A New Path to Medicine

January 2021

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 ATYR2810, and development programs, including our NRP2 antibody program and our tRNA synthetase program; 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 clinical results) and accomplish certain development goals, and the timing of such events; the potential market opportunity for our product candidates; 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

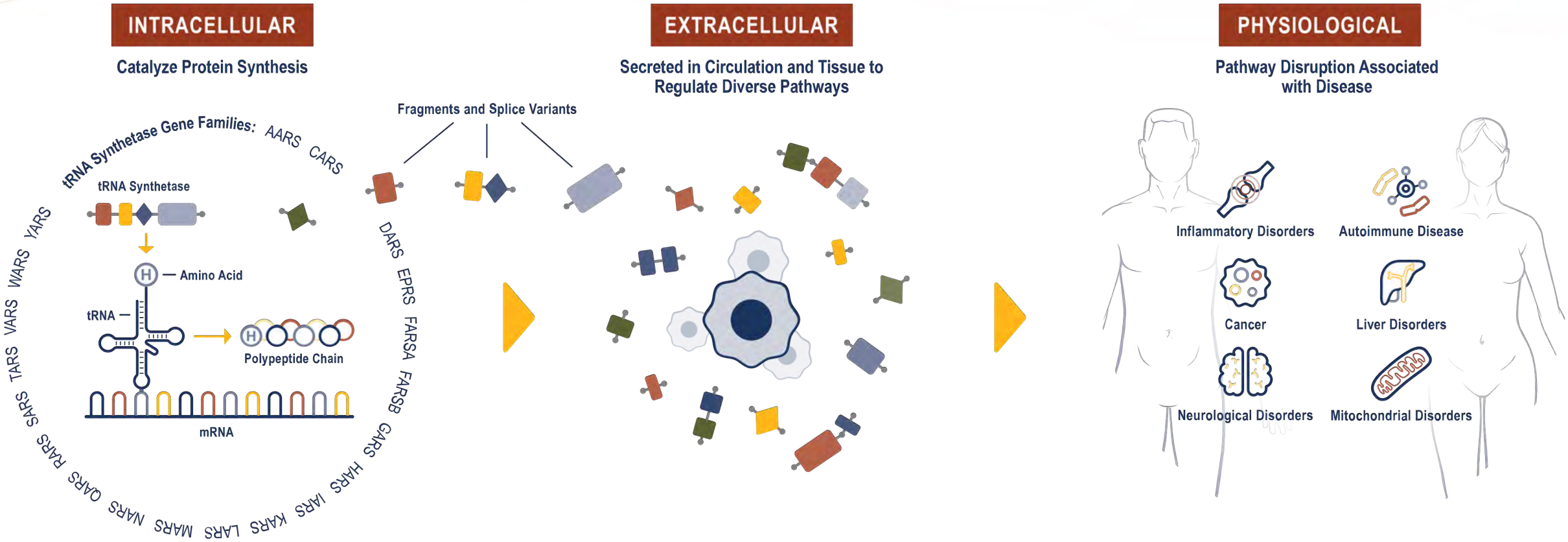
Mission	• Develop a new class of medicines based on proprietary biology platform
Phase 2 clinical program: ATYR1923	• Potential first-in-class immunomodulator for severe inflammatory lung diseases • Phase 1b/2a study in pulmonary sarcoidosis—target enrollment complete and data expected Q3 2021 • Phase 2 study in COVID-19 related severe respiratory complications—positive topline data reported January 2021 • Collaboration with Kyorin Pharmaceutical for ILDs in Japan with total deal value up to $175m
Preclinical program: ATYR2810	• First anti-neuropilin-2 (NRP2) antibody IND candidate in preclinical development for cancer • IND-enabling activities initiated
Pipeline of novel discovery candidates	• NRP2 antibody research program for distinct therapeutic applications • Extracellular functions of tRNA synthetases and associated signaling pathways
Financial Position	• Cash, cash equivalents and investments at $36.1m as of September 30, 2020

aTyr Development Pipeline

PROGRAM	INDICATION	RESEARCH	PRECLINICAL	PHASE 1	PHASE 2	PHASE 3
ATYR1923	Pulmonary Sarcoidosis					
	Other ILDs (CTD-ILD; CHP)(1)					
	Healthy Japanese Volunteers(2)					
	COVID-19 related severe respiratory complications					
ATYR2810	Solid Tumors					
NRP2 mAbs	Cancer; Inflammation					
tRNA Synthetase Candidates	Immunology;(3) Cancer; Fibrosis					

(1) CTD-ILD: connective tissue disease-related ILD (e.g. Scleroderma-related ILD); CHP: chronic hypersensitivity pneumonitis
(2) In partnership with Kyorin Pharmaceutical Co., Ltd.
(3) Includes research collaboration with CSL Behring, Ltd.

