disruption to our platform, systems and networks or the systems and networks of third parties that support us and our services.

Additionally, remote work has become more common and has increased the risk to our information technology assets and data, as more of our employees utilize network connections, computers and devices outside of our premises and networks, including working at home, while in transit and in public locations. Additionally, future or past business transactions could expose us to additional risks and vulnerabilities, as our systems could be negatively affected by vulnerabilities present in acquired or integrated entities’ systems and technologies.

While we have implemented security measures designed to protect against security breaches, there can be no assurance that we, or any third-party partner, will be successful in preventing a security breach or mitigating their effects. We may be unable to detect vulnerabilities in our information technology systems because such threats and techniques change frequently, are often sophisticated in nature, and may not be detected until after a security breach has occurred. Further, we may experience delays in developing and deploying remedial measures designed to address any such identified vulnerabilities. We may be required to expend significant resources, fundamentally change our business activities and practices, or modify our operations, including our clinical trial activities, or information technology in an effort to protect against security breaches and to mitigate, detect, and remediate actual and potential vulnerabilities. Applicable Data Protection Requirements (as defined above) may require us to implement specific security measures or use industry-standard or reasonable measures to protect against security breaches.

Furthermore, applicable Data Protection Requirements may require us to notify relevant stakeholders of security breaches. Such disclosures are costly, and the disclosures or the failure to comply with such requirements could lead to Material Adverse Impacts.

Our contracts may not contain limitations of liability, and even where they do, there can be no assurance that limitations of liability in our contracts are sufficient to protect us from liabilities, damages, or claims related to our data privacy and security obligations. Furthermore, we cannot be sure that our insurance coverage, will be adequate or otherwise protect us from or adequately mitigate liabilities or damages with respect to claims, costs, expenses, litigation, fines, penalties, business loss, data loss, regulatory actions or Material Adverse Impacts arising out of our Processing operations, privacy and security practices, or security breaches we may experience. The successful assertion of one or more large claims against us that exceeds our available insurance coverage, or results in changes to our insurance policies (including premium increases or the imposition of large excess or deductible or co-insurance requirements), could have a Material Adverse Impact.

We are subject to anti-corruption laws in the jurisdictions in which we operate.

We are subject to a number of anti-corruption laws, including the Foreign Corrupt Practices Act of 1977, as amended (FCPA), and various other anti-corruption laws. The FCPA generally prohibits companies and their intermediaries from making improper payments to foreign officials for the purpose of obtaining or keeping business and/or other benefits. Our business relies on approvals

and licenses from government and regulatory entities, and as a result, we are subject to certain elevated risks associated with interactions with these entities. Although we have adopted a code of business conduct and ethics that includes provisions governing the interactions of employees with government entities to mitigate these risks, there can be no assurance that this will be successful in preventing violations of anti-corruption laws. If we are not in compliance with anti-corruption laws and other laws governing the conduct of business with government entities (including local laws), we may be subject to criminal and civil penalties and other remedial measures, which could harm our reputation and have a material adverse effect on our business, financial condition, results of operations and prospects. Any investigation of any actual or alleged violations of such laws could also harm our reputation or have an adverse impact on our business, prospects, financial condition and results of operations.

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

As a public company, we have incurred and will continue to incur legal, accounting and other expenses. In addition, the Sarbanes-Oxley Act of 2002 as well as rules subsequently implemented by the SEC and The Nasdaq Stock Market have imposed various requirements on public companies. In July 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act (the Dodd-Frank Act) was enacted. There are significant corporate governance and executive compensation related provisions in the Dodd-Frank Act that require the SEC to adopt additional rules and regulations in these areas such as “say on pay” and proxy access. Stockholder activism, the current political environment and the current high level of government intervention and regulatory reform may lead to substantial new regulations and disclosure obligations, which may lead to additional compliance costs and impact the manner in which we operate our business in ways we cannot currently anticipate. Our management and other personnel will need to devote a substantial amount of time to these compliance initiatives. Moreover, these rules and regulations will increase our legal and financial compliance costs and will make some activities more time-consuming and costly. For example, we expect these rules and regulations to make it more difficult and more expensive for us to maintain director and officer liability insurance and we have been required to incur substantial costs to maintain our current levels of such coverage.

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

The trading market for our common stock relies in part on the research and reports that industry or financial analysts publish about us or our business. If no or few analysts commence coverage or continue coverage of us, the trading price of our stock would likely decrease. If one or more of the analysts covering our business downgrade their evaluations of our stock, the price of our stock could decline. If one or more of these analysts cease to cover our stock, we could lose visibility in the market for our stock, which in turn could cause our stock price to decline.

We could be subject to securities class action litigation.

In the past, securities class action litigation has often been brought against companies following a decline in the market price of their securities. This risk is especially relevant for us because pharmaceutical companies have experienced significant stock price volatility. If we face such litigation, it could result in substantial costs and a diversion of management’s attention and resources, which could harm our business and cause our stock price to decline.

We have broad discretion in the use of our cash, cash equivalents, restricted cash and available-for-sale investments and are exposed to risks related to the marketable securities we may purchase.

We have considerable discretion in the application of our existing cash, cash equivalents, restricted cash and available-for-sale investments. We expect to use our existing cash to fund research and development activities and for working capital and general corporate purposes, including funding the costs of operating as a public company. In addition, pending their use, we may invest our existing cash in certain short-term investments, including but not limited to investment-grade, interest-bearing securities. Historically, investment in these securities has been highly liquid and has experienced only very limited defaults. However, volatility in the financial markets in recent years has created additional uncertainty regarding the liquidity and safety of these investments. Additionally, we may use this cash, cash equivalents, restricted cash and available-for-sale investments for purposes that do not yield a significant return or any return at all for our stockholders.

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

None.

Item 3. Defaults Upon Senior Securities

None.

Item 4. Mine Safety Disclosures

Not applicable.

Item 5. Other Information

None.

Item 6. Exhibits

Index to Exhibits

Exhibit Number	Exhibit Title	Form	Incorporated by Reference		Filing Date
			File No.	Exhibit	
3.1	Restated Certificate of Incorporation of the Registrant	—	—	—	Filed herewith
3.2	Certificate of Amendment to Restated Certificate of Incorporation of the Registrant	8-K	001-37378	3.1	June 28, 2019
3.3	Certificate of Amendment to Restated Certificate of Incorporation of the Registrant	10-Q	001-37378	3.3	May 12, 2020
3.4	Certificate of Amendment to Restated Certificate of Incorporation of the Registrant	8-K	001-37378	3.1	May 4, 2021
3.5	Certificate of Amendment to Restated Certificate of Incorporation of the Registrant	8-K	001-37378	3.1	April 29, 2022
3.6	Amended and Restated Bylaws of the Registrant	—	—	—	Filed herewith
4.1	Specimen Common Stock Certificate	S-1/A	333-203272	4.1	April 27, 2015
4.2	Warrant to Purchase Stock issued to Silicon Valley Bank on July 24, 2013	S-1	333-203272	4.4	April 6, 2015
4.3	Warrant to Purchase Stock issued to Silicon Valley Bank on November 18, 2016	10-K	001-37378	4.5	March 16, 2017
4.4	Warrant to Purchase Stock issued to Solar Capital Ltd on November 18, 2016	10-K	001-37378	4.6	March 16, 2017
4.5	Warrant to Purchase Stock issued to Silicon Valley Bank on June 30, 2017	10-Q	001-37378	4.7	August 14, 2017
4.6	Warrant to Purchase Stock issued to Solar Capital Ltd on June 30, 2017	10-Q	001-37378	4.8	August 14, 2017
4.7	Warrant to Purchase Stock issued to Silicon Valley Bank on December 22, 2017	10-K	001-37378	4.8	March 20, 2018
4.8	Warrant to Purchase Stock issued to Solar Capital Ltd on December 22, 2017	10-K	001-37378	4.9	March 20, 2018
4.9	Registration Rights Agreement, by and between the Registrant and Aspire Capital Fund, LLC, dated September 11, 2020	8-K	001-37378	4.1	September 14, 2020
31.1	Certification of Principal Executive Officer required by 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 required by 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 pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002	—	—	—	Filed herewith

32.2#	Certification of Principal Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002	—	—	—	Filed herewith
101.INS	Inline XBRL Instance Document – the instance document does not appear in the Interactive Data File because 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 (embedded within the Inline XBRL document)	—	—	—	Filed herewith

The information in Exhibits 32.1 and 32.2 shall not be deemed “filed” for purposes of Section 18 of the Exchange Act, or otherwise subject to the liabilities of that section, nor shall it be deemed incorporated by reference in any filing under the Securities Act or the Exchange Act (including this Quarterly Report), unless the Registrant specifically incorporates the foregoing information into those documents by reference.

SIGNATURES

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

aTyr Pharma, Inc.

Date: November 14, 2022

By: /s/ Sanjay S. Shukla
Sanjay S. Shukla, M.D., M.S.
President and Chief Executive Officer
(Principal Executive Officer)

By: /s/ Jill M. Broadfoot
Jill M. Broadfoot
Chief Financial Officer
(Principal Financial and Accounting Officer)

RESTATED
CERTIFICATE OF INCORPORATION
OF
aTYR PHARMA, INC.

aTyr Pharma, Inc., a corporation organized and existing under the laws of the State of Delaware (the “ **Corporation** ”), hereby certifies as follows:

1. The name of the Corporation is aTyr Pharma, Inc. The date of the filing of its original Certificate of Incorporation with the Secretary of State of the State of Delaware was September 8, 2005.
2. This Restated Certificate of Incorporation (the “Certificate”) only restates and integrates and does not further amend the provisions of the Amended and Restated Certificate of Incorporation that was filed with the Secretary of State of the State of Delaware on May 11, 2015, as amended (the “Amended and Restated Certificate”) and there is no discrepancy between the provisions of the Amended and Restated Certificate and the provisions of this Certificate, and was duly adopted in accordance with the provisions of Section 245 of the General Corporation Law of the State of Delaware (the “DGCL”).
3. The text of the Amended and Restated Certificate is hereby integrated and restated in its entirety to provide as herein set forth in full.

ARTICLE I

The name of the Corporation is aTyr Pharma, Inc.

ARTICLE II

The address of the registered office of the Corporation in the State of Delaware is 160 Greentree Drive, Suite 101, in the City of Dover, County of Kent, 19904. The name of its registered agent at such address is National Registered Agents, Inc.

ARTICLE III

The purpose of the Corporation is to engage in any lawful act or activity for which corporations may be organized under the DGCL.

ARTICLE IV

CAPITAL STOCK

The total number of shares of capital stock which the Corporation shall have authority to issue is One Hundred Fifty-Seven Million Two Hundred Eighty-Five Thousand Four Hundred Fifty Six (157,285,456), of which (i) One Hundred Fifty Million (150,000,000) shares shall be a class designated as common stock, par value \$0.001 per share (the “**Common Stock**”), and (ii) Seven Million Two Hundred Eighty-Five Thousand Four Hundred Fifty Six (7,285,456) shares shall be a class designated as preferred stock, par value \$0.001 per share (the “**Preferred Stock**”), of which 72,000 shares are designated Series B Convertible Preferred Stock (“**Series B Preferred Stock**”), 15,957 shares are designated Series C Convertible Preferred Stock (“**Series C Preferred Stock**”), 2,197,499 shares are designated Series D Convertible Preferred Stock (“**Series D Preferred Stock**”), and together with the Series B Preferred Stock and Series C Preferred Stock, the “**Designated Preferred Stock**”), and Five Million (5,000,000) shares shall be undesignated preferred stock (the “**Undesignated Preferred Stock**”).

Except as otherwise provided in any certificate of designations of any series of Undesignated Preferred Stock, the number of authorized shares of the class of Common Stock or Undesignated Preferred Stock may from time to time be increased or decreased (but not below the number of shares of such class outstanding) by the affirmative vote of the holders of a majority in voting power of the outstanding shares of capital stock of the Corporation irrespective of the provisions of Section 242(b)(2) of the DGCL.

The powers, preferences and rights of, and the qualifications, limitations and restrictions upon, each class or series of stock shall be determined in accordance with, or as set forth below in, this Article IV and, with respect to the Designated Preferred Stock, on Exhibit A. Every reference to Preferred Stock in Exhibit A means the Designated Preferred Stock. Immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A), the Corporation shall no longer have the authority to issue any Designated Preferred Stock.

A. COMMON STOCK

Subject to all the rights, powers and preferences of the Designated Preferred Stock and Undesignated Preferred Stock and except as provided by law or in this Certificate (or in any certificate of designations of any series of Undesignated Preferred Stock):

(a) the holders of the Common Stock shall have the exclusive right to vote for the election of directors of the Corporation (the “**Directors**”) and on all other matters requiring stockholder action, each outstanding share entitling the holder thereof to one vote on each matter properly submitted to the stockholders of the Corporation for their vote; provided, however, that, except as otherwise required by law, holders of Common Stock, as such, shall not be entitled to vote on any amendment to this Certificate (or on any amendment to a certificate of designations of any series of Undesignated Preferred Stock) that alters or changes the powers,

preferences, rights or other terms of one or more outstanding series of Undesignated Preferred Stock if the holders of such affected series of Undesignated Preferred Stock are entitled to vote, either separately or together with the holders of one or more other such series, on such amendment pursuant to this Certificate (or pursuant to a certificate of designations of any series of Undesignated Preferred Stock) or pursuant to the DGCL;

(b) dividends may be declared and paid or set apart for payment upon the Common Stock out of any assets or funds of the Corporation legally available for the payment of dividends, but only when and as declared by the Board of Directors or any authorized committee thereof; and

(c) upon the voluntary or involuntary liquidation, dissolution or winding up of the Corporation, the net assets of the Corporation shall be distributed pro rata to the holders of the Common Stock.

B. UNDESIGNATED PREFERRED STOCK

The Board of Directors or any authorized committee thereof is expressly authorized, to the fullest extent permitted by law, to provide by resolution or resolutions for, out of the unissued shares of Undesignated Preferred Stock, the issuance of the shares of Undesignated Preferred Stock in one or more series of such stock, and by filing a certificate of designations pursuant to applicable law of the State of Delaware, to establish or change from time to time the number of shares of each such series, and to fix the designations, powers, including voting powers, full or limited, or no voting powers, preferences and the relative, participating, optional or other special rights of the shares of each series and any qualifications, limitations and restrictions thereof.

ARTICLE V

STOCKHOLDER ACTION

The following section shall become effective immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A).

1. Action without Meeting. Any action required or permitted to be taken by the stockholders of the Corporation at any annual or special meeting of stockholders of the Corporation must be effected at a duly called annual or special meeting of stockholders and may not be taken or effected by a written consent of stockholders in lieu thereof.

2. Special Meetings. Except as otherwise required by statute and subject to the rights, if any, of the holders of any series of Undesignated Preferred Stock, special meetings of the stockholders of the Corporation may be called only by the Board of Directors acting pursuant to a resolution approved by the affirmative vote of a majority of the Directors then in office, and special meetings of stockholders may not be called by any other person or persons. Only those matters set forth in the

notice of the special meeting may be considered or acted upon at a special meeting of stockholders of the Corporation.

ARTICLE VI

DIRECTORS

Sections 3, 4 and 5 of this Article VI shall become effective immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A).

1. General. The business and affairs of the Corporation shall be managed by or under the direction of the Board of Directors except as otherwise provided herein or required by law.

2. Election of Directors. Election of Directors need not be by written ballot unless the Bylaws of the Corporation (the “**Bylaws**”) shall so provide.

3. Number of Directors; Term of Office . The number of Directors of the Corporation shall be fixed solely and exclusively by resolution duly adopted from time to time by the Board of Directors. The Directors, other than those who may be elected by the holders of any series of Undesignated Preferred Stock, shall be classified, with respect to the term for which they severally hold office, into three classes. The Board of Directors shall assign Directors into classes at the time the classification becomes effective. The initial Class I Directors shall serve for a term expiring at the first annual meeting of stockholders to be held after the filing of this Certificate, the initial Class II Directors shall serve for a term expiring at the second annual meeting of stockholders to be held after the filing of this Certificate, and the initial Class III Directors shall serve for a term expiring at the third annual meeting of stockholders to be held after the filing of this Certificate. At each annual meeting of stockholders, Directors elected to succeed those Directors whose terms expire shall be elected for a term of office to expire at the third succeeding annual meeting of stockholders after their election. Notwithstanding the foregoing, the Directors elected to each class shall hold office until their successors are duly elected and qualified or until their earlier resignation, death or removal. Upon the effectiveness of this Section 3 of Article VI, Section B.2. of Exhibit A is hereby terminated and deleted and will be of no further force or effect.

Notwithstanding the foregoing, whenever, pursuant to the provisions of Article IV of this Certificate, the holders of any one or more series of Undesignated Preferred Stock shall have the right, voting separately as a series or together with holders of other such series, to elect Directors at an annual or special meeting of stockholders, the election, term of office, filling of vacancies and other features of such directorships shall be governed by the terms of this Certificate and any certificate of designations applicable to such series.

4. Vacancies. Subject to the rights, if any, of the holders of any series of Undesignated Preferred Stock to elect Directors and to fill vacancies in the Board of Directors

relating thereto, any and all vacancies in the Board of Directors, however occurring, including, without limitation, by reason of an increase in the size of the Board of Directors, or the death, resignation, disqualification or removal of a Director, shall be filled solely and exclusively by the affirmative vote of a majority of the remaining Directors then in office, even if less than a quorum of the Board of Directors, and not by the stockholders. Any Director appointed in accordance with the preceding sentence shall hold office for the remainder of the full term of the class of Directors in which the new directorship was created or the vacancy occurred and until such Director's successor shall have been duly elected and qualified or until his or her earlier resignation, death or removal. Subject to the rights, if any, of the holders of any series of Undesignated Preferred Stock to elect Directors, when the number of Directors is increased or decreased, the Board of Directors shall, subject to Article VI.3 hereof, determine the class or classes to which the increased or decreased number of Directors shall be apportioned; provided, however, that no decrease in the number of Directors shall shorten the term of any incumbent Director. In the event of a vacancy in the Board of Directors, the remaining Directors, except as otherwise provided by law, shall exercise the powers of the full Board of Directors until the vacancy is filled.

