A New Path to Medicine

Life Sciences Investor Forum

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September 17, 2020

Forward Looking Statements

The following slides and any accompanying oral presentation contain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995 and other federal securities laws. The use of words such as “may,” “might,” “will,” “should,” “expect,” “plan,” “anticipate,” “believe,” “estimate,” “project,” “intend,” “future,” “potential,” “opportunity,” or “continue,” and other similar expressions are intended to identify forward-looking statements. For example, all statements regarding: the potential therapeutic benefits of proteins derived from tRNA synthetase genes and our product candidates, including ATYR1923, and development programs; the ability to successfully advance our product candidates and undertake certain development activities (such as the initiation of clinical trials, clinical trials enrollment, the conduct of clinical trials and announcement of top-line results) and accomplish certain development goals, and the timing of such events; our ability to receive regulatory approvals for, and commercialize, our product candidates; our ability to identify and discover additional product candidates; potential activities and payments under collaboration agreements; and the ability of our intellectual property portfolio to provide protection are forward-looking statements. All forward-looking statements are based on estimates and assumptions by our management that, although we believe to be reasonable, are inherently uncertain. All forward-looking statements are subject to risks and uncertainties that may cause actual results to differ materially from those that we expected. These risks, uncertainties and other factors are more fully described in our filings with the U.S. Securities and Exchange Commission, including our Annual Report on Form 10-K, our Quarterly Reports on Form 10-Q, and in our other filings. The forward-looking statements in this presentation speak only as of the date of this presentation and neither we nor any other person assume responsibility for the accuracy and completeness of any forward-looking statement. We undertake no obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future events or otherwise, except as required by law.

aTyr: A New Path to Medicine

Mission	• Develop a new class of medicines based on proprietary biology platform
Phase 2 clinical program: ATYR1923	• Potential first-in-class immunomodulator for severe inflammatory lung diseases • Phase 1b/2a study in pulmonary sarcoidosis(1) • Phase 2 study in COVID-19 related severe respiratory complications readout expected in Q4 2020(2) • Japanese Phase 1 healthy volunteer study initiated by Kyorin Pharmaceuticals in Q3 2020
Pipeline of novel discovery candidates	• First anti-neuropilin-2 (NRP2) antibody IND candidate expected to be announced in Q4 2020 • tRNA synthetase immunology research collaboration update anticipated in Q4 2020
Financial Position	• Cash, cash equivalents and investments at $41.4m as of June 30, 2020

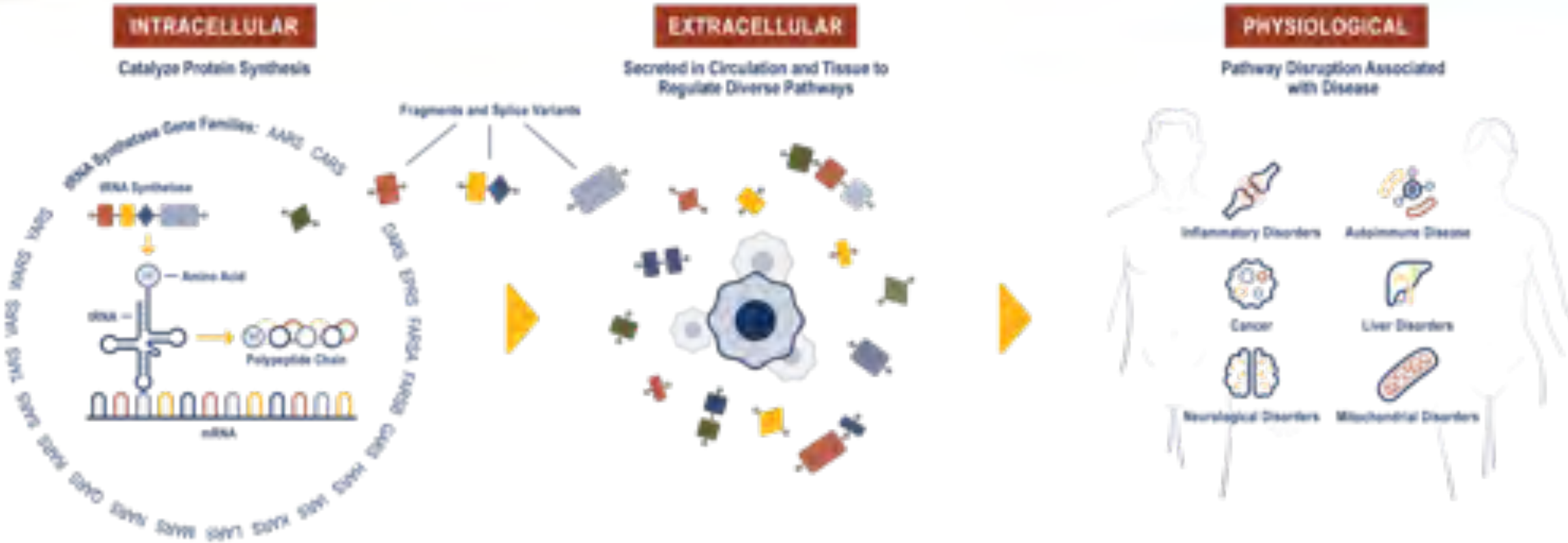
(1) Timing dependent on impact of the COVID-19 pandemic
(2) Timing dependent on site initiation and patient enrollment

aTyr Development Pipeline

PROGRAM	DISEASES	DISCOVERY	PRECLINCAL	PHASE 1	PHASE 2	PHASE 3	Partners
ATYR1923	Pulmonary Sarcoidosis						Kyorin (2)
	Other ILDs (CTD-ILD; CHP)(1)						
	COVID-19 related severe respiratory complications						
NRP2 Antibodies	Cancer; Inflammation						
tRNA Synthetase Candidates	Immunology						CSL Behring (3)