5. Removal. Subject to the rights, if any, of any series of Undesignated Preferred Stock to elect Directors and to remove any Director whom the holders of any such series have the right to elect, any Director (including persons elected by Directors to fill vacancies in the Board of Directors) may be removed from office (i) only with cause and (ii) only by the affirmative vote of the holders of 75% or more of the outstanding shares of capital stock then entitled to vote at an election of Directors. At least forty-five (45) days prior to any annual or special meeting of stockholders at which it is proposed that any Director be removed from office, written notice of such proposed removal and the alleged grounds thereof shall be sent to the Director whose removal will be considered at the meeting.

ARTICLE VII

LIMITATION OF LIABILITY

A Director of the Corporation shall not be personally liable to the Corporation or its stockholders for monetary damages for breach of fiduciary duty as a Director, except for liability (a) for any breach of the Director's duty of loyalty to the Corporation or its stockholders, (b) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (c) under Section 174 of the DGCL or (d) for any transaction from which the Director derived an improper personal benefit. If the DGCL is amended after the effective date of this Certificate to authorize corporate action further eliminating or limiting the personal liability of Directors, then the liability of a Director of the Corporation shall be eliminated or limited to the fullest extent permitted by the DGCL, as so amended.

Any amendment, repeal or modification of this Article VII by either of (i) the stockholders of the Corporation or (ii) an amendment to the DGCL shall not adversely affect any right or protection existing at the time of such amendment, repeal or modification with respect to any acts or omissions occurring before such amendment, repeal or modification of a person serving as a Director at the time of such amendment, repeal or modification.

ARTICLE VIII

AMENDMENT OF BYLAWS

1. Amendment by Directors. Except as otherwise provided by law, the Bylaws of the Corporation may be amended or repealed by the Board of Directors by the affirmative vote of a majority of the Directors then in office.
2. Amendment by Stockholders. Effective immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A), the Bylaws of the Corporation may be amended or repealed at any annual meeting of stockholders, or special meeting of stockholders called for such purpose, by the affirmative vote of at least 75% of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the affirmative vote of the majority of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class.

ARTICLE IX

AMENDMENT OF CERTIFICATE OF INCORPORATION

The Corporation reserves the right to amend or repeal this Certificate in the manner now or hereafter prescribed by statute and this Certificate, and all rights conferred upon stockholders herein are granted subject to this reservation. Whenever any vote of the holders of capital stock of the Corporation is required to amend or repeal any provision of this Certificate, and in addition to any other vote of holders of capital stock that is required by this Certificate or by law, such amendment or repeal shall require the affirmative vote of the majority of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of the majority of the outstanding shares of each class entitled to vote thereon as a class, at a duly constituted meeting of stockholders called expressly for such purpose; provided, however, that effective immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A), the affirmative vote of not less than 75% of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of not less than 75% of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of Article V, Article VI, Article VII, Article VIII or Article IX of this Certificate.

[End of Text]

THIS RESTATED CERTIFICATE OF INCORPORATION is executed as of this 12th day of May, 2015.

aTYR PHARMA, INC.

By: /s/ John D. Mendlein, Ph.D.
Name: John Mendlein, Ph.D.
Title: Chief Executive Officer and Executive Chairman

EXHIBIT A

A. PREFERRED STOCK.

1. **Dividends.** The holders of Preferred Stock shall be entitled to receive, on a *pari passu* and pro rata basis, from funds lawfully available therefor and subject to any preferential dividend rights of any then outstanding shares of any classes or series of the Corporation's Capital Securities that have been, or may hereafter be, authorized and issued having preferred dividend rights senior to or *pari passu* with the rights of holders of Preferred Stock, and prior and in preference to any dividends payable on shares of Common Stock (other than dividends payable in shares of Common Stock), dividends at the rate of eight percent (8%) of the Purchase Price for the applicable series of Preferred Stock per share per annum. All such dividends shall be non-cumulative and shall only be payable if, when and as declared by the Board of Directors. In addition to the foregoing, the holders of Preferred Stock shall participate in all dividends and other distributions (other than stock dividends in the nature of a stock split or the like, to the extent adjusted for elsewhere herein, and repurchases of securities by the Corporation from an employee or consultant of the Corporation at the lower of the original purchase price or the then-current fair market value thereof made pursuant to an agreement approved by the Board of Directors, including a majority of the then-sitting Preferred Directors) that are declared and paid on Common Stock on the same basis as if each share of Preferred Stock had been converted into the largest number of shares of Common Stock into which each share of Preferred Stock, as the case may be, may be converted pursuant to Section A.3 of Exhibit A on the record date established for the declaration of such dividends. The provisions of this Section A.1. of Exhibit A, including the rights, obligations and limitations set forth herein, may be waived by the affirmative vote or written consent of the Requisite Stockholders, which must include the Requisite D/E Preferred if such waiver would adversely affect the rights of the Series D Preferred Stock or the Series E Preferred Stock under this Section A.1. of Exhibit A.

2. Liquidation Preference.

(a) **Payments to Holders of Series E Preferred Stock and Series D Preferred Stock.** Upon (i) any liquidation, dissolution or winding up of the Corporation, whether voluntary or involuntary, or (ii) a Sale of the Corporation (each of the events referred to in clauses (i) and (ii) being referred to as a "**Liquidation Event**"), each holder of Series E Preferred Stock and Series D Preferred Stock shall be entitled, after provision for the payment of the Corporation's debts and other liabilities and in preference to, and, before any amount or property shall be paid or distributed to the holders of Series C Preferred Stock, Series B-2 Preferred Stock, Series B Preferred Stock, Series A Preferred Stock or Common Stock, to be paid in full, on a *pari passu* basis, out of the assets of the Corporation available for distribution to stockholders, with respect to each share of Series D Preferred Stock an amount equal to the greater of (iii) the Series D Liquidation Preference or (iv) such amount per share as would have been payable had all shares of Series D Preferred Stock been converted into Common Stock pursuant to Section A.3 immediately prior to such Liquidation Event (hereinafter referred to as the "**Series D Liquidation Amount**") and with respect to each share of Series E Preferred Stock an amount equal to the greater of (v) the Series E Liquidation Preference or (vi) such amount per share as would have been payable had all shares of Series E Preferred Stock been converted into

Common Stock pursuant to Section A.3 immediately prior to such Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series E Liquidation Amount**”). If upon any Liquidation Event the amount available for distribution to its stockholders shall be insufficient to permit the payment of the Series D Liquidation Amount for each share of Series D Preferred Stock and the Series E Liquidation Amount for each share of Series E Preferred Stock in full, then the amount available for distribution shall be distributed among the holders of the Series D Preferred Stock and the Series E Preferred Stock, *pro rata* in accordance with the amount that would be distributed to such holders if the amount available for distribution had been sufficient to pay the Series D Liquidation Amount and the Series E Liquidation Amount.

(b) Payments to Holders of Series C Preferred Stock and Series B-2 Preferred Stock . Upon any Liquidation Event, after the payment of all amounts pursuant to Section 2(a) above, each holder of Series C Preferred Stock and Series B-2 Preferred Stock shall be entitled, after provision for the payment of the Corporation’s debts and other liabilities and in preference to, and, before any amount or property shall be paid or distributed to the holders of Series B Preferred Stock or Series A Preferred Stock or Common Stock, to be paid in full, on a *pari passu* basis, out of the assets of the Corporation available for distribution to stockholders, with respect to each share of Series C Preferred Stock, an amount equal to the greater of (i) the Series C Liquidation Preference or (ii) such amount per share as would have been payable had all shares of Series C Preferred Stock been converted into Common Stock pursuant to Section A.3 immediately prior to such Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series C Liquidation Amount**”) and with respect to each share of Series B-2 Preferred Stock, an amount equal to the greater of (i) the Series B-2 Liquidation Preference or (ii) such amount per share as would have been payable had all shares of Series B-2 Preferred Stock been converted into Common Stock pursuant to Section A.3 immediately prior to such Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series B-2 Liquidation Amount**”). If upon any Liquidation Event the amount available for distribution to its stockholders shall be insufficient to permit the payment of the Series C Liquidation Amount for each share of Series C Preferred Stock and the Series B-2 Liquidation Amount for each share of Series B-2 Preferred Stock in full, then the amount available for distribution shall be distributed among the holders of the Series C Preferred Stock and Series B-2 Preferred Stock, *pro rata* in accordance with the amount that would be distributed to such holders if the amount available for distribution had been sufficient to pay the Series C Liquidation Amount and Series B-2 Liquidation Amount.

(c) Payments to Holders of Series B Preferred Stock and Series A Preferred Stock. Upon any Liquidation Event, after the payment of all amounts pursuant to Sections 2(a) and 2(b) above, each holder of Series B Preferred Stock and Series A Preferred Stock shall be entitled, after provision for the payment of the Corporation’s debts and other liabilities and in preference to, and, before any amount or property shall be paid or distributed to the holders of Common Stock, to be paid in full, on a *pari passu* basis, out of the assets of the Corporation available for distribution to stockholders, with respect to each share of Series B Preferred Stock, an amount equal to the greater of (i) the Series B Liquidation Preference or (ii) such amount per share as would have been payable had all shares of Series B Preferred Stock been converted into Common Stock pursuant to Section A.3 immediately prior to such Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the

“**Series B Liquidation Amount**”) and with respect to each share of Series A Preferred Stock, an amount equal to the greater of (i) the Series A Liquidation Preference or (ii) such amount per share as would have been payable had all shares of Series A Preferred Stock been converted into Common Stock pursuant to Section A.3 immediately prior to such Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series A Liquidation Amount**”). If upon any Liquidation Event the amount available for distribution to its stockholders shall be insufficient to permit the payment of the Series B Liquidation Amount for each share of Series B Preferred Stock and the Series A Liquidation Amount for each share of Series A Preferred Stock in full, then the amount available for distribution shall be distributed among the holders of the Series B Preferred Stock and Series A Preferred Stock, *pro rata* in accordance with the amount that would be distributed to such holders if the amount available for distribution had been sufficient to pay the Series B Liquidation Amount and Series A Liquidation Amount.

(d) Distribution of Remaining Assets. Upon any Liquidation Event, after the payment of all amounts pursuant to Sections 2(a), 2(b) and 2(c) above, the remaining net assets of the Corporation available for distribution to stockholders shall be distributed ratably among the holders of Common Stock.

(e) Consolidation, Merger, etc. Notwithstanding Section A.2(a), a Sale of the Corporation shall not be deemed to be a Liquidation Event for the purposes of this Section A.2 if the Requisite Stockholders, which must include (i) the holders of at least 75% of the outstanding shares of Series D Preferred Stock (voting separately as a single class) and (ii) the Requisite D/E Preferred, waive in writing the provisions of this Section A.2 with respect to such event.

(f) No Effect on Conversion Rights. The provisions of this Section A.2 shall not in any way limit the right of the holders of Preferred Stock to elect to convert their shares of Preferred Stock into shares of Common Stock in accordance with Section A.3.

(g) Valuation of Distribution Securities. Any securities or other consideration to be delivered to the holders of Preferred Stock upon any Liquidation Event in accordance with the terms hereof shall be valued as follows:

(i) If the consideration consists of cash or cash equivalents, then the value shall be computed at the aggregate amount of the cash or cash equivalents so delivered;

(ii) The per share value of securities traded on a national securities exchange or a nationally recognized interdealer quotation system shall be deemed to be the average of the closing prices of the securities on such exchange or system over the 20-day period ending three (3) Business Days prior to the closing of such Liquidation Event;

(iii) The per share value of securities traded over-the-counter shall be deemed to be the average of the closing bid and asked prices over the 30-day period ending three (3) Business Days prior to the closing of such Liquidation Event; and

(iv) For all other consideration, the value shall be the fair market value thereof as determined in good faith by the Board of Directors.

(v) In the event that the Requisite Stockholders dispute any valuation determined by the Board of Directors pursuant to Section A.2(g)(iv), such holders shall have the right to obtain an independent valuation of such property, security or other non-cash consideration from one nationally recognized investment bank, not affiliated with any holder of Preferred Stock, reasonably acceptable to the Corporation, and with substantial experience pertaining to such valuations, which valuation shall be binding. If the valuation determined by such bank is within 10% of the valuation determined by the Board of Directors, the holders of Preferred Stock requesting such valuation shall pay for the fees and expenses of such bank in making such valuation, otherwise the Corporation shall pay such fees and expenses.

(h) Merger Agreement. The Corporation shall not have the power to effect an Acquisition unless the agreement or plan of merger or consolidation for such transaction (the “**Merger Agreement**”) provides that the consideration payable to the stockholders of the Corporation shall be allocated among the holders of capital stock of the Corporation in accordance with Sections A.2(a)-A.2(d).

(i) In the event of a Sale of the Corporation, if the Corporation does not effect a dissolution of the Corporation under the General Corporation Law within 90 days after such Sale of the Corporation, then (i) the Corporation shall send a written notice to each holder of Preferred Stock no later than the 90th day after the Sale of the Corporation advising such holders of their right (and the requirements to be met to secure such right) pursuant to the terms of the following clause (ii) to require the redemption of such shares of Preferred Stock, and (ii) if the holders of a majority of the then outstanding shares of Preferred Stock so request in a written instrument delivered to the Corporation not later than 120 days after such Sale of the Corporation, the Corporation shall use the consideration received by the Corporation for such Sale of the Corporation (net of any retained liabilities associated with the assets sold or technology licensed, as determined in good faith by the Board of Directors), together with any other assets of the Corporation available for distribution to its stockholders, all to the extent permitted by Delaware law governing distributions to stockholders (the “**Available Proceeds**”), on the 150th day after such Sale of the Corporation, to redeem all outstanding shares of Preferred Stock at a price per share equal to the applicable Liquidation Amount. Notwithstanding the foregoing, in the event of a redemption pursuant to the preceding sentence, if the Available Proceeds are not sufficient to redeem all outstanding shares of Preferred Stock, the Corporation shall ratably redeem each holder’s shares of Preferred Stock to the fullest extent of such Available Proceeds, and shall redeem the remaining shares as soon as it may lawfully do so under Delaware law governing distributions to stockholders. The provisions of Section A.9 shall apply, with such necessary changes in the details thereof as are necessitated by the context, to the redemption of the Preferred Stock pursuant to this Section A.2(i). Prior to the distribution or redemption provided for in this Section A.2(i), the Corporation shall not expend or dissipate the consideration received for such Sale of the Corporation, except to discharge expenses incurred in connection with such Sale of the Corporation or in the ordinary course of business.

(j) Allocation of Escrow and Contingent Consideration. In the event of a Sale of the Corporation, if any portion of the consideration payable to the stockholders of the Corporation is

payable only upon satisfaction of contingencies (the “**Additional Consideration**”), the Merger Agreement shall provide that (a) the portion of such consideration that is not Additional Consideration (such portion, the “**Initial Consideration**”) shall be allocated among the holders of capital stock of the Corporation in accordance with Sections A.2(a)-A.2(d) as if the Initial Consideration were the only consideration payable in connection with such Sale of the Corporation and (b) any Additional Consideration which becomes payable to the stockholders of the Corporation upon satisfaction of such contingencies shall be allocated among the holders of capital stock of the Corporation in accordance with Sections A.2(a)-A.2(d) after taking into account the previous payment of the Initial Consideration as part of the same transaction. For the purposes of this Section A.2(j), consideration placed into escrow or retained as holdback to be available for satisfaction of indemnification or similar obligations in connection with such Sale of the Corporation shall be deemed to be Additional Consideration.

3. **Conversion into Common Stock.** The holders of Preferred Stock shall have the following conversion rights:

(a) **Voluntary Conversion.** At any time, each holder of shares of Preferred Stock shall be entitled, without the payment of any additional consideration, to cause all or any portion of the shares of Preferred Stock held by such holder to be converted into a number of shares of Common Stock determined as hereafter provided in this Section A.3(a), which shares shall upon the issuance thereof be fully paid and non-assessable. The number of shares of Common Stock issuable upon the conversion of each share of a series of Preferred Stock shall be equal to the quotient obtained by dividing (i) the applicable Purchase Price for such series of Preferred Stock by (ii) the applicable Conversion Price for such series of Preferred Stock, in each case as in effect at the time of conversion. As of the Effective Time, the “**Series A Conversion Price**” per share of the Series A Preferred Stock equals the Series A Purchase Price, the “**Series B Conversion Price**” per share of the Series B Preferred Stock equals the Series B Purchase Price, the “**Series B-2 Conversion Price**” per share of the Series B-2 Preferred Stock equals the Series B-2 Purchase Price, the “**Series C Conversion Price**” per share of the Series C Preferred Stock equals the Series C Purchase Price, the “**Series D Conversion Price**” per share of the Series D Preferred Stock equals the Series D Purchase Price, and the “**Series E Conversion Price**” per share of the Series E Preferred Stock equals the Series E Purchase Price, subject in each case to adjustment from time to time as hereinafter provided. Notwithstanding the foregoing, in the event, and only in the event, that shares of Series E Preferred Stock are converted into shares of Common Stock in connection with a Qualified Public Offering (as defined herein) consummated on or prior to March 1, 2016, the Series E Conversion Price shall be deemed to have been equal as of the Effective Time to \$1.362, subject to adjustment from time to time as hereinafter provided. For the avoidance of doubt, in the event of an adjustment to the Series E Conversion Price on or prior to March 1, 2016, and in the event that a Qualified Public Offering is consummated on or prior to March 1, 2016, such adjustment to the Series E Conversion Price shall be made after giving effect to the prior sentence (meaning that the adjustment shall be applied to the Series E Conversion Price of \$1.362 and not to the Conversion Price of \$1.119), including in the event that such adjustment preceded the Qualified Public Offering.

(b) **Automatic Conversion.** Each share of Preferred Stock shall automatically be converted, without the payment of any additional consideration, into the number of shares of Common Stock provided for in Section A.3(a) either (i) immediately upon consummation of the

Corporation's first underwritten Public Offering of Common Stock pursuant to an effective registration statement under the Securities Act (A) resulting in at least \$50,000,000 of gross proceeds to the Corporation, (B) reflecting a gross offering price per share of Common Stock to the public (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving Common Stock) of not less than 1.2 times the Series E Purchase Price (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving Common Stock), and (C) after giving effect to which the Common Stock is listed on a U.S. national securities exchange (a "**Qualified Public Offering**"), or (ii) upon the written request of the Requisite Stockholders, which must include the Requisite D/E Preferred (a "**Majority Conversion**"). For purposes of this Section A.3(b) only, the "Series E Purchase Price" shall mean (i) \$1.362 per share if the closing of such Qualified Public Offering occurs on or prior to March 1, 2016, or (ii) \$1.119 per share if the closing of such Qualified Public Offering occurs at any time after March 1, 2016 (in each case, as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving Common Stock).

(c) Procedure for Voluntary Conversion: Effective Date. Upon any election to convert any shares of Preferred Stock made in accordance with Section A.3(a), the holders of such shares of Preferred Stock making such election shall provide written notice of such conversion (a "**Voluntary Conversion Notice**") to the Corporation setting forth the number of shares of Preferred Stock each such holder elects to convert into Common Stock (the "**Elected Preferred Stock**"). On the date the Voluntary Conversion Notice is delivered to the Corporation, such shares of Elected Preferred Stock shall thereupon be converted, without further action, into the number of shares of Common Stock provided for in Section A.3(a), and such number of shares of Common Stock into which the Elected Preferred Stock is converted shall thereupon be deemed to have been issued to such holders of the Elected Preferred Stock. Such holders shall as soon as practicable thereafter surrender to the Corporation at the Corporation's principal executive office the certificate or certificates evidencing the Elected Preferred Stock, duly assigned or endorsed for transfer to the Corporation (or accompanied by duly executed stock powers relating thereto), or an Affidavit of Loss with respect thereto. Upon surrender of such certificates or delivery of an Affidavit of Loss with respect thereto, the Corporation shall issue and deliver to the holder so surrendering such certificates or to such holder's designee, at an address designated by such holder, certificates for the number of shares of Common Stock into which such holder's Elected Preferred Stock shall have been converted. The issuance of certificates for shares of Common Stock upon conversion of Elected Preferred Stock will be made without charge to the holders of such shares for any issuance tax in respect thereof or other costs incurred by the Corporation in connection with such conversion and the related issuance of such stock. Notwithstanding anything to the contrary set forth in this Section A.3(c), in the event that holders of shares of Preferred Stock elect to convert such shares pursuant to Section A.3(a) in connection with any Public Offering or other specified event, (i) such conversion may at the election of such holders be conditioned upon the consummation of such Public Offering or the occurrence of such other specified event, in which case, such conversion shall not be deemed to be effective until the consummation of such Public Offering or the occurrence of such other specified event and (ii) if such Public Offering or other specified

event is consummated or occurs, all shares of Elected Preferred Stock shall be deemed to have been converted into shares of Common Stock immediately prior thereto.

(d) Procedure for Automatic Conversion. As of the date of, and in all cases subject to, the consummation of a Qualified Public Offering or a Majority Conversion, all outstanding shares of Preferred Stock shall be converted automatically, without further action, into the number of shares of Common Stock provided for in Section A.3(a), and such number of shares of Common Stock into which such Preferred Stock is converted shall be deemed to have been issued to the holders of such Preferred Stock, as the case may be. Such holders shall, as soon as practicable thereafter, surrender the certificate or certificates evidencing the shares of Preferred Stock, as the case may be, duly assigned or endorsed for transfer to the Corporation (or accompanied by duly executed stock powers relating thereto) or an Affidavit of Loss with respect thereto. Upon surrender of such certificates or delivery of an Affidavit of Loss with respect thereto, the Corporation shall issue and deliver to such holder so surrendering such certificates or to such holder's designee, promptly (and in any event in such time as is sufficient to enable such holder to participate in such Qualified Public Offering or Majority Conversion, as applicable) at an address designated by such holder, certificates (or statements(s) of holdings if shares of Common Stock are held in book-entry form) for the number of shares of Common Stock into which such holder's Preferred Stock shall have been converted.

(e) Fractional Shares; Partial Conversion. No fractional shares shall be issued upon conversion of any shares of Preferred Stock. All shares of Common Stock (including fractions thereof) issuable upon conversion of shares of Preferred Stock by a holder thereof shall be aggregated for purposes of determining whether the conversion would result in the issuance of any fractional share. If any fractional interest in a share of Common Stock would, except for the provisions of the first sentence of this paragraph (e), be delivered upon any such conversion, the Corporation, in lieu of delivering the fractional share thereof, shall pay to the holder surrendering the shares of Preferred Stock for conversion an amount in cash equal to the current fair market value of such fractional interest as determined in good faith by the Board of Directors. In case the number of shares of Preferred Stock represented by the certificate or certificates surrendered at the time of conversion exceeds the number of shares to be converted, the Corporation shall, upon such conversion, execute and deliver to the holder thereof, at the expense of the Corporation, a new certificate or certificates for the number of shares of Preferred Stock represented by the certificate or certificates surrendered that are not to be converted.

4. Adjustments.

(a) Adjustments for Subdivisions, Combinations or Consolidation of Common Stock. In the event the outstanding shares of Common Stock shall be subdivided by stock split, stock dividends or otherwise, into a greater number of shares of Common Stock, the Conversion Price for each series of Preferred Stock then in effect shall, concurrently with the effectiveness of such subdivision, be proportionately decreased so that the number of shares of Common Stock issuable on conversion of any shares of Preferred Stock shall be increased in proportion to such increase in outstanding shares. In the event the outstanding shares of Common Stock shall be combined or consolidated, by reclassification or otherwise, into a lesser number of shares of Common Stock, the Conversion Price for each series of Preferred Stock then in effect shall, concurrently with the effectiveness of such combination or consolidation, be proportionately increased so that the number

of shares of Common Stock issuable on conversion of any shares of Preferred Stock shall be decreased in proportion to such decrease in outstanding shares.

(b) Adjustments for Reclassification, Exchange and Substitution. If the Common Stock issuable upon conversion of the Preferred Stock shall be changed into the same or a different number of shares of any other class or classes of stock or into any other securities or property, whether by capital reorganization, reclassification, merger, combination of shares, recapitalization, consolidation, business combination or other similar transaction (other than a subdivision, consolidation or combination of shares provided for above and other than a Liquidation Event which shall be governed by Section A.2), each share of Preferred Stock shall thereafter be convertible into the number of shares of stock or other securities or property to which a holder of the number of shares of Common Stock of the Corporation deliverable upon conversion of such share of Preferred Stock shall have been entitled upon such capital reorganization, reclassification, merger, combination of shares, recapitalization, consolidation, business combination or other similar transaction if immediately prior to such capital reorganization, reclassification, merger, combination of shares, recapitalization, consolidation, business combination or other similar transaction such holder had converted such holder's Preferred Stock into Common Stock. The provisions of this Section A.4(b) shall similarly apply to outstanding shares of Preferred Stock at the time of any successive capital reorganizations, reclassifications, mergers, combinations of shares, recapitalizations, consolidations, business combinations or other similar transactions. The Corporation shall not effect any Sale of the Corporation that is not, in accordance with Section A.2(b), a Liquidation Event unless prior to or simultaneously with the consummation thereof the successor corporation or purchaser, as the case may be, shall assume by written instrument the obligation to deliver to the holders of Preferred Stock, securities or assets as, in accordance with the foregoing provisions, each such holder is entitled to receive.

(c) Adjustment of the Conversion Price Upon Issuance of Additional Shares of Common Stock. In the event the Corporation shall on or at any time following the Effective Time issue or sell, or in accordance with Section A.4(e) is deemed to have issued or sold, any shares of Common Stock or Convertible Securities without consideration or for a consideration per share of Common Stock less than the applicable Conversion Price for any series of Preferred Stock in effect immediately prior to such issue or sale, then and in such event, such applicable Conversion Price shall be reduced, concurrently with such issue or sale, to a price (calculated to the nearest whole cent) determined by the following formula:

$$P = \frac{P1Q1 + P2Q2}{Q1 + Q2}$$

Where:

P	=	the applicable Conversion Price for such series of Preferred Stock in effect immediately following and after giving effect to such issue or sale
P1	=	the applicable Conversion Price for such series of Preferred Stock in effect immediately prior to such issue or sale
Q1	=	the number of shares of Common Stock Deemed Outstanding immediately prior to such issue or sale
P2	=	the consideration per share, if any, received or receivable by the Corporation on account of such issue or sale
Q2	=	the number of shares of Common Stock so issued or sold or, in accordance with Section A.4(e), deemed to have been issued or sold

(d) Multiple Closing Dates. In the event the Corporation shall issue on more than one date additional shares of Common Stock or Convertible Securities as part of one transaction or a series of related transactions, and such issuance dates occur within a period of no more than 60 days, then, upon the final such issuance (or at the time of any conversion, if earlier), the applicable Conversion Price for each series of Preferred Stock shall be readjusted to give effect to all such issuances as if they occurred on the date of the final such issuance (and without giving effect to any adjustments as a result of such prior issuances within such period).

(e) Effect of Certain Events on Conversion Prices. For purposes of determining the adjusted Conversion Price with respect to any series of Preferred Stock under Section A.4(c), the following shall be applicable:

(i) Issuance of Convertible Securities.

(A) If the Corporation in any manner grants, issues or sells any Convertible Securities, whether or not the rights to exercise, convert or exchange any such Convertible Securities are immediately exercisable, and the price per share for which Common Stock is issuable upon such exercise, conversion or exchange is less than any Conversion Price in effect immediately prior to the time of such grant, issue or sale, then the maximum number of shares of Common Stock issuable upon the exercise, conversion or exchange of such Convertible Securities shall be deemed to be outstanding and to have been issued and sold by the Corporation at the time of the grant, issue or sale of such Convertible Securities for such price per share.

(B) For the purposes of this paragraph, the “price per share for which Common Stock is issuable” in connection with the issuance of Convertible Securities shall be determined by dividing (x) the total amount received or receivable by the Corporation as consideration for the grant, issue or sale of such Convertible Securities, plus the cumulative minimum aggregate amount of additional consideration, if any, payable to the Corporation upon the exercise, conversion or exchange thereof and, if applicable, the exercise, conversion and exchange of any other Convertible Securities that such Convertible Securities may be converted into

or exercised or exchanged for (in each case, as set forth in the instruments and agreements relating thereto, without regard to any provision contained therein for a subsequent adjustment of such consideration), by (y) the total maximum number of shares of Common Stock issuable upon the exercise, conversion or exchange of all such Convertible Securities (as set forth in the instruments

and agreements relating thereto, without regard to any provision contained therein for a subsequent adjustment of such number). No further adjustment of any Conversion Price shall be made when Common Stock and, if applicable, any other Convertible Securities, are actually issued upon the exercise, conversion or exchange of such Convertible Securities.

(C) If the Corporation issues any Convertible Securities that entitle the holder thereof, *inter alia*, both (i) to exercise, convert or exchange the same into or for Common Stock or otherwise to participate with the holders of Common Stock in distributions upon the occurrence of a Liquidation Event and (ii) in connection with or following such exercise, conversion or exchange, to receive payment of a fixed or defined sum (such securities being referred to herein as “**Qualified Convertible Securities**” and such fixed or defined sum being referred to as the “**Preference Payment**”), the “total maximum number of shares of Common Stock issuable upon the exercise, conversion or exchange of all such Convertible Securities” for purposes of clause (y) of Section A.4(e)(i)(B) above shall include, in addition to the total maximum number of shares of Common Stock issuable upon the exercise, conversion or exchange of all such Convertible Securities, a number of shares of Common Stock equal to the quotient of (A) the aggregate Preference Payments of all such Qualified Convertible Securities so issued, divided by (B) the total amount received or receivable by the Corporation as consideration for the issue of one of such Qualified Convertible Securities (as set forth in the instruments and agreements relating thereto).

(ii) Change in Exercise Price or Conversion Rate. If the additional consideration payable to the Corporation upon the exercise, conversion or exchange of any Convertible Securities, or the rate at which any Convertible Securities are convertible into or exchangeable for Common Stock should change at any time, each Conversion Price that is in effect at the time of such change that was adjusted in accordance with Section A.4(e)(i) upon the issuance of such Convertible Securities shall be readjusted to the Conversion Price that would have been in effect at such time had such Convertible Securities that are still outstanding provided for such changed additional consideration or changed conversion rate, as the case may be, at the time such Convertible Securities were initially granted, issued or sold; and on the termination date of any right to exercise, convert or exchange such Convertible Securities without such right having been exercised, each Conversion Price then in effect hereunder shall be adjusted to the Conversion Price that would have been in effect at the time of such termination had such Convertible Securities, to the extent outstanding immediately prior to such termination, never been issued.

(iii) Exceptions for Excluded Securities. Notwithstanding the foregoing, no adjustments shall be made under Sections A.4(c), (d) and/or (e) with respect to the issue, grant or sale of any Excluded Securities.

(iv) Valuation of Non-Cash Consideration. The consideration received by the Corporation for the issue of any shares of Common Stock, Convertible Securities or any other

Convertible Securities that such Convertible Securities may be converted into or exercised or exchanged for shall be computed in accordance with Section A.2(g).

(f) Other Dilutive Issuances. If an event not specified in this Section A.4 (other than the issuance of Excluded Securities) occurs that has substantially the same economic effect on any series of Preferred Stock as those events specifically enumerated above in this Section A.4, then this Section A.4 shall be construed liberally, *mutatis mutandis*, in order to provide the holders of such series of Preferred Stock the intended benefit of the protections provided under this Section A.4. In such event, the Board of Directors shall make an appropriate adjustment in each applicable Conversion Price so as to protect the rights of the holders of such series of Preferred Stock; *provided* that no such adjustment (other than in accordance with an event in the nature of a combination or consolidation of the Common Stock) shall increase the applicable Conversion Price above the applicable Purchase Price for such series of Preferred Stock as otherwise determined pursuant to this Section A.4 or decrease the number of shares of Common Stock issuable upon conversion of each share of Preferred Stock as otherwise determined in accordance with this Section A.4.

(g) No Impairment. The Corporation will not, by amendment of this Certificate of Incorporation or through any reorganization, transfer of assets, consolidation, merger, dissolution, issue or sale of securities or any other voluntary action, avoid or seek to avoid the observance or performance of any of the terms to be observed or performed hereunder by the Corporation, and will at all times in good faith assist in the carrying out of all the provisions of this Section B.4 and in the taking of all such action as may be necessary or appropriate in order to protect the conversion rights of the holders of Preferred Stock hereunder against impairment by the Corporation or any successor entities. Notwithstanding the foregoing, nothing in this Section A.4(g) shall prohibit the Corporation from amending this Certificate of Incorporation with the requisite consent of its stockholders in accordance with Section B.4 and the approval of the Board.

(h) Certificate as to Adjustments. Upon the occurrence of each adjustment or readjustment of any Conversion Price pursuant to this Section A.4, the Corporation at its expense shall promptly compute such adjustment or readjustment in accordance with the terms hereof and furnish to each holder of Preferred Stock a certificate setting forth such adjustment or readjustment and showing in detail the facts upon which such adjustment or readjustment is based and the applicable Conversion Price then in effect. The Corporation shall, upon the written request at any time by any holder of Preferred Stock, furnish or cause to be furnished to such holder a like certificate setting forth (i) such adjustments and readjustments, (ii) the Conversion Price at the time in effect, and (iii) the number of shares of Common Stock and the amount, if any, of other property that at the time would be received upon the conversion of such holder's Preferred Stock.

(i) Rounding. All calculations under this Section A.4 shall be made to (i) the nearest one cent or (ii) the nearest share, as the case may be. All calculations of percentages, if any, shall be carried to three decimal points but shall not be rounded up or down.

(j) Limitations on Adjustments. Anything herein to the contrary notwithstanding, no adjustment in the Conversion Price of any series of Preferred Stock shall be required unless such adjustment, either by itself or with other adjustments not previously made, would require a change of at least \$0.0001 in such Conversion Price; provided, however, that any adjustment which by

reason of this paragraph (j) is not required to be made shall be carried forward and taken into account in any subsequent adjustment or immediately prior to any conversion.

5. **Reservation of Stock Issuable Upon Conversion.** The Corporation shall at all times

reserve and keep available out of its authorized but unissued shares of Common Stock, solely for the purpose of effecting the conversion of the issued or issuable shares of Preferred Stock, such number of its shares of Common Stock, as the case may be, as shall from time to time be sufficient to effect the conversion of all outstanding shares of Preferred Stock, and if at any time the number of authorized but unissued shares of Common Stock shall not be sufficient to effect the conversion of all then outstanding shares of Preferred Stock, the Corporation will take all such corporate action as may be necessary to increase its authorized but unissued shares of Common Stock to such number of shares as shall be sufficient for such purpose.

6. **No Closing of Transfer Books.** The Corporation shall not close its books against the transfer of shares of Preferred Stock in any manner that would interfere with the timely conversion of any shares of Preferred Stock in accordance with the provisions hereof.

7. **Notice.**

(a) **Liquidation Events, Extraordinary Transactions, Etc.** In the event (i) the Corporation establishes a record date to determine the holders of any class of securities who are entitled to receive any dividend or other distribution or who are entitled to vote at a meeting (or by written consent) in connection with any Liquidation Event or (ii) any Liquidation Event is approved by the Board of Directors or the Corporation enters into any agreement with respect thereto, the Corporation shall mail or cause to be mailed by first class mail (postage prepaid) to each holder of Preferred Stock at least ten (10) days prior to such record date specified therein or the expected effective date of any such transaction, a notice specifying (A) such record date for the purpose of such dividend or distribution or meeting or consent and a description of such dividend or distribution or the action to be taken at such meeting or by such consent, (B) the date on which any such Liquidation Event is expected to become effective and, in the case of a Sale of the Corporation, the identity of the parties thereto, and (C) the date on which the books of the Corporation shall close or a record shall be taken with respect to any such event.

(b) **Waiver of Notice.** The Requisite Stockholders, which must include the Requisite D/E Preferred, may, at any time upon written notice to the Corporation, waive, either prospectively or retrospectively, any notice provisions specified herein, and any such waiver shall be effective as to all holders of Preferred Stock.

(c) **General.** In the event that the Corporation provides any notice, report or statement to holders of Common Stock, the Corporation shall at the same time provide a copy of any such notice, report or statement to each holder of outstanding Preferred Stock.

8. **No Reissuance of Preferred Stock.** No share or shares of Preferred Stock acquired by the Corporation by reason of redemption, purchase, conversion or otherwise shall be reissued, and all such shares shall be canceled, retired and eliminated from the shares that the Corporation shall be authorized to issue.