(1) CTD-ILD = connective tissue disease-related ILD; CHP = chronic hypersensitivity pneumonitis
(2) Kyorin partnership for ILD in Japan
(3) CSL partnership for up to 4 tRNA synthetases

tRNA Synthetases May Have Novel Functions Extracellularly

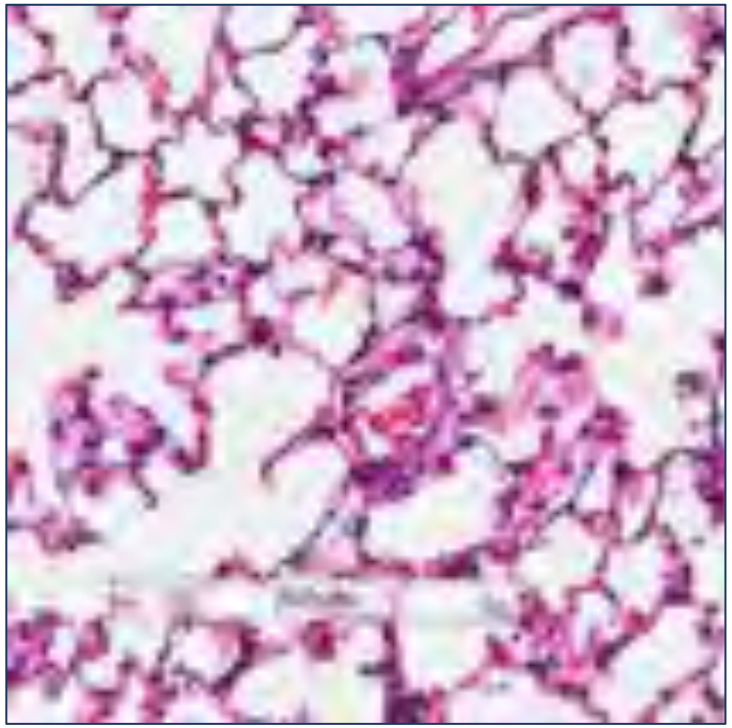


ATYR1923

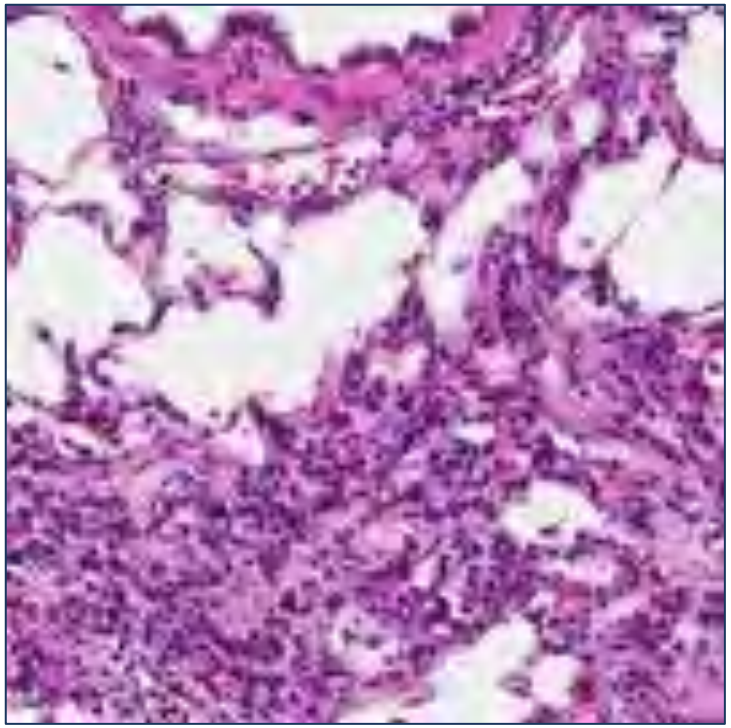
A Novel Immunomodulator for Inflammatory Lung Disease