9. Redemption.

(a) The Preferred Stock may be redeemed, in whole or in part, at the option of the holders of such Preferred Stock pursuant to redemption proceedings which must first be initiated by the Requisite Stockholders, which must include the Requisite D/E Preferred, at any time on or after the fifth anniversary of the Effective Time. In any such case, the Requisite Stockholders, which must include the Requisite D/E Preferred, shall notify the Corporation in writing (the “**Redemption Notice**”) of their election to exercise the rights afforded by this Section A.9 (including as to any shares of Series A Preferred Stock or Series B Preferred Stock held by any such holders). Upon receipt of the Redemption Notice, the Corporation shall promptly notify the remaining holders of the Preferred Stock thereof. Any holder of Preferred Stock that did not deliver the Redemption Notice may, at such holder’s option, then submit to the Corporation, within thirty (30) days following receipt of the notice from the Corporation, notice of intent and election to seek redemption of all or any part of their Preferred Stock (the “**Secondary Redemption Notice**”) and such Secondary Redemption Notice shall be deemed to have been delivered on the same date that the Redemption Notice was delivered. The redemption price for each share of Preferred Stock shall be cash in an amount equal to the applicable Liquidation Preference for such series of Preferred Stock (the “**Redemption Price**”). The Redemption Price shall be payable by the Corporation to holders of the Preferred Stock in three equal annual installments the first such installment being due no later than the ninetieth (90th) day following the receipt of the Redemption Notice and on the anniversary of such first installment thereafter.

(b) If the funds of the Corporation legally available for redemption of its shares are insufficient to redeem the total number of outstanding shares of Preferred Stock for which redemption was elected, then the funds available for redemption shall be used to redeem the Preferred Stock as follows: (i) first, the holders of shares of Series E Preferred Stock and Series D Preferred Stock for which redemption was elected shall share ratably in any funds legally therefor according to the respective amounts that would be payable with respect to the full number of shares of Series E Preferred Stock and Series D Preferred Stock owned by them if all such outstanding shares were redeemed in full; (ii) second, the holders of shares of Series C Preferred Stock and Series B-2 Preferred Stock for which redemption was elected shall share ratably in any funds legally therefor according to the respective amounts that would be payable with respect to the full number of shares of Series C Preferred Stock and Series B-2 Preferred Stock owned by them if all such outstanding shares were redeemed in full; and (iii) the holders of shares of Series B Preferred Stock and Series A Preferred Stock for which redemption was elected shall share ratably in any funds legally therefor according to the respective amounts that would be payable with respect to the full number of shares of Series B Preferred Stock and Series A Preferred Stock owned by them if all such outstanding shares were redeemed in full. At any time thereafter when additional funds of the Corporation are legally available for the redemption of such shares of Preferred Stock, such funds will be used at the earliest permissible time to redeem the balance of such shares, or such portion thereof for which funds are then legally available. For the avoidance of doubt, in no event shall any shares of Series C Preferred Stock or Series B-2 Preferred Stock be redeemed prior to redemption of all of the shares of Series E Preferred Stock and Series D Preferred Stock which the holders of such shares of Series E Preferred Stock and Series D Preferred Stock, respectively, have elected to redeem pursuant to Section A.9(a). The Corporation shall be obligated to use its best efforts to take such actions as may be necessary (including, without limitation, the issuance of additional equity securities, the revaluation or recapitalization of the Corporation or the consummation of Sale of the

Corporation in order to permit the full and timely redemption of the shares of Preferred Stock for which redemption was elected).

(c) Until the holders of shares of Preferred Stock have received in cash payment in full of all amounts provided in this Section A.9, any such shares of Preferred Stock shall not be considered redeemed. Such unredeemed shares shall remain outstanding and shall continue to have all rights and preferences (including, without limitation, dividend, conversion and voting rights) provided for herein; *provided, however*, that the holders of such unredeemed shares shall have the ongoing right to be redeemed, together with such rights and remedies as may be available under applicable law, at each such holder's election either (i) to have such holder's remaining outstanding shares of Preferred Stock redeemed, or (ii) rescind the Redemption Notice with respect to all or any portion of such unredeemed shares and to continue holding such shares, free of any right of the Corporation to redeem such shares

(d) The notices provided for in this Section A.9 shall be sent, if by or on behalf of the Corporation, to the holders of the Preferred Stock at their respective addresses as shall then appear on the records of the Corporation, or if by any holder of Preferred Stock to the Corporation, at its principal executive office or registered office in Delaware, by first class mail, postage prepaid, and (i) in the case of a Redemption Notice or Secondary Redemption Notice, shall contain the number of shares of Preferred Stock to be redeemed, and (ii) in the case of any notice by or on behalf of the Corporation, stating the place or places and time at which the shares called for redemption shall, upon presentation and surrender of such certificates representing such shares, be redeemed and the redemption price therefor.

B. VOTING; ELECTION OF DIRECTORS; EXIT TRANSACTION.

1. **Voting Generally.** Except as expressly set forth herein, the holder of each share of Preferred Stock shall vote with holders of Common Stock, voting together as a single class on an as-converted basis, upon all matters submitted to a vote of stockholders. For such purpose, each holder of any share of a series of Preferred Stock shall be entitled to the number of votes per share of such series of Preferred Stock as equals the largest number of shares of Common Stock into which each share of such series of Preferred Stock may be converted pursuant to Section A.3 on the record date fixed for the determination of stockholders entitled to vote or on the effective date of any written consent of stockholders, as applicable. In determining the number of shares into which shares of any series of Preferred Stock may be converted for purposes of the preceding sentence, the applicable Conversion Price shall be deemed to be the applicable Purchase Price of such series of Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving Common Stock), rather than any imputed Conversion Price to be determined in the event of a Qualified Public Offering (as defined herein) consummated on or prior to March 1, 2016. Fractional votes shall not, however, be permitted and any fractional voting rights resulting from the above formula with respect to any holder of Preferred Stock shall be rounded to the nearest whole number (with one-half rounded upward to one). Notwithstanding Section 228(a) of the DGCL and except as otherwise provided herein, no action that is required by the DGCL to be taken by stockholders at any annual or special meeting of stockholders of the Corporation or that may be taken by stockholders at any annual or special meeting of stockholders of the Corporation may be taken

without a meeting, without prior notice and without a vote unless a consent or consents in writing setting forth the action so taken shall be signed by the Requisite Stockholders which must include the Requisite D/E Preferred if such consent or consents would adversely affect the rights of the Series D Preferred Stock or the Series E Preferred Stock under this Section B.1. of Exhibit A. There shall be no cumulative voting.

2. **Board of Directors.** The Corporation's board of directors (the "**Board**" or the "**Board of Directors**") shall be elected as follows:

(a) two directors of the Corporation shall be elected by the holders of Common Stock, voting separately as a single class for such purpose;

(b) one director of the Corporation shall be elected by the holders of the Series A Preferred Stock, voting separately as a single class for such purpose (such director being referred to as the "**Series A Director**");

(c) two directors of the Corporation shall be elected by the holders of the Series B-2 Preferred Stock, voting separately as a single class for such purpose (such directors being referred to as the "**Series B-2 Directors**");

(d) one director of the Corporation shall be elected by the holders of the Series C Preferred Stock, voting separately as a single class for such purpose (such director being referred to as the "**Series C Director**");

(d) two directors of the Corporation shall be elected by the holders of the Series E Preferred Stock, voting separately as a single class for such purpose (such directors being referred to as the "**Series E Directors**"); and

(e) one director of the Corporation shall be elected by the holders of the Preferred Stock and Common Stock, voting together as a single class, on an as-converted basis for such purpose.

3. **Election of Directors.** The election of any director as provided in Section B.2 above by the holders of the shares of the class or series of Capital Stock entitled to elect such director or directors shall occur (i) at the annual meeting of stockholders, (ii) at any special meeting of stockholders, (iii) at any special meeting of holders of the shares of the class or series of Capital Stock entitled to elect such director or directors called by the holders of not less than a majority of such class or series then outstanding or (iv) by the written consent of holders of not less than a majority of the shares of the class or series of Capital Stock entitled to elect such director or directors then outstanding. Any director elected as provided in Section B.2 may be removed at any time with or without cause by and only by the requisite vote or written consent of the holders of the shares of the class or series of Capital Stock entitled to elect such director or directors, and any vacancy occurring by reason of such removal or by reason of the death, resignation or inability to serve of any such director, shall be filled by and only by a vote or written consent of the holders of the shares of the class or series of Capital Stock entitled to elect such director or directors. Any director so elected shall serve until such director's successor is duly elected and qualified, or such director's earlier death, resignation or removal by the holders of the shares of the class or series of Capital Stock entitled to elect such director or directors.

4. Special Approval Rights.

(a) Approval Rights of the Requisite Holders. So long as any shares of Preferred Stock remain outstanding, the affirmative vote or consent of the Requisite Stockholders shall be necessary to authorize the Corporation to take any of the following actions, either directly or indirectly, whether by merger, consolidation, or otherwise (together with those actions set forth in Sections B.4(b), (c) and (d) below, the “**Restricted Actions**”), and any such action taken or transaction entered into without such consent or vote shall be null and void *ab initio*:

(i) Amend, repeal or change, directly or indirectly, any of the provisions of the Certificate of Incorporation, or the Bylaws of the Corporation in any manner that would adversely alter, change or affect the powers, preferences or special rights of the shares of any series of Preferred Stock including, without limitation, increasing the aggregate authorized number of shares of any series of Preferred Stock or altering the rights and preferences of any series of Preferred Stock; or

(ii) Authorize, or increase the authorized number of shares of, or issue additional shares of any series of Preferred Stock, or any class or series of the Corporation’s capital stock or options, warrants or other rights to acquire any such capital stock ranking with respect to liquidation preference, dividends or redemption rights, senior to, or *pari passu* with, any series of Preferred Stock.

(iii) Authorize or effect a Sale of the Corporation or other change of control, liquidation, merger, re-incorporation, recapitalization of the Corporation, or sale or other transfer of all or substantially all of the Corporation’s assets other than in the ordinary course of business;

(iv) Authorize or effect or permit, any acquisition of the capital stock of another entity, which results in the consolidation of that entity into the results of operations of the Corporation or acquisition of all or substantially all of the assets of another entity;

(v) Authorize or effect the creation of any indebtedness for borrowed money, in a single or related series of transactions, in an amount in excess of \$5,000,000, unless approved by the Board, including a majority of the then-sitting Preferred Directors;

(vi) Authorize or effect the creation of a new plan or arrangement for the grant of stock options or the issuance of restricted stock or increase the number of shares available under such a plan or arrangement, unless approved by the Board, including a majority of the then-sitting Preferred Directors;

(vii) Authorize or effect an increase in the number of directors;

(viii) Authorize or effect the payment or declaration any dividend or distribution on any shares of the Corporation’s Capital Stock (except dividends payable solely in shares of common stock), or apply of any of the Corporation’s assets to the redemption or repurchase of the Corporation’s Capital Stock (except as contemplated herein); or

(ix) Create, or hold capital stock in, any Subsidiary (excluding any Subsidiary existing as of the Effective Time) that is not wholly owned (either directly or through one or more other Subsidiaries) by the Corporation, or sell, transfer or otherwise dispose of any capital stock of any direct or indirect Subsidiary of the Corporation unless approved by the Board, including a majority of the then-sitting Preferred Directors, or permit any direct or indirect Subsidiary to sell, lease, transfer, exclusively license or otherwise dispose (in a single transaction or series of related transactions) of all or substantially all of the assets of such Subsidiary, unless approved by the Board, including a majority of the then-sitting Preferred Directors.

(b) Approval Rights of the Series D Preferred Stock. So long as any shares of Series D Preferred Stock remain outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of a majority of the then outstanding shares of Series D Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) separately as a class, and any such act or transaction entered into without such consent or vote shall be null and void *ab initio*, and of no force or effect:

(i) Amend, alter or repeal any provision of the Certificate of Incorporation or Bylaws of the Corporation in a manner that alters the powers, preferences or rights of the Series D Preferred Stock; provided, however, that the authorization and/or creation of a new series of Preferred Stock which is junior to, *pari passu* with, or senior to, the Series D Preferred Stock shall not in and of itself be deemed to adversely affect the powers, preferences or rights of the Series D Preferred Stock;

(ii) Increase or decrease the authorized number of shares of Series D Preferred Stock;

(iii) (A) Reclassify, alter or amend any existing security of the Corporation that is *pari passu* with the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series D Preferred Stock in respect of any such right, preference or privilege, or (B) reclassify, alter or amend any existing security of the Corporation that is junior to the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or *pari passu* with the Series D Preferred Stock in respect of any such right, preference or privilege;

(iv) Purchase or redeem (or permit any Subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock, and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any Subsidiary in connection with the cessation of such employment or service at

the lower of the original purchase price or the then-current fair market value thereof; or

(v) Consummate any merger or other transaction with a Subsidiary, other than pursuant to the terms of a transaction between a Subsidiary and the Corporation whereby the Corporation's stockholders immediately prior to such transaction continue to hold Capital Securities in the same proportion and having the same economic rights, privileges and preferences immediately following such transaction, if such transaction would, directly or indirectly, have the impact of adversely affecting the rights, preferences and privileges of the Series D Preferred Stock set forth in the Certificate of Incorporation or would result in any shares of Series D Preferred Stock outstanding immediately prior to such transaction not being outstanding immediately following such transaction.

(c) Approval Rights of the Series E Preferred Stock. So long as any shares of Series E Preferred Stock remain outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of a majority of the then outstanding shares of Series E Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) separately as a class, and any such act or transaction entered into without such consent or vote shall be null and void *ab initio*, and of no force or effect:

(i) Amend, alter or repeal any provision of the Certificate of Incorporation or Bylaws of the Corporation in a manner that alters the powers, preferences or rights of the Series E Preferred Stock; provided, however, that the authorization and/or creation of a new series of Preferred Stock which is junior to or *pari passu* with the Series E Preferred Stock shall not in and of itself be deemed to adversely affect the powers, preferences or rights of the Series E Preferred Stock;

(ii) Increase or decrease the authorized number of shares of Series E Preferred Stock;

(iii) (A) Reclassify, alter or amend any existing security of the Corporation that is *pari passu* with the Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series E Preferred Stock in respect of any such right, preference or privilege, or (B) reclassify, alter or amend any existing security of the Corporation that is junior to the Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or *pari passu* with the Series E Preferred Stock in respect of any such right, preference or privilege; or

(iv) Purchase or redeem (or permit any Subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock

solely in the form of additional shares of Common Stock, and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any Subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof.

(d) Approval Rights of the Requisite D/E Preferred. So long as any shares of Series D Preferred Stock or Series E Preferred Stock remain outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the Requisite D/E Preferred, given in writing or by vote at a meeting, consenting or voting (as the case may be) separately as a class, and any such act or transaction entered into without such consent or vote shall be null and void *ab initio*, and of no force or effect:

(i) Authorize or effect a Sale of the Corporation or other change of control, liquidation, merger, re-incorporation, recapitalization of the Corporation, or sale or other transfer of all or substantially all of the Corporation's assets other than in the ordinary course of business, unless such Sale of the Corporation or other such event results in Initial Consideration payable at the closing of such transaction to the holders of Series E Preferred Stock and the holders of Series D Preferred Stock of an amount per share (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving Common Stock) which is equal to or more than (A) two times the Series D Purchase Price, in the case of the Series D Preferred Stock, and (B) two times the Series E Purchase Price, in the case of the Series E Preferred Stock;

(ii) Create, or authorize the creation of, any additional class or series of capital stock that ranks senior to the Series D Preferred Stock or the Series E Preferred Stock with respect to the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption;

(iii) (A) Reclassify, alter or amend any existing security of the Corporation that is *pari passu* with the Series E Preferred Stock or the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series E Preferred Stock or the Series D Preferred Stock in respect of any such right, preference or privilege, or (B) reclassify, alter or amend any existing security of the Corporation that is junior to the Series E Preferred Stock or the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or *pari passu* with the Series E Preferred Stock or the Series D Preferred Stock in respect of any such right, preference or privilege.

(e) Approval.

(i) The approval rights of the holders of shares of Preferred Stock to authorize the Corporation to take any Restricted Action as provided in Section B.4(a) may be

exercised at any annual meeting of stockholders, at a special meeting of the holders of Preferred Stock held for such purpose or by written consent of such holders. At each meeting of stockholders at which the holders of shares of Preferred Stock shall have the right, voting together as a single class, to authorize the Corporation to take any Restricted Action as provided in Section B.4(a), the presence in person or by proxy of the Requisite Stockholders shall be necessary and sufficient to constitute a quorum. At any such meeting or at any adjournment thereof, in the absence of a quorum of the holders of shares of Preferred Stock, a majority of the holders of such shares present in person or by proxy shall have the power to adjourn the meeting as to the actions to be taken by the holders of shares of Preferred Stock from time to time and place to place without notice other than announcement at the meeting until a quorum shall be present.

(ii) The approval rights of the holders of shares of Series D Preferred Stock to authorize the Corporation to take any Restricted Action as provided in Section B.4(b) may be exercised at any annual meeting of stockholders, at a special meeting of the holders of Preferred Stock held for such purpose or by written consent of such holders. At each meeting of stockholders at which the holders of shares of Series D Preferred Stock shall have the right, voting together as a single class, to authorize the Corporation to take any Restricted Action as provided in Section B.4(b), the presence in person or by proxy of such holders shall be necessary and sufficient to constitute a quorum. At any such meeting or at any adjournment thereof, in the absence of a quorum of the holders of shares of Series D Preferred Stock, a majority of the holders of such shares present in person or by proxy shall have the power to adjourn the meeting as to the actions to be taken by the holders of shares of Series D Preferred Stock from time to time and place to place without notice other than announcement at the meeting until a quorum shall be present.

(iii) The approval rights of the holders of shares of Series E Preferred Stock to authorize the Corporation to take any Restricted Action as provided in Section B.4(c) may be exercised at any annual meeting of stockholders, at a special meeting of the holders of Preferred Stock held for such purpose or by written consent of such holders. At each meeting of stockholders at which the holders of shares of Series E Preferred Stock shall have the right, voting together as a single class, to authorize the Corporation to take any Restricted Action as provided in Section B.4(c), the presence in person or by proxy of such holders shall be necessary and sufficient to constitute a quorum. At any such meeting or at any adjournment thereof, in the absence of a quorum of the holders of shares of Series E Preferred Stock, a majority of the holders of such shares present in person or by proxy shall have the power to adjourn the meeting as to the actions to be taken by the holders of shares of Series E Preferred Stock from time to time and place to place without notice other than announcement at the meeting until a quorum shall be present.