A Novel Mechanism to Treat Inflammation

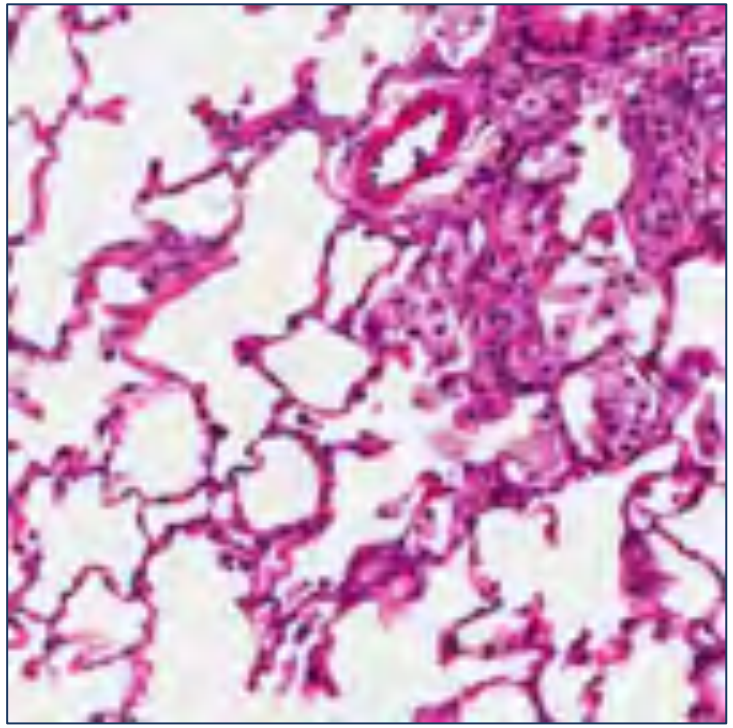
Healthy lung



Injured lung



ATYR1923 treated



Representative histology showing immune cell infiltrate in a rat model of bleomycin induced lung fibrosis presented at the American Thoracic Society annual meeting 2018.

ATYR1923: Potential First-in-Class Therapy for Severe Inflammatory Lung Disease

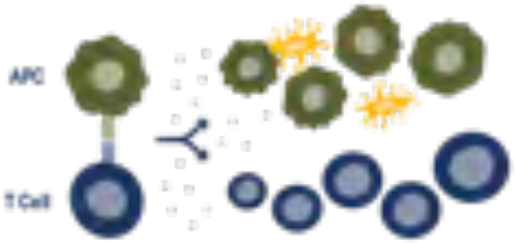
- Fc fusion protein therapeutic derived from aTyr's proprietary protein library
- Binds selectively to NRP2, a cell surface receptor upregulated in inflamed lung tissue
- Downregulates inflammatory and pro-fibrotic cytokine and chemokine levels as well as histological inflammation and fibrosis in pre-clinical models
- Well tolerated in 25 healthy subjects in Phase 1 with PK supporting monthly IV Dosing
- No safety concerns identified in independent interim safety reviews in pulmonary sarcoidosis and COVID-19 patients

ATYR1923 Mechanism of Action in Inflammatory Lung Disease

Disease Trigger

Organic; inorganic; infectious; autoimmune

Aberrant Immune Responses

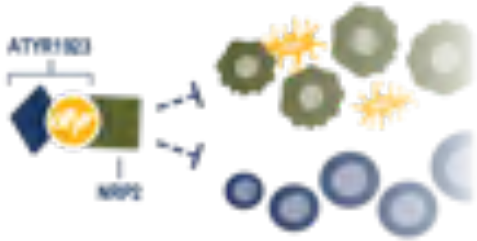


T-cell activation; Pro-inflammatory cytokine/chemokines triggering fibrotic pathways; NRP2 upregulation on immune cells

Lung Inflammation & Fibrosis

Persistent, unresolved inflammation in the lung can lead to fibrosis; patients experience chronic cough, dyspnea, mortality

ATYR1923 Dampens Immune Responses



ATYR1923 binds to NRP2 and downregulates cytokine and chemokine production and T-cell activation

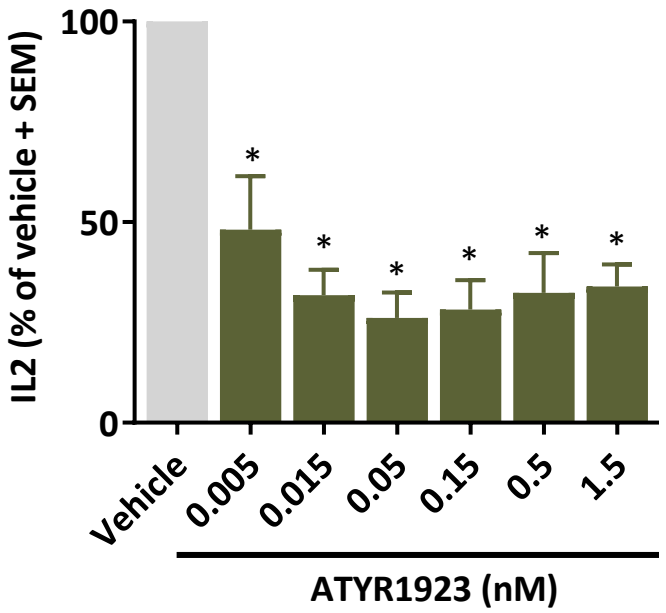
Stabilized Lung

Reduced inflammation and fibrotic deposition; symptom relief, stabilized lung function*

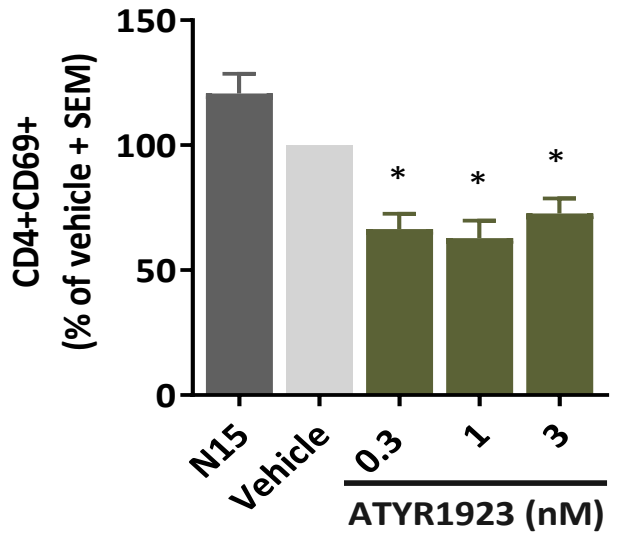
*aTyr hypothesis

First Identified Mechanism: Inhibition of T Cell Activation

Human naïve T cells
Stimulated with anti-CD3/CD28



CD4+ T cells
Surface activation marker (CD69)



Also inhibits release of other cytokines: IFNγ, IL-17, IL-5, IL-13, IL-21, IL-10, TNFα

Modified from *in vitro* data presented at AAI 2018; * = $p < 0.05$; N15 = negative control for ATYR1923

Demonstrated Effect in Animal Lung Injury Models

P. acnes (Sarcoidosis)	↓ pro-fibrotic proteins
S. Rectivirgula (CHP)	↓ tissue cytokines/chemokines and enzymes
Sclerodermatous GvHD (SSc-ILD)	↓ fibrosis
SKG mice (RA-ILD)	↓ immune infiltrates
Bleomycin-Induced Lung Fibrosis (IPF)	↓ inflammation / fibrosis

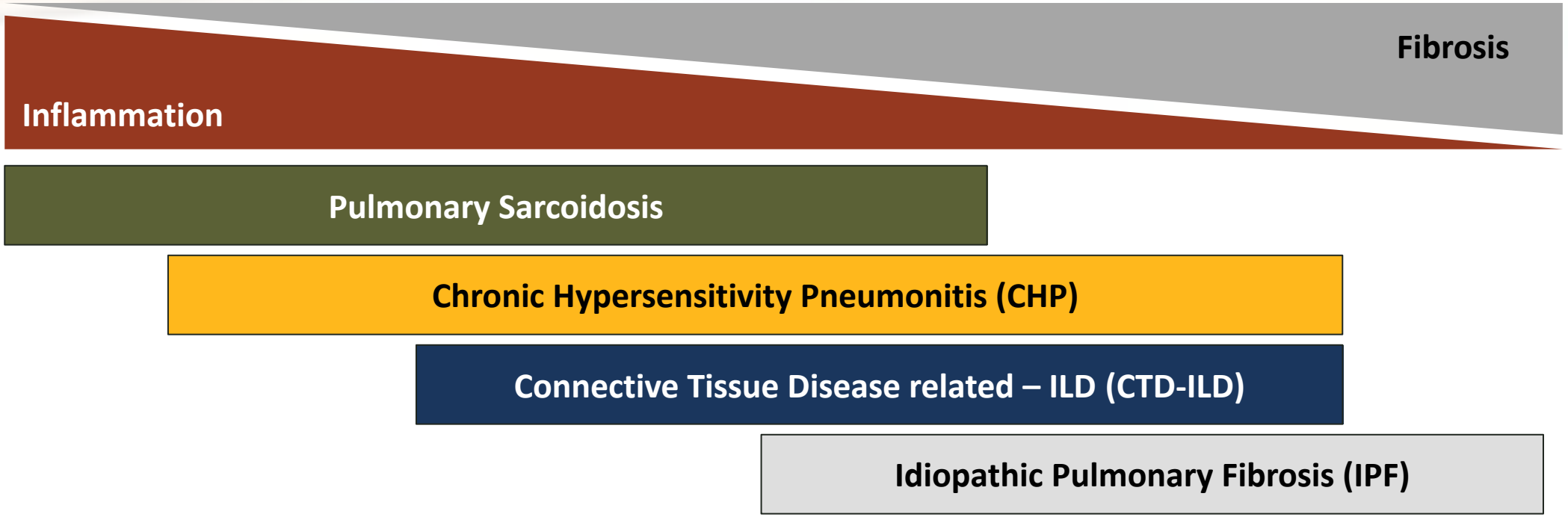
Consistent downregulation of pro-inflammatory cytokines including IL-6, MCP-1, and IFN-γ