(iv) The approval rights of the Requisite D/E Preferred to authorize the Corporation to take any Restricted Action as provided in Section B.4(d) may be exercised at any annual meeting of stockholders, at a special meeting of the holders of Preferred Stock held for such purpose or by written consent of such holders. At each meeting of stockholders at which the holders of shares of Series D Preferred Stock or Series E Preferred Stock shall have the right, voting together as a single class, to authorize the Corporation to take any Restricted Action as provided in Section B.4(d), the presence in person or by proxy of such holders shall be necessary and sufficient

to constitute a quorum. At any such meeting or at any adjournment thereof, in the absence of a quorum of the holders of shares of Series D Preferred Stock or Series E Preferred Stock, a majority of the holders of such shares present in person or by proxy shall have the power to adjourn the meeting as to the actions to be taken by the holders of shares of Series D Preferred Stock and Series E Preferred Stock from time to time and place to place without notice other than announcement at the meeting until a quorum shall be present.

5. **Renunciation of Corporate Opportunities.** Pursuant to Section 122(17) of the DGCL, the Corporation hereby renounces any interest or expectancy of the Corporation in, or in being offered an opportunity to participate in, any and all business opportunities that are presented to the holders of Preferred Stock, their Affiliates, the Series A Director, Series B-2 Directors, Series C Director or the Series E Directors (collectively, the “**Preferred Investor Parties**”) at any time that a Series A Director, Series B-2 Director, Series C Director or Series E Directors sits on the Board or that such holders hold any Capital Securities of the Corporation. Without limiting the foregoing renunciation, the Corporation acknowledges that the Preferred Investor Parties are in the business of making investments in, and have investments in, other businesses similar to and that may compete with the Corporation’s businesses (“**Competing Businesses**”), and agrees that the Corporation shall have no right to limit or restrict any of the Preferred Investor Parties from making additional investments in or having relationships with other Competing Businesses independent of their investments in the Corporation. By virtue of a Preferred Investor Party holding Capital Securities of the Corporation or by having persons designated by or affiliated with such Preferred Investor Party serving on or observing at meetings of the Board of Directors or otherwise, no Preferred Investor Party shall have any obligation to the Corporation, any of its Subsidiaries or any other holder of Capital Securities of the Corporation to refrain from competing with the Corporation and any of its Subsidiaries, making investments in or having relationships with Competing Businesses, or otherwise engaging in any commercial activity; and none of the Corporation, any of its Subsidiaries or any other holder of Capital Securities shall have any right with respect to any such investments or activities undertaken by such Preferred Investor Party. Without limitation of the foregoing, each Preferred Investor Party may engage in or possess any interest in other business ventures of any nature or description, independently or with others, similar or dissimilar to the business of the Corporation or any of its Subsidiaries, and none of the Corporation, any of its Subsidiaries or any other holder of Capital Securities of the Corporation shall in such capacity have any rights or expectancy by virtue of such Preferred Investor Party’s relationships with the Corporation, or otherwise in and to such independent ventures or the income or profits derived therefrom; and the pursuit of any such venture, even if such investment is in a Competing Business shall not be deemed wrongful or improper. No Preferred Investor Party shall be obligated to present any particular investment opportunity to the Corporation or any of its Subsidiaries even if such opportunity is of a character that, if presented to the Corporation or such Subsidiary, could be taken by the Corporation or such Subsidiary, and the Preferred Investor Party shall continue to have the right to take for its own respective account or to recommend to others any such particular investment opportunity. The provisions of this Section B.5 shall in no way limit or eliminate any Preferred Investor Party’s duties, responsibilities and obligations with respect to the protection of any proprietary information of the Corporation and any of its Subsidiaries, including any applicable duty to not disclose or use such proprietary information improperly or to obtain therefrom an improper personal benefit.

6. **Waiver.** Except as otherwise set forth herein, (a) any of the rights, powers, preferences and other terms of the Series A Preferred Stock set forth herein may be waived on behalf of all holders of Series A Preferred Stock by the affirmative written consent or vote of the holders of a majority of the Series A Preferred Stock, (b) any of the rights, powers, preferences and other terms of the Series B Preferred Stock set forth herein may be waived on behalf of all holders of Series B Preferred Stock by the affirmative written consent or vote of the holders of a majority of the Series B Preferred Stock, (c) any of the rights, powers, preferences and other terms of the Series B-2 Preferred Stock set forth herein may be waived on behalf of all holders of Series B-2 Preferred Stock by the affirmative written consent or vote of the holders of a majority of the Series B-2 Preferred Stock, (d) any of the rights, powers, preferences and other terms of the Series C Preferred Stock set forth herein may be waived on behalf of all holders of Series C Preferred Stock by the affirmative written consent or vote of the holders of a majority of the Series C Preferred Stock, (e) any of the rights, powers, preferences and other terms of the Series D Preferred Stock set forth herein may be waived on behalf of all holders of Series D Preferred Stock by the affirmative written consent or vote of the holders of a majority of the Series D Preferred Stock, and (f) any of the rights, powers, preferences and other terms of the Series E Preferred Stock set forth herein may be waived on behalf of all holders of Series E Preferred Stock by the affirmative written consent or vote of the holders of a majority of the Series E Preferred Stock.

ARTICLE II **DEFINITIONS**

The following terms are used herein with the meanings indicated:

“**Acquisition**” means a merger or consolidation of the Corporation into or with any other Person or Persons in a single transaction or a series of related transactions in which the stockholders of the Corporation immediately prior to such merger, consolidation, transaction or first of such related series of transaction possess less than fifty percent (50%) of the surviving entity’s issued and outstanding voting Capital Securities immediately after such merger, consolidation, transaction or related series of such transactions (provided that a Qualified Public Offering or Majority Conversion after which the stockholders of the Corporation as of immediately prior to such event continue to maintain an ownership interest in the Corporation as of immediately after such event, or the sale of Capital Securities by the Corporation for bona fide capital raising purposes, shall not be an “Acquisition”).

“**Affidavit of Loss**” means an affidavit or written agreement reasonably satisfactory to the Corporation to indemnify the Corporation from any loss incurred in connection with the loss of any share certificate evidencing shares of the Corporation’s Capital Securities.

“**Affiliate**” means, as applied to the Corporation or any other specified Person, any Person directly or indirectly controlling, controlled by or under direct or indirect common control with the Corporation (or such other specified Person) and shall also include (a) any Person who is an officer or director of the Corporation or any Subsidiary (or other specified Person) and (b) in the case of a specified Person who is an individual, any Family Members of any such Person.

“**Asset Transfer**” means a sale of all or substantially all of the Corporation’s assets to any Person (including indirectly by the grant of an exclusive license or licenses to all or substantially all of the Corporation’s intellectual property).

“**Board**” and “**Board of Directors**” each has the meaning specified in Exhibit A, Section B.2.

“**Business Day**” means a day other than a Saturday, Sunday or legal holiday in Delaware.

“**Capital Securities**” means, as to any Person that is a corporation, the authorized shares of such Person’s capital stock, including all classes of common, preferred, voting and nonvoting capital stock, and, as to any Person that is not a corporation or an individual, the ownership interests in such Person, including, without limitation, the right to share in profits and losses, the right to receive distributions of cash and property, and the right to receive allocations of items of income, gain, loss, deduction and credit and similar items from such Person, whether or not such interests include voting or similar rights entitling the holder thereof to exercise control over such Person.

“**Certificate of Incorporation**” means this Amended and Restated Certificate of Incorporation, as amended from time to time.

“**Common Stock**” has the meaning specified in the Certificate of Incorporation.

“**Common Stock Deemed Outstanding**” means, at any time of measurement thereof, the number of shares of Common Stock actually outstanding at such time, plus the number of shares of Common Stock issuable upon conversion of the Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving Common Stock after the Effective Time), plus (without duplication) the number of shares of Common Stock issuable upon the exercise in full of all outstanding Convertible Securities whether or not such Convertible Securities are convertible into or exchangeable or exercisable for Common Stock at such time.

“**Competing Businesses**” has the meaning specified in Exhibit A, Section B.5.

“**Conversion Price**” means each of the Series A Conversion Price, the Series B Conversion Price, the Series B-2 Conversion Price, the Series C Conversion Price, the Series D Conversion Price, and the Series E Conversion Price, as applicable.

“**Convertible Securities**” means securities or obligations that are directly or indirectly exercisable for, convertible into or exchangeable for shares of Common Stock. The term includes, without limitation, shares of Preferred Stock, warrants or other rights to subscribe for or purchase Common Stock or to subscribe for or purchase other Capital Securities or obligations that are, directly or indirectly, exercisable for, convertible into or exchangeable for Common Stock.

“**DGCL**” means the General Corporation Law of the State of Delaware, as in effect from time to time.

“**Effective Time**” means the consummation by the Corporation of the first sale of any shares of Series E Preferred Stock following the filing of this Amended and Restated Certificate of Incorporation with the Office of the Secretary of State of Delaware in accordance with the DGCL.

“**Elected Preferred Stock**” has the meaning specified in Exhibit A, Section A.3(c).

“**Excluded Securities**” means (i) Capital Securities issued by the Corporation in a Qualified Public Offering, (ii) Convertible Securities or restricted stock grants issued to officers, employees or members of the Board of Directors of, or consultants or other service providers to, the Corporation or any Subsidiary that are options to purchase or grants of shares of Common Stock, and the issuance of shares of Common Stock upon the exercise of any such options or grants, (iii) Capital Securities issued by the Corporation as direct consideration to any Persons (including the stockholders or owners of Persons) as all or part of the consideration paid for the acquisition of ownership interests in, or assets of, such Person in a transaction in which there is not a readily determinable value being ascribed to such shares unless (A) such Person is an Affiliate of the Corporation (other than a Subsidiary) or (B) Affiliates of the Corporation collectively own more than ten percent (10%) of the ownership interests in such Person, (iv) Convertible Securities (including Capital Securities issued upon exercise, conversion or exchange thereof) and/or Capital Securities issued by the Corporation to Persons who are not Affiliates of the Corporation as partial consideration for senior debt financing, real estate leases, equipment lease financing or licensing, (v) Convertible Securities (including Capital Securities issued upon exercise, conversion or exchange thereof) and/or Capital Securities issued by the Corporation in connection with a stock split, stock dividend, combination, consolidation, reorganization, recapitalization or other similar event for which adjustment is made in accordance with Exhibit A, Section A.4, (vi) Capital Securities issued by the Corporation upon the conversion of shares of Preferred Stock, (vii) shares of Series E Preferred Stock issued pursuant to that certain Stock Purchase Agreement, entered into on or around March 31, 2015, (viii) Capital Securities issued by the Corporation upon conversion of the convertible promissory note issued to BioMed Realty, L.P., and/or (ix) Capital Securities issued to The Scripps Research Institute in connection with the Amended and Restated Research Funding and Option Agreement, dated as of January 19, 2015.

“**Family Member**” means, as applied to any individual, such individual’s spouse, children (including stepchildren or adopted children), grandchildren, parent, or any spouse of any of the foregoing, and each trust or partnership created for the exclusive benefit of any one or more of them.

“**Liquidation Amount**” means each of the Series A Liquidation Amount, Series B Liquidation Amount, Series B-2 Liquidation Amount, Series C Liquidation Amount, the Series D Liquidation Amount, and Series E Liquidation Amount, as applicable.

“**Liquidation Event**” has the meaning specified in Exhibit A, Section A.2(a).

“**Liquidation Preference**” means each of the Series A Liquidation Preference, Series B Liquidation Preference, Series B-2 Liquidation Preference, Series C Liquidation Preference, the Series D Liquidation Preference, and Series E Liquidation Preference, as applicable.

“**Majority Conversion**” has the meaning specified in Exhibit A, Section A.3(b).

“**New Securities**” means any Capital Securities and Convertible Securities of the Corporation or any other security, obligation or instrument (whether denominated as equity, debt or otherwise) that has significant equity-like economic attributes; *provided, however*, that Excluded Securities shall not constitute New Securities.

“**Person**” or “**person**” means an individual, partnership, corporation, limited liability company, association, trust, joint venture, unincorporated organization or other entity and any government, governmental department or agency or political subdivision thereof.

“**Preferred Directors**” shall mean the Series A Director, the Series B-2 Directors, the Series C Director, and the Series E Directors.

“**Preferred Investor Parties**” has the meaning specified in Exhibit A, Section B.5.

“**Public Offering**” means any offering by the Corporation of its Common Stock to the public pursuant to an effective registration statement under the Securities Act, or any comparable statement under any similar federal statute then in force, other than an offering of shares being issued as consideration in a business acquisition or combination or an offering in connection with an employee benefit plan.

“**Purchase Price**” means each of the Series A Purchase Price, Series B Purchase Price, Series B-2 Purchase Price, Series C Purchase Price, Series D Purchase Price and Series E Purchase Price, as applicable.

“**Qualified Public Offering**” has the meaning specified in Exhibit A, Section A.3(b).

“**Redemption Notice**” has the meaning specified in Exhibit A, Section A.9(a).

“**Redemption Price**” has the meaning specified in Exhibit A, Section A.9(a).

“**Requisite D/E Preferred**” means the holders of a majority of the issued and outstanding shares of Series D Preferred Stock and Series E Preferred Stock, voting together as a single class on an as-if-converted to Common Stock basis.

“**Requisite Stockholders**” means the holders of a majority of the issued and outstanding shares of Series B-2 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock and Series E Preferred Stock, voting together as a single class on an as-if-converted to Common Stock basis.

“**Restricted Action**” has the meaning specified in Exhibit A, Section B.4(a).

“**Sale of the Corporation**” means an Acquisition or an Asset Transfer.

“**Securities Act**” means the Securities Act of 1933, as amended.

“**Series A Conversion Price**” has the meaning specified in Exhibit A, Section A.3(a).

“**Series A Director**” has the meaning specified in Exhibit A, Section B.2(b).

“**Series A Liquidation Preference**” means an amount initially equal to the Series A Purchase Price, plus any declared but unpaid dividends on the Series A Preferred Stock.

“**Series A Preferred Stock**” has the meaning specified in Exhibit A.

“**Series A Purchase Price**” means \$0.25 per share of Series A Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving the Series A Preferred Stock after the Effective Time).

“**Series B Conversion Price**” has the meaning specified in Exhibit A, Section A.3(a).

“**Series B Liquidation Preference**” means an amount initially equal to the Series B Purchase Price, plus any declared but unpaid dividends on the Series B Preferred Stock.

“**Series B Preferred Stock**” has the meaning specified in Exhibit A.

“**Series B Purchase Price**” means \$0.8333 per share of Series B Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving the Series B Preferred Stock after the Effective Time).

“**Series B-2 Conversion Price**” has the meaning specified in Exhibit A, Section A.3(a).

“**Series B-2 Directors**” has the meaning specified in Exhibit A, Section B.2(c).

“**Series B-2 Liquidation Preference**” means an amount initially equal to the Series B-2 Purchase Price, plus any declared but unpaid dividends on the Series B-2 Preferred Stock.

“**Series B-2 Preferred Stock**” has the meaning specified in Exhibit A.

“**Series B-2 Purchase Price**” means \$0.8333 per share of Series B-2 Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving the Series B-2 Preferred Stock after the Effective Time).

“**Series C Conversion Price**” has the meaning specified in Exhibit A, Section A.3(a).

“**Series C Director**” has the meaning specified in Exhibit A, Section B.2(d).

“**Series C Liquidation Preference**” means an amount initially equal to the Series C Purchase Price, plus any declared but unpaid dividends on the Series C Preferred Stock.

“**Series C Preferred Stock**” has the meaning specified in Exhibit A.

“**Series C Purchase Price**” means \$0.94 per share of Series C Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization,

recapitalization, reclassification or other similar event involving the Series C Preferred Stock after the Effective Time).

“**Series D Conversion Price**” has the meaning specified in Exhibit A, Section A.3(a).

“**Series D Liquidation Preference**” means an amount initially equal to the Series D Purchase Price, plus any declared but unpaid dividends on the Series D Preferred Stock.

“**Series D Preferred Stock**” has the meaning specified in Exhibit A.

“**Series D Purchase Price**” means \$2.662 per share of Series D Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving the Series D Preferred Stock after the Effective Time).

“**Series E Conversion Price**” has the meaning specified in Exhibit A, Section A.3(a).

“**Series E Directors**” has the meaning specified in Exhibit A, Section B.2(d).

“**Series E Liquidation Preference**” means an amount initially equal to the Series E Purchase Price, plus any declared but unpaid dividends on the Series E Preferred Stock.

“**Series E Preferred Stock**” has the meaning specified in Exhibit A.

“**Series E Purchase Price**” means \$1.119 per share of Series E Preferred Stock (as equitably adjusted to reflect any stock split, stock dividend, combination, consolidation, reorganization, recapitalization, reclassification or other similar event involving the Series E Preferred Stock after the Effective Time).

“**Subsidiary**”/“**Subsidiaries**” means any corporation, partnership, limited liability company, association or other business entity of which (i) if a corporation, a majority of the total voting power of shares of stock entitled (without regard to the occurrence of any contingency) to vote in the election of directors thereof is at the time owned or controlled, directly or indirectly, by the Corporation or one or more of the other Subsidiaries of the Corporation or a combination thereof, or (ii) if a partnership, limited liability company, association or other business entity, a majority of the ownership interests therein is at the time owned or controlled, directly or indirectly, by the Corporation or one or more Subsidiaries of that person or a combination thereof. For purposes hereof, the Corporation shall be deemed to have a majority ownership interest in a partnership, limited liability company, association or other business entity if and only if the Corporation shall be allocated a majority of partnership, limited liability company, association or other business entity gains or losses and shall be or control the managing general partner of such partnership, association or other business entity or the managing member of such limited liability company.

“**Voluntary Conversion Notice**” has the meaning specified in Exhibit A, Section A.3(c).

AMENDED AND RESTATED

BYLAWS

OF

aTYR PHARMA, INC.

(the "Corporation")ARTICLE IStockholders

SECTION 1. Annual Meeting. The annual meeting of stockholders (any such meeting being referred to in these Bylaws as an "Annual Meeting") shall be held at the hour, date and place within or without the United States which is fixed by the Corporation's Board of Directors (the "Board of Directors"), which time, date and place may subsequently be changed at any time by vote of the Board of Directors. If no Annual Meeting has been held for a period of thirteen (13) months after the Corporation's last Annual Meeting, a special meeting in lieu thereof may be held, and such special meeting shall have, for the purposes of these Bylaws or otherwise, all the force and effect of an Annual Meeting. Any and all references hereafter in these Bylaws to an Annual Meeting or Annual Meetings also shall be deemed to refer to any special meeting(s) in lieu thereof.

SECTION 2. Notice of Stockholder Business and Nominations.

(a) Annual Meetings of Stockholders.

(1) Nominations of persons for election to the Board of Directors and the proposal of other business to be considered by the stockholders may be brought before an Annual Meeting (i) by or at the direction of the Board of Directors or (ii) by any stockholder of the Corporation who was a stockholder of record at the time of giving of notice provided for in this Bylaw, who is entitled to vote at the meeting, who is present (in person or by proxy) at the meeting and who complies with the notice procedures set forth in this Bylaw as to such nomination or business. For the avoidance of doubt, the foregoing clause (ii) shall be the exclusive means for a stockholder to bring nominations or business properly before an Annual Meeting (other than matters properly brought under Rule 14a-8 (or any successor rule) under the Securities Exchange Act of 1934, as amended (the "Exchange Act")), and such stockholder must comply with the notice and other procedures set forth in Article I, Section 2(a)(2) and (3) of this Bylaw to bring such nominations or business properly before an Annual Meeting. In addition to the other requirements set forth in this Bylaw, for any proposal of business to be considered at an Annual Meeting, it must be a proper subject for action by stockholders of the Corporation under Delaware law.

(2) For nominations or other business to be properly brought before an Annual Meeting by a stockholder pursuant to clause (ii) of Article I, Section 2(a)(1) of this Bylaw, the stockholder must (i) have given Timely Notice (as defined below) thereof in writing to the Secretary of the Corporation, (ii) have provided any updates or supplements to such notice at the times and in the forms required by this Bylaw and (iii) together with the beneficial owner(s), if any, on whose behalf the nomination or business proposal is made, have acted in accordance with the representations set forth in the Solicitation Statement (as defined below) required by this Bylaw. To be timely, a stockholder's written notice shall be received by the Secretary at the principal executive offices of the Corporation not later than the close of business on the ninetieth (90th) day nor earlier than the close of business on the one hundred twentieth (120th) day prior to the one-year anniversary of the preceding year's Annual Meeting; provided, however, that in the event the Annual Meeting is first convened more than thirty (30) days before or more than sixty (60) days after such anniversary date, or if no Annual Meeting were held in the preceding year, notice by the stockholder to be timely must be received by the Secretary of the Corporation not later than the close of business on the later of the ninetieth (90th) day prior to the scheduled date of such Annual Meeting or the tenth (10th) day following the day on which public announcement of the date of such meeting is first made (such notice within such time periods shall be referred to as "Timely Notice"). Notwithstanding anything to the contrary provided herein, for the first Annual Meeting following the initial public offering of common stock of the Corporation, a stockholder's notice shall be timely if received by the Secretary at the principal executive offices of the Corporation not later than the close of business on the later of the ninetieth (90th) day prior to the scheduled date of such Annual Meeting or the tenth (10th) day following the day on which public announcement of the date of such Annual Meeting is first made or sent by the Corporation. Such stockholder's Timely Notice shall set forth:

(A) as to each person whom the stockholder proposes to nominate for election or reelection as a Director, all information relating to such person that is required to be disclosed in solicitations of proxies for election of Directors in an election contest, or is otherwise required, in each case pursuant to Regulation 14A under the Exchange Act (including such person's written consent to being named in the proxy statement as a nominee and to serving as a Director if elected);

(B) as to any other business that the stockholder proposes to bring before the meeting, a brief description of the business desired to be brought before the meeting, the reasons for conducting such business at the meeting, and any material interest in such business of each Proposing Person (as defined below);

(C) (i) the name and address of the stockholder giving the notice, as they appear on the Corporation's books, and the names and addresses of the other Proposing Persons (if any) and (ii) as to each Proposing Person, the following information: (a) the class or series and number of all shares of capital stock of the Corporation which are, directly or indirectly, owned beneficially or of record by such Proposing Person or any of its affiliates or associates (as such terms are defined in Rule 12b-2 promulgated under the Exchange Act), including any shares of any class or series of capital stock of the Corporation as to which such

Proposing Person or any of its affiliates or associates has a right to acquire beneficial ownership at any time in the future, (b) all Synthetic Equity Interests (as defined below) in which such Proposing Person or any of its affiliates or associates, directly or indirectly, holds an interest including a description of the material terms of each such Synthetic Equity Interest, including without limitation, identification of the counterparty to each such Synthetic Equity Interest and disclosure, for each such Synthetic Equity Interest, as to (x) whether or not such Synthetic Equity Interest conveys any voting rights, directly or indirectly, in such shares to such Proposing Person, (y) whether or not such Synthetic Equity Interest is required to be, or is capable of being, settled through delivery of such shares and (z) whether or not such Proposing Person and/or, to the extent known, the counterparty to such Synthetic Equity Interest has entered into other transactions that hedge or mitigate the economic effect of such Synthetic Equity Interest, (c) any proxy (other than a revocable proxy given in response to a public proxy solicitation made pursuant to, and in accordance with, the Exchange Act), agreement, arrangement, understanding or relationship pursuant to which such Proposing Person has or shares a right to, directly or indirectly, vote any shares of any class or series of capital stock of the Corporation, (d) any rights to dividends or other distributions on the shares of any class or series of capital stock of the Corporation, directly or indirectly, owned beneficially by such Proposing Person that are separated or separable from the underlying shares of the Corporation, and (e) any performance-related fees (other than an asset based fee) that such Proposing Person, directly or indirectly, is entitled to based on any increase or decrease in the value of shares of any class or series of capital stock of the Corporation or any Synthetic Equity Interests (the disclosures to be made pursuant to the foregoing clauses (a) through (e) are referred to, collectively, as “ Material Ownership Interests ”) and (iii) a description of the material terms of all agreements, arrangements or understandings (whether or not in writing) entered into by any Proposing Person or any of its affiliates or associates with any other person for the purpose of acquiring, holding, disposing or voting of any shares of any class or series of capital stock of the Corporation;

(D) (i) a description of all agreements, arrangements or understandings by and among any of the Proposing Persons, or by and among any Proposing Persons and any other person (including with any proposed nominee(s)), pertaining to the nomination(s) or other business proposed to be brought before the meeting of stockholders (which description shall identify the name of each other person who is party to such an agreement, arrangement or understanding), and (ii) identification of the names and addresses of other stockholders (including beneficial owners) known by any of the Proposing Persons to support such nominations or other business proposal(s), and to the extent known the class and number of all shares of the Corporation’s capital stock owned beneficially or of record by such other stockholder(s) or other beneficial owner(s); and

(E) a statement whether or not the stockholder giving the notice and/or the other Proposing Person(s), if any, will deliver a proxy statement and form of proxy

to holders of, in the case of a business proposal, at least the percentage of voting power of all of the shares of capital stock of the Corporation required under applicable law to approve the proposal or, in the case of a nomination or nominations, at least the percentage of voting power of all of the shares of capital stock of the Corporation reasonably believed by such Proposing Person to be sufficient to elect the nominee or nominees proposed to be nominated by such stockholder (such statement, the “Solicitation Statement”).

For purposes of this Article I of these Bylaws, the term “Proposing Person” shall mean the following persons:

(i) the stockholder of record providing the notice of nominations or business proposed to be brought before a stockholders’ meeting, and (ii) the beneficial owner(s), if different, on whose behalf the nominations or business proposed to be brought before a stockholders’ meeting is made. For purposes of this Section 2 of Article I of these Bylaws, the term “Synthetic Equity Interest” shall mean any transaction, agreement or arrangement (or series of transactions, agreements or arrangements), including, without limitation, any derivative, swap, hedge, repurchase or so-called “stock borrowing” agreement or arrangement, the purpose or effect of which is to, directly or indirectly: (a) give a person or entity economic benefit and/or risk similar to ownership of shares of any class or series of capital stock of the Corporation, in whole or in part, including due to the fact that such transaction, agreement or arrangement provides, directly or indirectly, the opportunity to profit or avoid a loss from any increase or decrease in the value of any shares of any class or series of capital stock of the Corporation, (b) mitigate loss to, reduce the economic risk of or manage the risk of share price changes for, any person or entity with respect to any shares of any class or series of capital stock of the Corporation, (c) otherwise provide in any manner the opportunity to profit or avoid a loss from any decrease in the value of any shares of any class or series of capital stock of the Corporation, or (d) increase or decrease the voting power of any person or entity with respect to any shares of any class or series of capital stock of the Corporation.

(3) A stockholder providing Timely Notice of nominations or business proposed to be brought before an Annual Meeting shall further update and supplement such notice, if necessary, so that the information (including, without limitation, the Material Ownership Interests information) provided or required to be provided in such notice pursuant to this Bylaw shall be true and correct as of the record date for the meeting and as of the date that is ten (10) business days prior to such Annual Meeting, and such update and supplement shall be received by the Secretary at the principal executive offices of the Corporation not later than the close of business on the fifth (5th) business day after the record date for the Annual Meeting (in the case of the update and supplement required to be made as of the record date), and not later than the close of business on the eighth (8th) business day prior to the date of the Annual Meeting (in the case of the update and supplement required to be made as of ten (10) business days prior to the meeting).

(4) Notwithstanding anything in the second sentence of Article I, Section 2(a)(2) of this Bylaw to the contrary, in the event that the number of Directors to be elected to the Board of Directors of the Corporation is increased and there is no public announcement naming all of the nominees for Director or specifying the size of the

increased Board of Directors made by the Corporation at least ten (10) days before the last day a stockholder may deliver a notice of nomination in accordance with the second sentence of Article I, Section 2(a)(2), a stockholder's notice required by this Bylaw shall also be considered timely, but only with respect to nominees for any new positions created by such increase, if it shall be received by the Secretary of the Corporation not later than the close of business on the tenth (10th) day following the day on which such public announcement is first made by the Corporation.

(b) General.

(1) Only such persons who are nominated in accordance with the provisions of this Bylaw shall be eligible for election and to serve as Directors and only such business shall be conducted at an Annual Meeting as shall have been brought before the meeting in accordance with the provisions of this Bylaw or in accordance with Rule 14a-8 under the Exchange Act. The Board of Directors or a designated committee thereof shall have the power to determine whether a nomination or any business proposed to be brought before the meeting was made in accordance with the provisions of this Bylaw. If neither the Board of Directors nor such designated committee makes a determination as to whether any stockholder proposal or nomination was made in accordance with the provisions of this Bylaw, the presiding officer of the Annual Meeting shall have the power and duty to determine whether the stockholder proposal or nomination was made in accordance with the provisions of this Bylaw. If the Board of Directors or a designated committee thereof or the presiding officer, as applicable, determines that any stockholder proposal or nomination was not made in accordance with the provisions of this Bylaw, such proposal or nomination shall be disregarded and shall not be presented for action at the Annual Meeting.

(2) Except as otherwise required by law, nothing in this Article I, Section 2 shall obligate the Corporation or the Board of Directors to include in any proxy statement or other stockholder communication distributed on behalf of the Corporation or the Board of Directors information with respect to any nominee for Director or any other matter of business submitted by a stockholder.

(3) Notwithstanding the foregoing provisions of this Article I, Section 2, if the nominating or proposing stockholder (or a qualified representative of the stockholder) does not appear at the Annual Meeting to present a nomination or any business, such nomination or business shall be disregarded, notwithstanding that proxies in respect of such vote may have been received by the Corporation. For purposes of this Article I, Section 2, to be considered a qualified representative of the proposing stockholder, a person must be authorized by a written instrument executed by such stockholder or an electronic transmission delivered by such stockholder to act for such stockholder as proxy at the meeting of stockholders and such person must produce such written instrument or electronic transmission, or a reliable reproduction of the written instrument or electronic transmission, to the presiding officer at the meeting of stockholders.

(4) For purposes of this Bylaw, "public announcement" shall mean disclosure in a press release reported by the Dow Jones News Service, Associated Press or

comparable national news service or in a document publicly filed by the Corporation with the Securities and Exchange Commission pursuant to Section 13, 14 or 15(d) of the Exchange Act.

(5) Notwithstanding the foregoing provisions of this Bylaw, a stockholder shall also comply with all applicable requirements of the Exchange Act and the rules and regulations thereunder with respect to the matters set forth in this Bylaw. Nothing in this Bylaw shall be deemed to affect any rights of (i) stockholders to have proposals included in the Corporation's proxy statement pursuant to Rule 14a-8 (or any successor rule), as applicable, under the Exchange Act and, to the extent required by such rule, have such proposals considered and voted on at an Annual Meeting or (ii) the holders of any series of Undesignated Preferred Stock to elect Directors under specified circumstances.

SECTION 3. Special Meetings. Except as otherwise required by statute and subject to the rights, if any, of the holders of any series of Undesignated Preferred Stock, special meetings of the stockholders of the Corporation may be called only by the Board of Directors acting pursuant to a resolution approved by the affirmative vote of a majority of the Directors then in office. The Board of Directors may postpone or reschedule any previously scheduled special meeting of stockholders. Only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of stockholders of the Corporation. Nominations of persons for election to the Board of Directors and stockholder proposals of other business shall not be brought before a special meeting of stockholders to be considered by the stockholders unless such special meeting is held in lieu of an annual meeting of stockholders in accordance with Article I, Section 1 of these Bylaws, in which case such special meeting in lieu thereof shall be deemed an Annual Meeting for purposes of these Bylaws and the provisions of Article I, Section 2 of these Bylaws shall govern such special meeting.

SECTION 4. Notice of Meetings; Adjournments.

(a) A notice of each Annual Meeting stating the hour, date and place, if any, of such Annual Meeting and the means of remote communication, if any, by which stockholders and proxyholders may be deemed to be present in person and vote at such meeting, shall be given not less than ten (10) days nor more than sixty (60) days before the Annual Meeting, to each stockholder entitled to vote thereat by delivering such notice to such stockholder or by mailing it, postage prepaid, addressed to such stockholder at the address of such stockholder as it appears on the Corporation's stock transfer books. Without limiting the manner by which notice may otherwise be given to stockholders, any notice to stockholders may be given by electronic transmission in the manner provided in Section 232 of the Delaware General Corporation Law ("DGCL").

(b) Notice of all special meetings of stockholders shall be given in the same manner as provided for Annual Meetings, except that the notice of all special meetings shall state the purpose or purposes for which the meeting has been called.

(c) Notice of an Annual Meeting or special meeting of stockholders need not be given to a stockholder if a waiver of notice is executed, or waiver of notice by electronic

transmission is provided, before or after such meeting by such stockholder or if such stockholder attends such meeting, unless such attendance is for the express purpose of objecting at the beginning of the meeting to the transaction of any business because the meeting was not lawfully called or convened.

(d) The Board of Directors may postpone and reschedule any previously scheduled Annual Meeting or special meeting of stockholders and any record date with respect thereto, regardless of whether any notice or public disclosure with respect to any such meeting has been sent or made pursuant to Section 2 of this Article I of these Bylaws or otherwise. In no event shall the public announcement of an adjournment, postponement or rescheduling of any previously scheduled meeting of stockholders commence a new time period for the giving of a stockholder's notice under this Article I of these Bylaws.

(e) When any meeting is convened, the presiding officer may adjourn the meeting if (i) no quorum is present for the transaction of business, (ii) the Board of Directors determines that adjournment is necessary or appropriate to enable the stockholders to consider fully information which the Board of Directors determines has not been made sufficiently or timely available to stockholders, or (iii) the Board of Directors determines that adjournment is otherwise in the best interests of the Corporation. When any Annual Meeting or special meeting of stockholders is adjourned to another hour, date or place, notice need not be given of the adjourned meeting other than an announcement at the meeting at which the adjournment is taken of the hour, date and place, if any, to which the meeting is adjourned and the means of remote communications, if any, by which stockholders and proxyholders may be deemed to be present in person and vote at such adjourned meeting; provided, however, that if the adjournment is for more than thirty (30) days from the meeting date, or if after the adjournment a new record date is fixed for the adjourned meeting, notice of the adjourned meeting and the means of remote communications, if any, by which stockholders and proxyholders may be deemed to be present in person and vote at such adjourned meeting shall be given to each stockholder of record entitled to vote thereat and each stockholder who, by law or under the Certificate of Incorporation of the Corporation (as the same may hereafter be amended and/or restated, the "Certificate") or these Bylaws, is entitled to such notice.

SECTION 5. Quorum. A majority of the shares entitled to vote, present in person or represented by proxy, shall constitute a quorum at any meeting of stockholders. If less than a quorum is present at a meeting, the holders of voting stock representing a majority of the voting power present at the meeting or the presiding officer may adjourn the meeting from time to time, and the meeting may be held as adjourned without further notice, except as provided in Section 4 of this Article I. At such adjourned meeting at which a quorum is present, any business may be transacted which might have been transacted at the meeting as originally noticed. The stockholders present at a duly constituted meeting may continue to transact business until adjournment, notwithstanding the withdrawal of enough stockholders to leave less than a quorum.

SECTION 6. Voting and Proxies. Stockholders shall have one vote for each share of stock entitled to vote owned by them of record according to the stock ledger of the Corporation as of the record date, unless otherwise provided by law or by the Certificate. Stockholders may

vote either (i) in person, (ii) by written proxy or (iii) by a transmission permitted by Section 212(c) of the DGCL. Any copy, facsimile telecommunication or other reliable reproduction of the writing or transmission permitted by Section 212(c) of the DGCL may be substituted for or used in lieu of the original writing or transmission for any and all purposes for which the original writing or transmission could be used, provided that such copy, facsimile telecommunication or other reproduction shall be a complete reproduction of the entire original writing or transmission. Proxies shall be filed in accordance with the procedures established for the meeting of stockholders. Except as otherwise limited therein or as otherwise provided by law, proxies authorizing a person to vote at a specific meeting shall entitle the persons authorized thereby to vote at any adjournment of such meeting, but they shall not be valid after final adjournment of such meeting. A proxy with respect to stock held in the name of two or more persons shall be valid if executed by or on behalf of any one of them unless at or prior to the exercise of the proxy the Corporation receives a specific written notice to the contrary from any one of them.

SECTION 7. Action at Meeting. When a quorum is present at any meeting of stockholders, any matter before any such meeting (other than an election of a Director or Directors) shall be decided by a majority of the votes properly cast for and against such matter, except where a larger vote is required by law, by the Certificate or by these Bylaws. Any election of Directors by stockholders shall be determined by a plurality of the votes properly cast on the election of Directors.