Data available at https://www.atyrpharma.com/our-science/publications/

ATYR1923

Interstitial Lung Disease

ILDs Share Common Immune Pathology Leading to Fibrosis

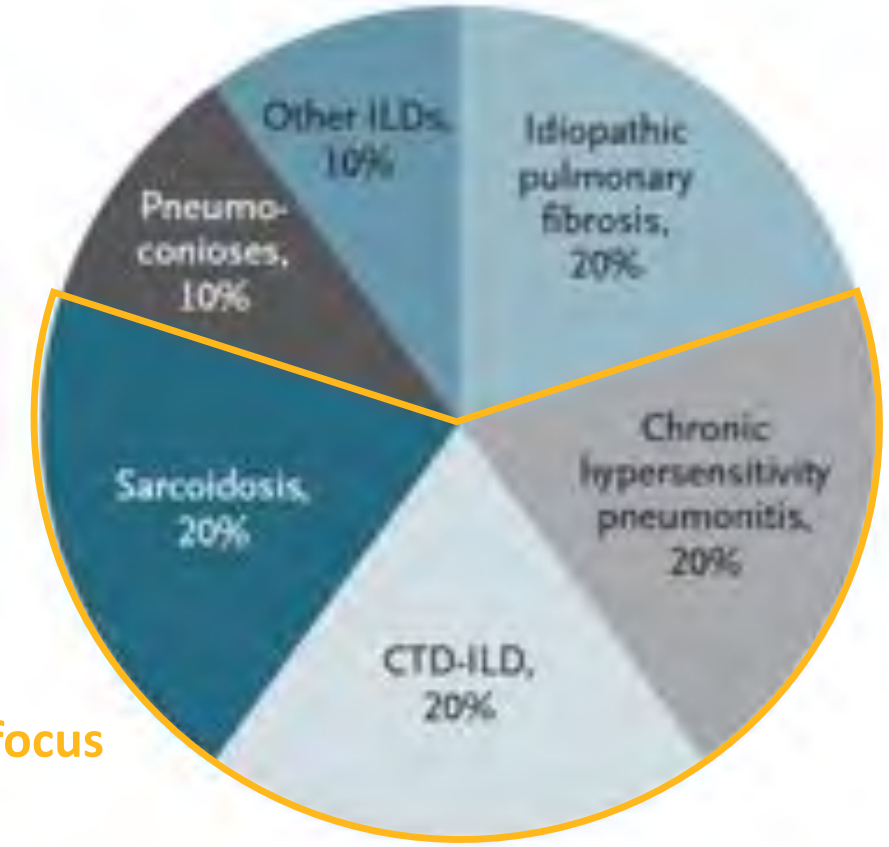


- ILDs lie on a spectrum of inflammation and fibrosis, but all share an immune pathology
- Progression to fibrosis is a key driver of morbidity and mortality
- By targeting aberrant immune response driving fibrosis, ATYR1923 has potential to improve outcomes in multiple ILDs

Slide adapted from Dr. Steven Nathan, Medical Director, Advanced Lung Disease and Transplant Program at Inova Fairfax Hospital, Falls Church, VA

Market Opportunity in Inflammatory Interstitial Lung Disease

Relative Distribution of ILDs in the USA(1)



- >200 types of ILD: 4 major types comprise 80% of patients
- Limited standard of care with substantial morbidity and mortality
- aTyr focused on 3 most inflammatory types: ~500-600k US patients(2); ~3m globally
- $2-3b global market opportunity(3)

(1) Lederer, Martinez. NEJM 2018
(2) All ILDs individually have potential for orphan status
(3) aTyr estimates for ATYR1923 in Pulmonary Sarcoidosis, CHP, CTD-ILD; excludes IPF

First ATYR1923 Indication: Pulmonary Sarcoidosis

- Inflammatory disease of unknown etiology characterized by the formation of granulomas (clumps of immune cells)
- T cell driven: CD4+ (Th1 / Th17)
- Pulmonary sarcoidosis occurs in ~90% of all sarcoidosis patients
- Treatment options are limited with associated toxicity: Corticosteroids, antimetabolite immunosuppressants, TNF inhibitors