SECTION 8. Stockholder Lists. The Secretary or an Assistant Secretary (or the Corporation's transfer agent or other person authorized by these Bylaws or by law) shall prepare and make, at least ten (10) days before every Annual Meeting or special meeting of stockholders, a complete list of the stockholders entitled to vote at the meeting, arranged in alphabetical order, and showing the address of each stockholder and the number of shares registered in the name of each stockholder. Such list shall be open to the examination of any stockholder, for a period of at least ten (10) days prior to the meeting in the manner provided by law. The list shall also be open to the examination of any stockholder during the whole time of the meeting as provided by law.

SECTION 9. Presiding Officer. The Board of Directors shall designate a representative to preside over all Annual Meetings or special meetings of stockholders, provide that if the Board of Directors does not so designate such a presiding officer, then the Chairman of the Board of Directors (the "Chairman of the Board"), if one is elected, shall preside over such meetings. If the Board of Directors does not so designate such a presiding officer and there is no Chairman of the Board or the Chairman of the Board is unable to so preside or is absent, then the Chief Executive Officer, if one is elected, shall preside over such meetings, provided further that if there is no Chief Executive Officer or the Chief Executive Officer is unable to so preside or is absent, then the President shall preside over such meetings. The presiding officer at any Annual Meeting or special meeting of stockholders shall have the power, among other things, to adjourn such meeting at any time and from time to time, subject to Sections 4 and 5 of this Article I. The order of business and all other matters of procedure at any meeting of the stockholders shall be determined by the presiding officer.

SECTION 10. Inspectors of Elections. The Corporation shall, in advance of any meeting of stockholders, appoint one or more inspectors to act at the meeting and make a written report thereof. The Corporation may designate one or more persons as alternate inspectors to replace any inspector who fails to act. If no inspector or alternate is able to act at a meeting of stockholders, the presiding officer shall appoint one or more inspectors to act at the meeting. Any inspector may, but need not, be an officer, employee or agent of the Corporation. Each inspector, before entering upon the discharge of his or her duties, shall take and sign an oath faithfully to execute the duties of inspector with strict impartiality and according to the best of his or her ability. The inspectors shall perform such duties as are required by the DGCL, including the counting of all votes and ballots. The inspectors may appoint or retain other persons or entities to assist the inspectors in the performance of the duties of the inspectors. The presiding officer may review all determinations made by the inspectors, and in so doing the presiding officer shall be entitled to exercise his or her sole judgment and discretion and he or she shall not be bound by any determinations made by the inspectors. All determinations by the inspectors and, if applicable, the presiding officer, shall be subject to further review by any court of competent jurisdiction.

ARTICLE II

Directors

SECTION 1. Powers. The business and affairs of the Corporation shall be managed by or under the direction of the Board of Directors except as otherwise provided by the Certificate or required by law.

SECTION 2. Number and Terms. The number of Directors of the Corporation shall be fixed solely and exclusively by resolution duly adopted from time to time by the Board of Directors. The Directors shall hold office in the manner provided in the Certificate.

SECTION 3. Qualification. No Director need be a stockholder of the Corporation.

SECTION 4. Vacancies. Vacancies in the Board of Directors shall be filled in the manner provided in the Certificate.

SECTION 5. Removal. Directors may be removed from office only in the manner provided in the Certificate.

SECTION 6. Resignation. A Director may resign at any time by giving written notice to the Chairman of the Board, if one is elected, the President or the Secretary. A resignation shall be effective upon receipt, unless the resignation otherwise provides.

SECTION 7. Regular Meetings. The regular annual meeting of the Board of Directors may be held, without notice other than this Section 7, on the same date and at the same place as the Annual Meeting following the close of such meeting of stockholders. Other regular meetings

of the Board of Directors may be held at such hour, date and place as the Board of Directors may by resolution from time to time determine and publicize by means of reasonable notice given to any Director who is not present at the meeting at which such resolution is adopted.

SECTION 8. Special Meetings. Special meetings of the Board of Directors may be called, orally or in writing, by or at the request of a majority of the Directors, the Chairman of the Board, if one is elected, or the President. The person calling any such special meeting of the Board of Directors may fix the hour, date and place thereof.

SECTION 9. Notice of Meetings. Notice of the hour, date and place of all special meetings of the Board of Directors shall be given to each Director by the Secretary or an Assistant Secretary, or in case of the death, absence, incapacity or refusal of such persons, by the Chairman of the Board, if one is elected, or the President or such other officer designated by the Chairman of the Board, if one is elected, or the President. Notice of any special meeting of the Board of Directors shall be given to each Director in person, by telephone, or by facsimile, electronic mail or other form of electronic communication, sent to his or her business or home address, at least twenty-four (24) hours in advance of the meeting, or by written notice mailed to his or her business or home address, at least forty-eight (48) hours in advance of the meeting. Such notice shall be deemed to be delivered when hand-delivered to such address, read to such Director by telephone, deposited in the mail so addressed, with postage thereon prepaid if mailed, dispatched or transmitted if sent by facsimile transmission or by electronic mail or other form of electronic communications. A written waiver of notice signed before or after a meeting by a Director and filed with the records of the meeting shall be deemed to be equivalent to notice of the meeting. The attendance of a Director at a meeting shall constitute a waiver of notice of such meeting, except where a Director attends a meeting for the express purpose of objecting at the beginning of the meeting to the transaction of any business because such meeting is not lawfully called or convened. Except as otherwise required by law, by the Certificate or by these Bylaws, neither the business to be transacted at, nor the purpose of, any meeting of the Board of Directors need be specified in the notice or waiver of notice of such meeting.

SECTION 10. Quorum. At any meeting of the Board of Directors, a majority of the total number of Directors shall constitute a quorum for the transaction of business, but if less than a quorum is present at a meeting, a majority of the Directors present may adjourn the meeting from time to time, and the meeting may be held as adjourned without further notice. Any business which might have been transacted at the meeting as originally noticed may be transacted at such adjourned meeting at which a quorum is present. For purposes of this section, the total number of Directors includes any unfilled vacancies on the Board of Directors.

SECTION 11. Action at Meeting. At any meeting of the Board of Directors at which a quorum is present, the vote of a majority of the Directors present shall constitute action by the Board of Directors, unless otherwise required by law, by the Certificate or by these Bylaws.

SECTION 12. Action by Consent. Any action required or permitted to be taken at any meeting of the Board of Directors may be taken without a meeting if all members of the Board of Directors consent thereto in writing or by electronic transmission and the writing or writings or

electronic transmission or transmissions are filed with the records of the meetings of the Board of Directors. Such filing shall be in paper form if the minutes are maintained in paper form and shall be in electronic form if the minutes are maintained in electronic form. Such consent shall be treated as a resolution of the Board of Directors for all purposes.

SECTION 13. Manner of Participation. Directors may participate in meetings of the Board of Directors by means of conference telephone or other communications equipment by means of which all Directors participating in the meeting can hear each other, and participation in a meeting in accordance herewith shall constitute presence in person at such meeting for purposes of these Bylaws.

SECTION 14. Presiding Director. The Board of Directors shall designate a representative to preside over all meetings of the Board of Directors, provided that if the Board of Directors does not so designate such a presiding Director or such designated presiding Director is unable to so preside or is absent, then the Chairman of the Board, if one is elected, shall preside over all meetings of the Board of Directors. If both the designated presiding Director, if one is so designated, and the Chairman of the Board, if one is elected, are unable to preside or are absent, the Board of Directors shall designate an alternate representative to preside over a meeting of the Board of Directors.

SECTION 15. Committees. The Board of Directors, by vote of a majority of the Directors then in office, may elect one or more committees, including, without limitation, a Compensation Committee, a Nominating & Corporate Governance Committee and an Audit Committee, and may delegate thereto some or all of its powers except those which by law, by the Certificate or by these Bylaws may not be delegated. Except as the Board of Directors may otherwise determine, any such committee may make rules for the conduct of its business, but unless otherwise provided by the Board of Directors or in such rules, its business shall be conducted so far as possible in the same manner as is provided by these Bylaws for the Board of Directors. All members of such committees shall hold such offices at the pleasure of the Board of Directors. The Board of Directors may abolish any such committee at any time. Any committee to which the Board of Directors delegates any of its powers or duties shall keep records of its meetings and shall report its action to the Board of Directors.

SECTION 16. Compensation of Directors. Directors shall receive such compensation for their services as shall be determined by a majority of the Board of Directors, or a designated committee thereof, provided that Directors who are serving the Corporation as employees and who receive compensation for their services as such, shall not receive any salary or other compensation for their services as Directors of the Corporation.

ARTICLE III

Officers

SECTION 1. Enumeration. The officers of the Corporation shall consist of a President,

a Treasurer, a Secretary and such other officers, including, without limitation, a Chairman of the Board, a Chief Executive Officer and one or more Vice Presidents (including Executive Vice Presidents or Senior Vice Presidents), Assistant Vice Presidents, Assistant Treasurers and Assistant Secretaries, as the Board of Directors may determine.

SECTION 2. Election. The Board of Directors shall elect, from time to time at a regular or special meeting, the President, the Treasurer and the Secretary. Other officers may be elected by the Board of Directors at any other regular or special meeting.

SECTION 3. Qualification. No officer need be a stockholder or a Director. Any person may occupy more than one office of the Corporation at any time.

SECTION 4. Tenure. Except as otherwise provided by the Certificate or by these Bylaws, each of the officers of the Corporation shall hold office until his or her successor is elected and qualified or until his or her earlier resignation or removal.

SECTION 5. Resignation. Any officer may resign by delivering his or her written resignation to the Corporation addressed to the President or the Secretary, and such resignation shall be effective upon receipt, unless the resignation otherwise provides.

SECTION 6. Removal. Except as otherwise provided by law, the Board of Directors may remove any officer with or without cause by the affirmative vote of a majority of the Directors then in office.

SECTION 7. Absence or Disability. In the event of the absence or disability of any officer, the Board of Directors may designate another officer to act temporarily in place of such absent or disabled officer.

SECTION 8. Vacancies. Any vacancy in any office may be filled for the unexpired portion of the term by the Board of Directors.

SECTION 9. President. The President shall, subject to the direction of the Board of Directors, have such powers and shall perform such duties as the Board of Directors may from time to time designate.

SECTION 10. Chairman of the Board. The Chairman of the Board, if one is elected, shall have such powers and shall perform such duties as the Board of Directors may from time to time designate.

SECTION 11. Chief Executive Officer. The Chief Executive Officer, if one is elected, shall have such powers and shall perform such duties as the Board of Directors may from time to time designate.

SECTION 12. Vice Presidents and Assistant Vice Presidents. Any Vice President (including any Executive Vice President or Senior Vice President) and any Assistant Vice President shall have such powers and shall perform such duties as the Board of Directors or the Chief Executive Officer may from time to time designate.

SECTION 13. Treasurer and Assistant Treasurers. The Treasurer shall, subject to the direction of the Board of Directors and except as the Board of Directors or the Chief Executive Officer may otherwise provide, have general charge of the financial affairs of the Corporation and shall cause to be kept accurate books of account. The Treasurer shall have custody of all funds, securities, and valuable documents of the Corporation. He or she shall have such other duties and powers as may be designated from time to time by the Board of Directors or the Chief Executive Officer. Any Assistant Treasurer shall have such powers and perform such duties as the Board of Directors or the Chief Executive Officer may from time to time designate.

SECTION 14. Secretary and Assistant Secretaries. The Secretary shall record all the proceedings of the meetings of the stockholders and the Board of Directors (including committees of the Board of Directors) in books kept for that purpose. In his or her absence from any such meeting, a temporary secretary chosen at the meeting shall record the proceedings thereof. The Secretary shall have charge of the stock ledger (which may, however, be kept by any transfer or other agent of the Corporation). The Secretary shall have custody of the seal of the Corporation, and the Secretary, or an Assistant Secretary shall have authority to affix it to any instrument requiring it, and, when so affixed, the seal may be attested by his or her signature or that of an Assistant Secretary. The Secretary shall have such other duties and powers as may be designated from time to time by the Board of Directors or the Chief Executive Officer. In the absence of the Secretary, any Assistant Secretary may perform his or her duties and responsibilities. Any Assistant Secretary shall have such powers and perform such duties as the Board of Directors or the Chief Executive Officer may from time to time designate.

SECTION 15. Other Powers and Duties. Subject to these Bylaws and to such limitations as the Board of Directors may from time to time prescribe, the officers of the Corporation shall each have such powers and duties as generally pertain to their respective offices, as well as such powers and duties as from time to time may be conferred by the Board of Directors or the Chief Executive Officer.

ARTICLE IV

Capital Stock

SECTION 1. Certificates of Stock. Each stockholder shall be entitled to a certificate of the capital stock of the Corporation in such form as may from time to time be prescribed by the Board of Directors. Such certificate shall be signed by the Chairman of the Board, the President or a Vice President and by the Treasurer or an Assistant Treasurer, or the Secretary or an Assistant Secretary. The Corporation's seal and the signatures by the Corporation's officers, the transfer agent or the registrar may be facsimiles. In case any officer, transfer agent or registrar who has signed or whose facsimile signature has been placed on such certificate shall have

ceased to be such officer, transfer agent or registrar before such certificate is issued, it may be issued by the Corporation with the same effect as if he or she were such officer, transfer agent or registrar at the time of its issue. Every certificate for shares of stock which are subject to any restriction on transfer and every certificate issued when the Corporation is authorized to issue more than one class or series of stock shall contain such legend with respect thereto as is required by law. Notwithstanding anything to the contrary provided in these Bylaws, the Board of Directors may provide by resolution or resolutions that some or all of any or all classes or series of its stock shall be uncertificated shares (except that the foregoing shall not apply to shares represented by a certificate until such certificate is surrendered to the Corporation), and by the approval and adoption of these Bylaws the Board of Directors has determined that all classes or series of the Corporation's stock may be uncertificated, whether upon original issuance, re-issuance, or subsequent transfer.

SECTION 2. Transfers. Subject to any restrictions on transfer and unless otherwise provided by the Board of Directors, shares of stock that are represented by a certificate may be transferred on the books of the Corporation by the surrender to the Corporation or its transfer agent of the certificate theretofore properly endorsed or accompanied by a written assignment or power of attorney properly executed, with transfer stamps (if necessary) affixed, and with such proof of the authenticity of signature as the Corporation or its transfer agent may reasonably require. Shares of stock that are not represented by a certificate may be transferred on the books of the Corporation by submitting to the Corporation or its transfer agent such evidence of transfer and following such other procedures as the Corporation or its transfer agent may require.

SECTION 3. Record Holders. Except as may otherwise be required by law, by the Certificate or by these Bylaws, the Corporation shall be entitled to treat the record holder of stock as shown on its books as the owner of such stock for all purposes, including the payment of dividends and the right to vote with respect thereto, regardless of any transfer, pledge or other disposition of such stock, until the shares have been transferred on the books of the Corporation in accordance with the requirements of these Bylaws.

SECTION 4. Record Date. In order that the Corporation may determine the stockholders entitled to notice of or to vote at any meeting of stockholders or any adjournment thereof or entitled to receive payment of any dividend or other distribution or allotment of any rights, or entitled to exercise any rights in respect of any change, conversion or exchange of stock or for the purpose of any other lawful action, the Board of Directors may fix a record date, which record date shall not precede the date upon which the resolution fixing the record date is adopted by the Board of Directors, and which record date: (a) in the case of determination of stockholders entitled to vote at any meeting of stockholders, shall, unless otherwise required by law, not be more than sixty (60) nor less than ten (10) days before the date of such meeting and (b) in the case of any other action, shall not be more than sixty (60) days prior to such other action. If no record date is fixed: (i) the record date for determining stockholders entitled to notice of or to vote at a meeting of stockholders shall be at the close of business on the day next preceding the day on which notice is given, or, if notice is waived, at the close of business on the day next preceding the day on which the meeting is held; and (ii) the record date for determining stockholders for any other purpose shall be at the close of business on the day on which the Board of Directors adopts the resolution relating thereto.

SECTION 5. Replacement of Certificates. In case of the alleged loss, destruction or mutilation of a certificate of stock of the Corporation, a duplicate certificate may be issued in place thereof, upon such terms as the Board of Directors may prescribe.

ARTICLE V

Indemnification

SECTION 1. Definitions. For purposes of this Article:

(a) “Corporate Status” describes the status of a person who is serving or has served (i) as a Director of the Corporation, (ii) as an Officer of the Corporation, (iii) as a Non-Officer Employee of the Corporation, or (iv) as a director, partner, trustee, officer, employee or agent of any other corporation, partnership, limited liability company, joint venture, trust, employee benefit plan, foundation, association, organization or other legal entity which such person is or was serving at the request of the Corporation. For purposes of this Section 1(a), a Director, Officer or Non-Officer Employee of the Corporation who is serving or has served as a director, partner, trustee, officer, employee or agent of a Subsidiary shall be deemed to be serving at the request of the Corporation. Notwithstanding the foregoing, “Corporate Status” shall not include the status of a person who is serving or has served as a director, officer, employee or agent of a constituent corporation absorbed in a merger or consolidation transaction with the Corporation with respect to such person’s activities prior to said transaction, unless specifically authorized by the Board of Directors or the stockholders of the Corporation;

(b) “Director” means any person who serves or has served the Corporation as a director on the Board of Directors of the Corporation;

(c) “Disinterested Director” means, with respect to each Proceeding in respect of which indemnification is sought hereunder, a Director of the Corporation who is not and was not a party to such Proceeding;

(d) “Expenses” means all attorneys’ fees, retainers, court costs, transcript costs, fees of expert witnesses, private investigators and professional advisors (including, without limitation, accountants and investment bankers), travel expenses, duplicating costs, printing and binding costs, costs of preparation of demonstrative evidence and other courtroom presentation aids and devices, costs incurred in connection with document review, organization, imaging and computerization, telephone charges, postage, delivery service fees, and all other disbursements, costs or expenses of the type customarily incurred in connection with prosecuting, defending, preparing to prosecute or defend, investigating, being or preparing to be a witness in, settling or otherwise participating in, a Proceeding;

(e) “Liabilities” means judgments, damages, liabilities, losses, penalties, excise taxes, fines and amounts paid in settlement;

(f) “Non-Officer Employee” means any person who serves or has served as an employee or agent of the Corporation, but who is not or was not a Director or Officer;

(g) “Officer” means any person who serves or has served the Corporation as an officer of the Corporation appointed by the Board of Directors;

(h) “Proceeding” means any threatened, pending or completed action, suit, arbitration, alternate dispute resolution mechanism, inquiry, investigation, administrative hearing or other proceeding, whether civil, criminal, administrative, arbitral or investigative; and

(i) “Subsidiary” shall mean any corporation, partnership, limited liability company, joint venture, trust or other entity of which the Corporation owns (either directly or through or together with another Subsidiary of the Corporation) either (i) a general partner, managing member or other similar interest or (ii) (A) fifty percent (50%) or more of the voting power of the voting capital equity interests of such corporation, partnership, limited liability company, joint venture or other entity, or (B) fifty percent (50%) or more of the outstanding voting capital stock or other voting equity interests of such corporation, partnership, limited liability company, joint venture or other entity.