50% require systemic therapy

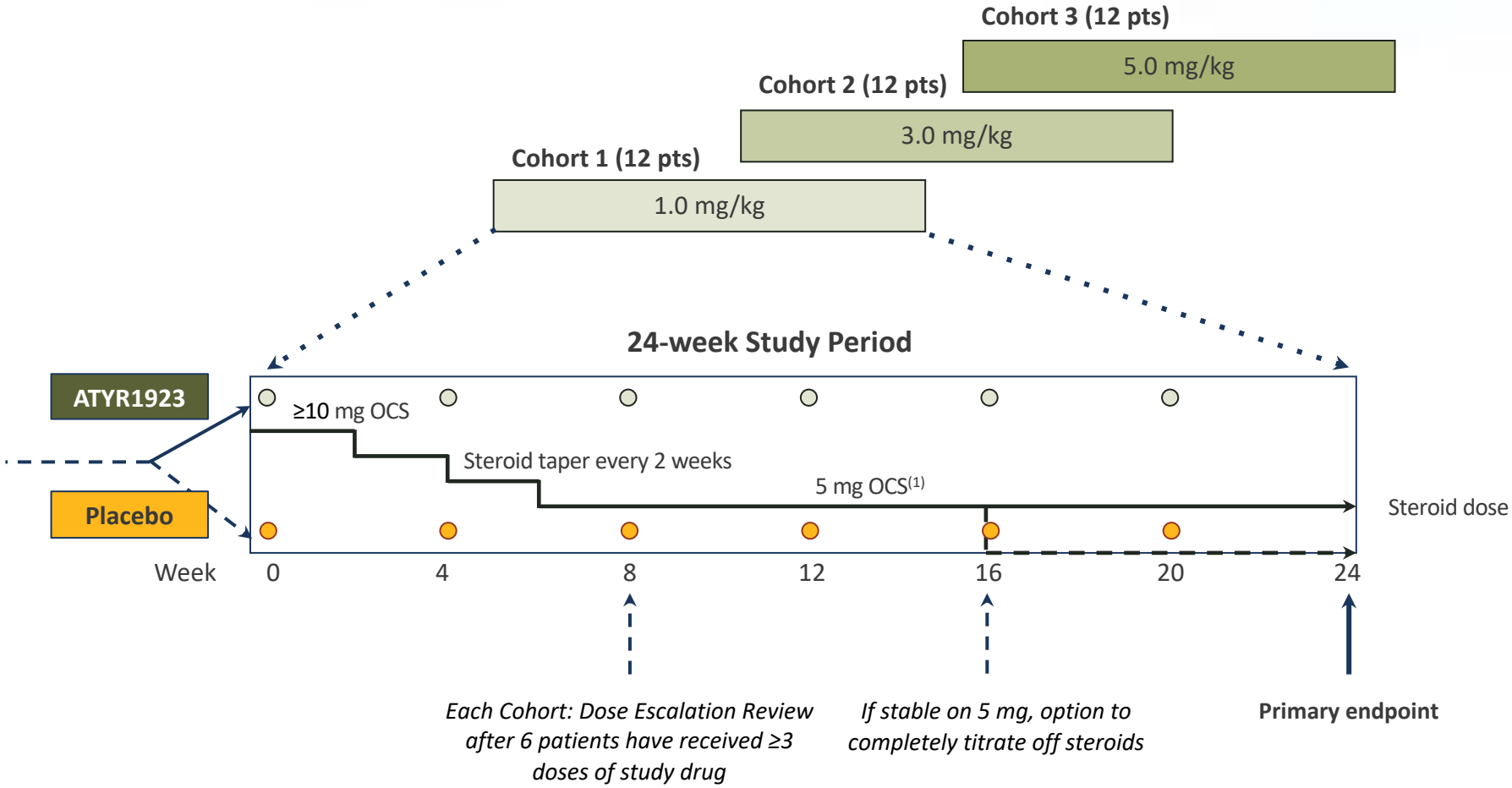
30% have chronic progressive disease despite available treatment

Culver et al. BMJ 2019; Baughman ATS Annals 2016

Phase 1b/2a Study in Pulmonary Sarcoidosis Ongoing

Design	• Randomized (2:1), double-blind, placebo-controlled, multiple ascending dose • 3 IV doses of ATYR1923 being tested at 1.0, 3.0, and 5.0 mg/kg • Forced steroid taper to 5.0 mg by week 8; taper to 0 mg possible at week 16 in responders
Population	• 36 histologically confirmed pulmonary sarcoidosis patients • ≥10 mg stable oral corticosteroid treatment • Symptomatic/active disease at baseline
Primary Endpoint	• Safety and tolerability of multiple ascending IV ATYR1923 doses
Secondary Endpoints	• Steroid-sparing effect • Immunogenicity • Pharmacokinetics (PK) • Exploratory efficacy measures: FDG-PET/CT imaging; Lung function (FVC); Serum biomarkers; Health-related quality of life scales

Phase 1b/2a Pulmonary Sarcoidosis Study Schema



(1) subtherapeutic dose

ATYR1923 Japan Collaboration

Kyorin Overview

- Founded: 1923
- Focus: Respiratory, ENT, Urology
- 1600 employees: incl. 350 in R&D; 750 sales reps covering top respiratory centers in Japan
- Sales: ~$1b USD
- Market cap: $1.1b USD (4569:JP TSE)

Key Terms

- Scope: ATYR1923; Japan; ILD
- Upfront payment: $8m
- Development, regulatory and commercial milestones: $167m
- Tiered sales royalties into double digits
- Kyorin to fund all development and commercial activities in Japan

Phase 1 study to evaluate the safety, pharmacokinetics and immunogenicity in Japanese healthy volunteers initiated.

ATYR1923

COVID-19 Related Severe Respiratory Complications

ATYR1923 for COVID-19 Related Severe Respiratory Complications

COVID-19 Pathology	ATYR1923 MOA
• A subset of COVID-19 patients experience significant lung inflammation leading to morbidity and mortality • Lung inflammation is driven by certain cytokines: IL-2, -7, -6,-10, G-CSF, MCP1, MIP1A and TNF-α	• ATYR1923 decreases inflammatory cytokine release, including IL-2, TNF-α, and IL-13, from human T cells activated *in vitro* • ATYR1923 anti-inflammatory and anti-fibrotic effects, including decreased cytokine/chemokine signaling (IL-6, MCP1 and IFN-ɣ), have been demonstrated in multiple animal models of immune-mediated lung injury
• Lung tissue from patients who died from COVID-19 related respiratory failure shows increased NRP2 (1) • SARS-CoV-2 Spike protein S1 directly binds to the b1 domain of NRP2 (2) (3)	• ATYR1923 binds selectively to NRP2, primarily in the b1 domain

(1) Ackermann, M., Verleden, S.E., Kuehnel, M., et al. NEJM 2020.
(2) http://doi.org/dx5d; 2020
(3) http://doi.org/dx5c; 2020

ATYR1923 Phase 2 Study in COVID-19 Related Severe Respiratory Complications Ongoing

Objective	Evaluate safety and preliminary efficacy of ATYR1923 in subjects hospitalized with COVID-19-related severe respiratory complications not requiring mechanical ventilation
Design	Randomized, double-blind, placebo controlled, single dose
Population	30 adult patients with severe respiratory complications related to COVID-19 infection
Doses	Randomized 1:1:1 - Single dose of 1.0 or 3.0 mg/kg ATYR1923 or Placebo
Endpoints	• Primary: Safety and Tolerability • Secondary: Oxygenation, Fever, Hospital / ICU metrics, Inflammatory markers

NRP2 Antibodies

Regulating Diverse Disease Pathways

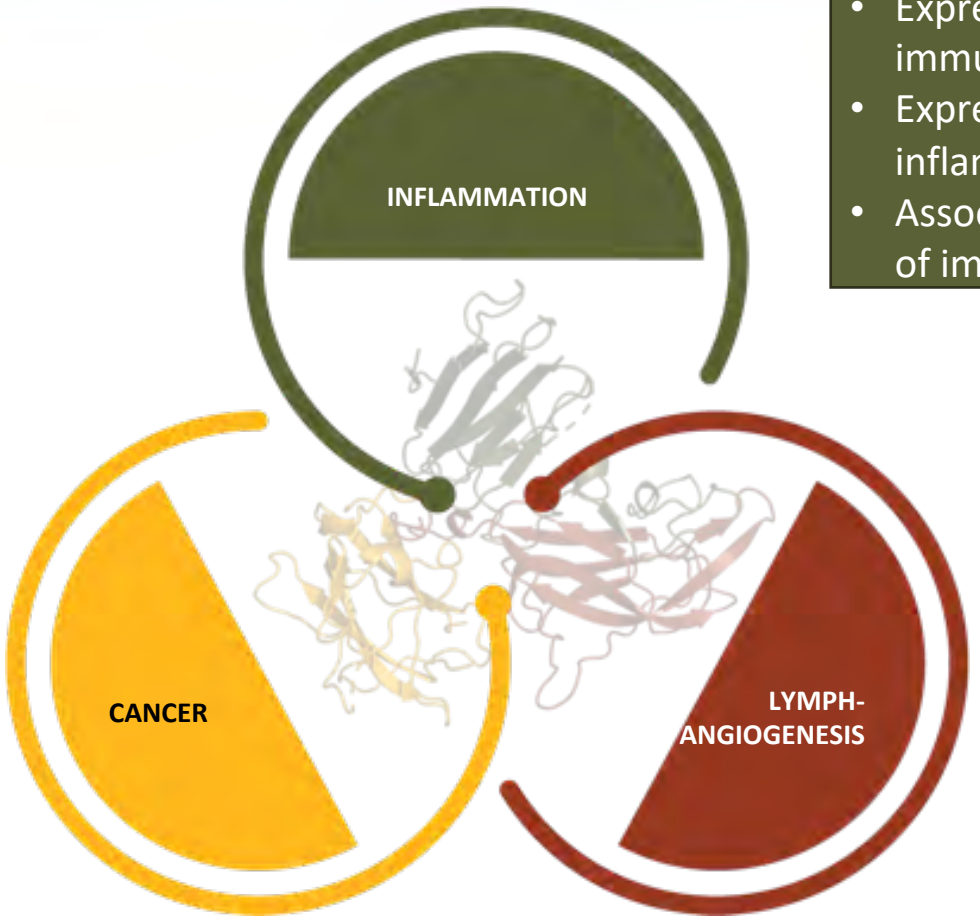
NRP2: A Novel Therapeutic Target

- NRP2 is a potentially novel target for cancer and inflammatory disorders
- Acts as a co-receptor for VEGF-C, class 3 Semaphorins and CCL21
- NRP2 expression is upregulated on tumors and immune cells during inflammation
- NRP2 expression is linked to worse outcomes in many cancers
- aTyr has developed antibodies to selectively target different NRP2 epitopes for diverse therapeutic applications
- aTyr's aNRP210 antibody blocked VEGF-C binding to NRP2 and showed tumor inhibitory effect in preclinical models of triple-negative breast cancer, increasing sensitivity to chemotherapy (1)
- This data suggests aNRP210 could potentially be effective in certain types of solid tumors, including aggressive tumors (1)

(1) Domain-Specific Antibodies to Neuropilin 2 Implicate VEGF-C and not Semaforin 3F in Breast Cancer Stem Cell Function. American Association for Cancer Research, 2020