SECTION 2. Indemnification of Directors and Officers.

(a) Subject to the operation of Section 4 of this Article V of these Bylaws, each Director and Officer shall be indemnified and held harmless by the Corporation to the fullest extent authorized by the DGCL, as the same exists or may hereafter be amended (but, in the case of any such amendment, only to the extent that such amendment permits the Corporation to provide broader indemnification rights than such law permitted the Corporation to provide prior to such amendment), and to the extent authorized in this Section 2.

(1) Actions, Suits and Proceedings Other than By or In the Right of the Corporation. Each Director and Officer shall be indemnified and held harmless by the Corporation against any and all Expenses and Liabilities that are incurred or paid by such Director or Officer or on such Director’s or Officer’s behalf in connection with any Proceeding or any claim, issue or matter therein (other than an action by or in the right of the Corporation), which such Director or Officer is, or is threatened to be made, a party to or participant in by reason of such Director’s or Officer’s Corporate Status, if such Director or Officer acted in good faith and in a manner such Director or Officer reasonably believed to be in or not opposed to the best interests of the Corporation and, with respect to any criminal proceeding, had no reasonable cause to believe his or her conduct was unlawful.

(2) Actions, Suits and Proceedings By or In the Right of the Corporation. Each Director and Officer shall be indemnified and held harmless by the Corporation against any and all Expenses that are incurred by such Director or Officer or on such Director’s or Officer’s behalf in connection with any Proceeding or any claim, issue or matter therein by or in the right of the Corporation, which such Director or Officer is, or is threatened to be made, a party to or participant in by reason of such Director’s or Officer’s Corporate Status, if such Director or Officer acted in good faith and in a manner such Director or Officer reasonably believed to be in or not opposed to the best interests of the Corporation; provided, however, that no indemnification shall be made under this Section 2(a)(2) in respect of any claim, issue or matter as to which such Director or

Officer shall have been finally adjudged by a court of competent jurisdiction to be liable to the Corporation, unless, and only to the extent that, the Court of Chancery or another court in which such Proceeding was brought shall determine upon application that, despite adjudication of liability, but in view of all the circumstances of the case, such Director or Officer is fairly and reasonably entitled to indemnification for such Expenses that such court deems proper.

(3) Survival of Rights. The rights of indemnification provided by this Section 2 shall continue as to a Director or Officer after he or she has ceased to be a Director or Officer and shall inure to the benefit of his or her heirs, executors, administrators and personal representatives.

(4) Actions by Directors or Officers. Notwithstanding the foregoing, the Corporation shall indemnify any Director or Officer seeking indemnification in connection with a Proceeding initiated by such Director or Officer only if such Proceeding (including any parts of such Proceeding not initiated by such Director or Officer) was authorized in advance by the Board of Directors, unless such Proceeding was brought to enforce such Officer's or Director's rights to indemnification or, in the case of Directors, advancement of Expenses under these Bylaws in accordance with the provisions set forth herein.

SECTION 3. Indemnification of Non-Officer Employees. Subject to the operation of Section 4 of this Article V of these Bylaws, each Non-Officer Employee may, in the discretion of the Board of Directors, be indemnified by the Corporation to the fullest extent authorized by the DGCL, as the same exists or may hereafter be amended, against any or all Expenses and Liabilities that are incurred by such Non-Officer Employee or on such Non-Officer Employee's behalf in connection with any threatened, pending or completed Proceeding, or any claim, issue or matter therein, which such Non-Officer Employee is, or is threatened to be made, a party to or participant in by reason of such Non-Officer Employee's Corporate Status, if such Non-Officer Employee acted in good faith and in a manner such Non-Officer Employee reasonably believed to be in or not opposed to the best interests of the Corporation and, with respect to any criminal proceeding, had no reasonable cause to believe his or her conduct was unlawful. The rights of indemnification provided by this Section 3 shall exist as to a Non-Officer Employee after he or she has ceased to be a Non-Officer Employee and shall inure to the benefit of his or her heirs, personal representatives, executors and administrators. Notwithstanding the foregoing, the Corporation may indemnify any Non-Officer Employee seeking indemnification in connection with a Proceeding initiated by such Non-Officer Employee only if such Proceeding was authorized in advance by the Board of Directors.

SECTION 4. Determination. Unless ordered by a court, no indemnification shall be provided pursuant to this Article V to a Director, to an Officer or to a Non-Officer Employee unless a determination shall have been made that such person acted in good faith and in a manner such person reasonably believed to be in or not opposed to the best interests of the Corporation and, with respect to any criminal Proceeding, such person had no reasonable cause to believe his or her conduct was unlawful. Such determination shall be made by (a) a majority vote of the Disinterested Directors, even though less than a quorum of the Board of Directors, (b) a

committee comprised of Disinterested Directors, such committee having been designated by a majority vote of the Disinterested Directors (even though less than a quorum), (c) if there are no such Disinterested Directors, or if a majority of Disinterested Directors so directs, by independent legal counsel in a written opinion, or (d) by the stockholders of the Corporation.

SECTION 5. Advancement of Expenses to Directors Prior to Final Disposition.

(a) The Corporation shall advance all Expenses incurred by or on behalf of any Director in connection with any Proceeding in which such Director is involved by reason of such Director's Corporate Status within thirty (30) days after the receipt by the Corporation of a written statement from such Director requesting such advance or advances from time to time, whether prior to or after final disposition of such Proceeding. Such statement or statements shall reasonably evidence the Expenses incurred by such Director and shall be preceded or accompanied by an undertaking by or on behalf of such Director to repay any Expenses so advanced if it shall ultimately be determined that such Director is not entitled to be indemnified against such Expenses. Notwithstanding the foregoing, the Corporation shall advance all Expenses incurred by or on behalf of any Director seeking advancement of expenses hereunder in connection with a Proceeding initiated by such Director only if such Proceeding (including any parts of such Proceeding not initiated by such Director) was (i) authorized by the Board of Directors, or (ii) brought to enforce such Director's rights to indemnification or advancement of Expenses under these Bylaws.

(b) If a claim for advancement of Expenses hereunder by a Director is not paid in full by the Corporation within thirty (30) days after receipt by the Corporation of documentation of Expenses and the required undertaking, such Director may at any time thereafter bring suit against the Corporation to recover the unpaid amount of the claim and if successful in whole or in part, such Director shall also be entitled to be paid the expenses of prosecuting such claim. The failure of the Corporation (including its Board of Directors or any committee thereof, independent legal counsel, or stockholders) to make a determination concerning the permissibility of such advancement of Expenses under this Article V shall not be a defense to an action brought by a Director for recovery of the unpaid amount of an advancement claim and shall not create a presumption that such advancement is not permissible. The burden of proving that a Director is not entitled to an advancement of expenses shall be on the Corporation.

(c) In any suit brought by the Corporation to recover an advancement of Expenses pursuant to the terms of an undertaking, the Corporation shall be entitled to recover such Expenses upon a final adjudication that the Director has not met any applicable standard for indemnification set forth in the DGCL.

SECTION 6. Advancement of Expenses to Officers and Non-Officer Employees Prior to Final Disposition.

(a) The Corporation may, at the discretion of the Board of Directors, advance any or all Expenses incurred by or on behalf of any Officer or any Non-Officer Employee in connection with any Proceeding in which such person is involved by reason of his or her Corporate Status as an Officer or Non-Officer Employee upon the receipt by the Corporation of a statement or

statements from such Officer or Non-Officer Employee requesting such advance or advances from time to time, whether prior to or after final disposition of such Proceeding. Such statement or statements shall reasonably evidence the Expenses incurred by such Officer or Non-Officer Employee and shall be preceded or accompanied by an undertaking by or on behalf of such person to repay any Expenses so advanced if it shall ultimately be determined that such Officer or Non-Officer Employee is not entitled to be indemnified against such Expenses.

(b) In any suit brought by the Corporation to recover an advancement of expenses pursuant to the terms of an undertaking, the Corporation shall be entitled to recover such expenses upon a final adjudication that the Officer or Non-Officer Employee has not met any applicable standard for indemnification set forth in the DGCL.

SECTION 7. Contractual Nature of Rights.

(a) The provisions of this Article V shall be deemed to be a contract between the Corporation and each Director and Officer entitled to the benefits hereof at any time while this Article V is in effect, in consideration of such person's past or current and any future performance of services for the Corporation. Neither amendment, repeal or modification of any provision of this Article V nor the adoption of any provision of the Certificate of Incorporation inconsistent with this Article V shall eliminate or reduce any right conferred by this Article V in respect of any act or omission occurring, or any cause of action or claim that accrues or arises or any state of facts existing, at the time of or before such amendment, repeal, modification or adoption of an inconsistent provision (even in the case of a proceeding based on such a state of facts that is commenced after such time), and all rights to indemnification and advancement of Expenses granted herein or arising out of any act or omission shall vest at the time of the act or omission in question, regardless of when or if any proceeding with respect to such act or omission is commenced. The rights to indemnification and to advancement of expenses provided by, or granted pursuant to, this Article V shall continue notwithstanding that the person has ceased to be a Director or Officer of the Corporation and shall inure to the benefit of the estate, heirs, executors, administrators, legatees and distributees of such person.

(b) If a claim for indemnification hereunder by a Director or Officer is not paid in full by the Corporation within sixty (60) days after receipt by the Corporation of a written claim for indemnification, such Director or Officer may at any time thereafter bring suit against the Corporation to recover the unpaid amount of the claim, and if successful in whole or in part, such Director or Officer shall also be entitled to be paid the expenses of prosecuting such claim. The failure of the Corporation (including its Board of Directors or any committee thereof, independent legal counsel, or stockholders) to make a determination concerning the permissibility of such indemnification under this Article V shall not be a defense to an action brought by a Director or Officer for recovery of the unpaid amount of an indemnification claim and shall not create a presumption that such indemnification is not permissible. The burden of proving that a Director or Officer is not entitled to indemnification shall be on the Corporation.

(c) In any suit brought by a Director or Officer to enforce a right to indemnification hereunder, it shall be a defense that such Director or Officer has not met any applicable standard for indemnification set forth in the DGCL.

SECTION 8. Non-Exclusivity of Rights. The rights to indemnification and to advancement of Expenses set forth in this Article V shall not be exclusive of any other right which any Director, Officer, or Non-Officer Employee may have or hereafter acquire under any statute, provision of the Certificate or these Bylaws, agreement, vote of stockholders or Disinterested Directors or otherwise.

SECTION 9. Insurance. The Corporation may maintain insurance, at its expense, to protect itself and any Director, Officer or Non-Officer Employee against any liability of any character asserted against or incurred by the Corporation or any such Director, Officer or Non-Officer Employee, or arising out of any such person's Corporate Status, whether or not the Corporation would have the power to indemnify such person against such liability under the DGCL or the provisions of this Article V.

SECTION 10. Other Indemnification. The Corporation's obligation, if any, to indemnify or provide advancement of Expenses to any person under this Article V as a result of such person serving, at the request of the Corporation, as a director, partner, trustee, officer, employee or agent of another corporation, partnership, joint venture, trust, employee benefit plan or other enterprise shall be reduced by any amount such person may collect as indemnification or advancement of Expenses from such other corporation, partnership, joint venture, trust, employee benefit plan or enterprise (the "Primary Indemnitor"). Any indemnification or advancement of Expenses under this Article V owed by the Corporation as a result of a person serving, at the request of the Corporation, as a director, partner, trustee, officer, employee or agent of another corporation, partnership, joint venture, trust, employee benefit plan or other enterprise shall only be in excess of, and shall be secondary to, the indemnification or advancement of Expenses available from the applicable Primary Indemnitor(s) and any applicable insurance policies.

ARTICLE VI

Miscellaneous Provisions

SECTION 1. Fiscal Year. The fiscal year of the Corporation shall be determined by the Board of Directors.

SECTION 2. Seal. The Board of Directors shall have power to adopt and alter the seal of the Corporation.

SECTION 3. Execution of Instruments. All deeds, leases, transfers, contracts, bonds, notes and other obligations to be entered into by the Corporation in the ordinary course of its business without director action may be executed on behalf of the Corporation by the Chairman of the Board, if one is elected, the Chief Executive Officer, the President or the Treasurer or any other officer, employee or agent of the Corporation as the Board of Directors or a committee of the Board of Directors may authorize.

SECTION 4. Voting of Securities. Unless the Board of Directors otherwise provides, the Chairman of the Board, if one is elected, the Chief Executive Officer, the President or the Treasurer may waive notice of and act on behalf of the Corporation, or appoint another person or persons to act as proxy or attorney in fact for the Corporation with or without discretionary power and/or power of substitution, at any meeting of stockholders or shareholders of any other corporation or organization, any of whose securities are held by the Corporation.

SECTION 5. Resident Agent. The Board of Directors may appoint a resident agent upon whom legal process may be served in any action or proceeding against the Corporation.

SECTION 6. Corporate Records. The original or attested copies of the Certificate, Bylaws and records of all meetings of the incorporators, stockholders and the Board of Directors and the stock transfer books, which shall contain the names of all stockholders, their record addresses and the amount of stock held by each, may be kept outside the State of Delaware and shall be kept at the principal office of the Corporation, at an office of its counsel, at an office of its transfer agent or at such other place or places as may be designated from time to time by the Board of Directors.

SECTION 7. Certificate. All references in these Bylaws to the Certificate shall be deemed to refer to the Amended and Restated Certificate of Incorporation of the Corporation, as amended and/or restated and in effect from time to time.

SECTION 8. Exclusive Jurisdiction of Delaware Courts. Unless the Corporation consents in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware shall be the sole and exclusive forum for (i) any derivative action or proceeding brought on behalf of the Corporation, (ii) any action asserting a claim of breach of a fiduciary duty owed by any Director, officer or other employee of the Corporation to the Corporation or the Corporation's stockholders, (iii) any action asserting a claim arising pursuant to any provision of the Delaware General Corporation Law or the Certificate or Bylaws, or (iv) any action asserting a claim against the Corporation governed by the internal affairs doctrine. Any person or entity purchasing or otherwise acquiring any interest in shares of capital stock of the Corporation shall be deemed to have notice of and consented to the provisions of this Section 8.

SECTION 9. Amendment of Bylaws.

(a) Amendment by Directors. Except as provided otherwise by law, these Bylaws may be amended or repealed by the Board of Directors by the affirmative vote of a majority of the Directors then in office.

(b) Amendment by Stockholders. These Bylaws may be amended or repealed at any Annual Meeting, or special meeting of stockholders called for such purpose in accordance with these Bylaws, by the affirmative vote of at least seventy-five percent (75%) of the outstanding shares entitled to vote on such amendment or repeal, voting together as a single class; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the

affirmative vote of the majority of the outstanding shares entitled to vote on such amendment or repeal, voting together as a single class. Notwithstanding the foregoing, stockholder approval shall not be required unless mandated by the Certificate, these Bylaws, or other applicable law.

SECTION 10. Notices. If mailed, notice to stockholders shall be deemed given when deposited in the mail, postage prepaid, directed to the stockholder at such stockholder's address as it appears on the records of the Corporation. Without limiting the manner by which notice otherwise may be given to stockholders, any notice to stockholders may be given by electronic transmission in the manner provided in Section 232 of the DGCL.

SECTION 11. Waivers. A written waiver of any notice, signed by a stockholder or Director, or waiver by electronic transmission by such person, whether given before or after the time of the event for which notice is to be given, shall be deemed equivalent to the notice required to be given to such person. Neither the business to be transacted at, nor the purpose of, any meeting need be specified in such a waiver.

Adopted April 25, 2015, subject to effectiveness immediately prior to the completion of the Corporation's initial public offering of its common stock.

**CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) OF THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Sanjay S. Shukla, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q of aTyr Pharma, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) 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(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: November 14, 2022

/s/ Sanjay S. Shukla

Sanjay S. Shukla, M.D., M.S.
President and Chief Executive Officer
(Principal Executive Officer)

**CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) OF THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Jill M. Broadfoot, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q of aTyr Pharma, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) 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(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: November 14, 2022

/s/ Jill M. Broadfoot

Jill M. Broadfoot

Chief Financial Officer

(Principal Financial and Accounting Officer)

**CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

In connection with the Quarterly Report on Form 10-Q of aTyr Pharma, Inc. (the "Company") for the period ended September 30, 2022, as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Sanjay S. Shukla, President and Chief Executive Officer of the Company, certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that:

1. The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; 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 14, 2022

/s/ Sanjay S. Shukla

Sanjay S. Shukla, M.D., M.S.
President and Chief Executive Officer
(Principal Executive Officer)

The foregoing certification is being furnished solely to accompany the Report pursuant to 18 U.S.C. § 1350, is not being filed for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, and is not to be incorporated by reference into any filing of the Company, whether made before or after the date hereof, regardless of any general incorporation language in such filing. A signed original of this written statement required by Section 906 of the Sarbanes-Oxley Act of 2002 has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

**CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

In connection with the Quarterly Report on Form 10-Q of aTyr Pharma, Inc. (the "Company") for the period ended September 30, 2022, as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Jill M. Broadfoot, Chief Financial Officer of the Company, certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that:

1. The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; 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 14, 2022

/s/ Jill M. Broadfoot

Jill M. Broadfoot

Chief Financial Officer

(Principal Financial and Accounting Officer)

The foregoing certification is being furnished solely to accompany the Report pursuant to 18 U.S.C. § 1350, is not being filed for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, and is not to be incorporated by reference into any filing of the Company, whether made before or after the date hereof, regardless of any general incorporation language in such filing. A signed original of this written statement required by Section 906 of the Sarbanes-Oxley Act of 2002 has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.