NRP2 is a Compelling Target for Cancer and Inflammation

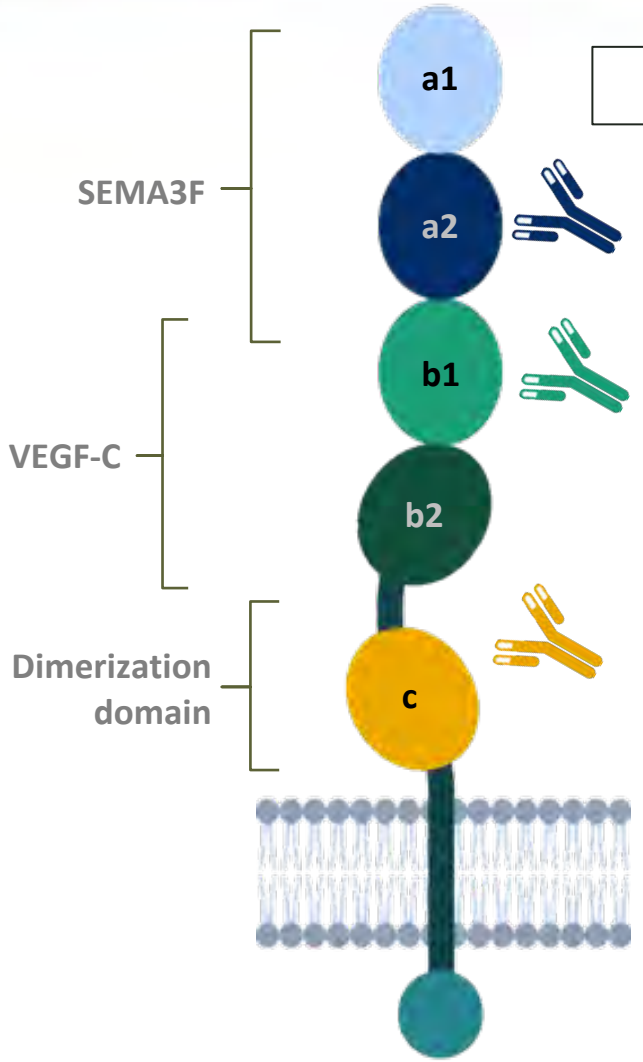
- Overexpressed in a variety of cancers
- Tumor expression linked to worse outcomes



- Expressed on multiple immune cell types
- Expression upregulated in inflammatory conditions
- Associated with trafficking of immune cells

- Lymphatic development and function impaired in NRP2 knockout

aTyr is Developing Human NRP2 Blocking Antibodies



aTyr lead antibodies(1)

SEMA3F Blocker
α-NRP2-14

VEGF-C Blocker
α-NRP2-10

CCL21 Blocker(s)
Under evaluation

(1) Distinct from ATYR1923 interaction with NRP2

tRNA Synthetases

A Potential New Therapeutic Protein Class

tRNA Synthetases: A Potential New Therapeutic Protein Class

- aTyr owns IP covering proteins derived from all 20 tRNA synthetase gene families
- Lead program ATYR1923 is based on a naturally occurring splice variant of one of these families, histidyl-tRNA synthetase (HARS)
- tRNA synthetases are secreted extracellularly and occur in novel forms which lose their canonical function
- Extracellular tRNA synthetase disruption (genetic / autoimmune) is associated with disease in humans
- aTyr working with leading biopharmaceutical company CSL Behring on identifying new IND candidates for immunological disorders in up to four tRNA synthetases from aTyr's pipeline (non-HARS derived)
  - CSL will fund all R&D activities and will pay a total of up to $17.0m in option fees if all four synthetase programs advance
  - aTyr will grant CSL an option to negotiate licenses for worldwide rights to each IND candidate that emerges from this research collaboration

A New Path to Medicine

aTyr: A New Path to Medicine

- Platform of proprietary new biology
- Phase 2 clinical program: ATYR1923
  - Novel MOA for inflammatory lung disease
  - Demonstrated effect in multiple animal lung injury models
  - Phase 1 in healthy volunteers completed
  - Phase 1b/2a clinical study in pulmonary sarcoidosis enrolling in US – positive interim safety data reported 12/2019
  - Kyorin collaboration for ILD in Japan with total deal value up to $175m; Phase 1 study initiated
  - Phase 2 trial in COVID-19 patients with severe respiratory complications enrolling in US– positive outcome from interim safety analysis conducted by an independent data and safety monitoring board reported 8/2020
- Discovery stage programs in cancer and immunology
  - Recently published poster shows aTyr antibody anti-tumor effects in triple-negative breast cancer model
- Cash, cash equivalents, and investments at $41.4m as of June 30, 2020

Upcoming Catalysts

ATYR1923

- Phase 1b/2a results in pulmonary sarcoidosis patients(1)
- Kyorin's Phase 1 in healthy volunteers to support trials for ILD in Japan initiated in Q3 2020
- Phase 2 results in COVID-19 patients expected in Q4 2020(2)
- Potential expansion into Phase 2 studies for second ILD indication

NRP2 Antibodies

- Selection of first anti-NRP2 antibody IND candidate expected in Q4 2020

tRNA Synthetase Candidates

- Outcome from the first phase of the CSL Behring research collaboration planned in Q4 2020

(1) Timing dependent on impact of the COVID-19 pandemic
(2) Timing dependent on site initiation and patient enrollment

Thank You