tRNA Synthetases May Have Novel Functions Extracellularly

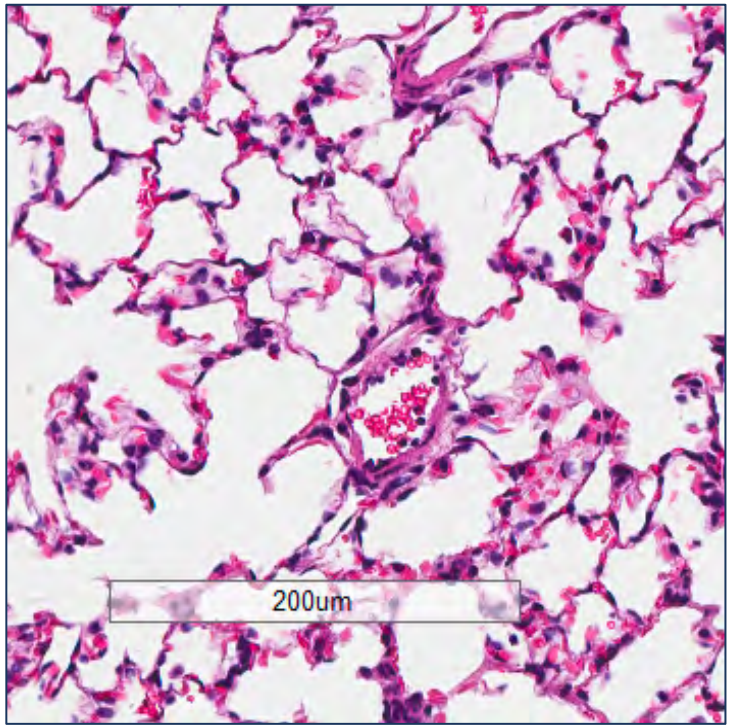


ATYR1923

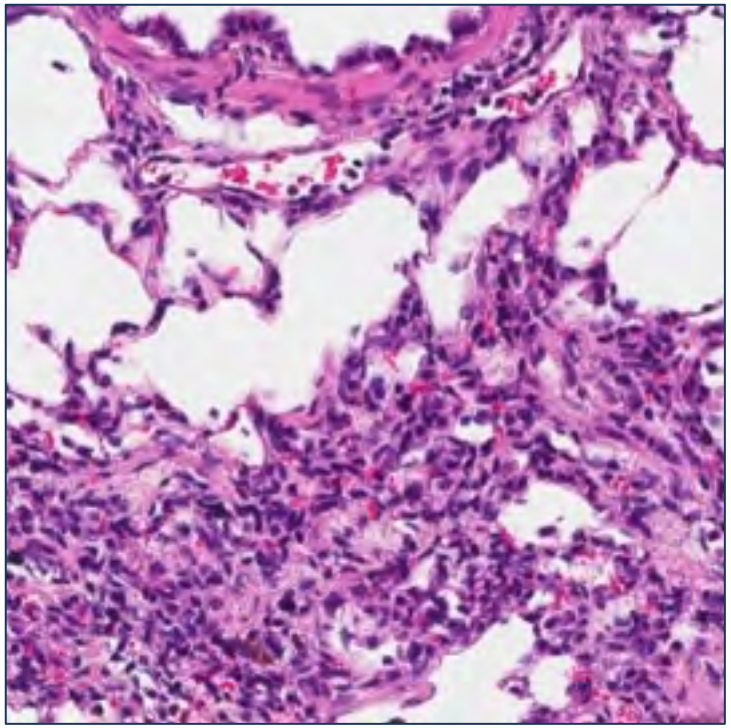
A Novel Immunomodulator for Inflammatory Lung Disease

A Novel Mechanism to Treat Inflammation

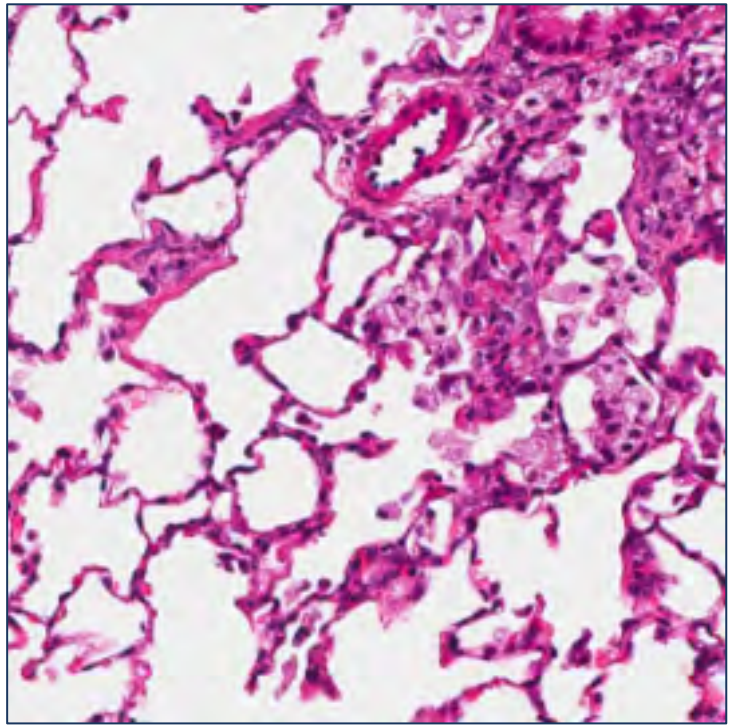
Healthy lung



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: Early Data Supports Therapeutic Potential in Immune-Mediated Lung Disease

- Fc fusion protein, based on lung-enriched histidyl-tRNA synthetase (HARS) fragment, recombinantly expressed in *E. coli*
- Receptor screen identified selective binding to NRP2, a cell surface receptor upregulated on key immune cells during inflammation and is enriched in inflamed lung tissue
  - NRP2expression is detected in granulomas associated with human sarcoidosis of the lung and skin
  - Lung tissue from patients who died from COVID-19 related respiratory failure shows increased NRP2
- Downregulates inflammatory and pro-fibrotic cytokine and chemokine levels as well as histological inflammation and fibrosis in pre-clinical models
- Phase 1 study in healthy volunteers PK supports with once-monthly intravenous dosing
- Well tolerated in patients and subjects dosed to date with exposure up to 24 weeks

Demonstrated Effect in Animal Lung Injury Models

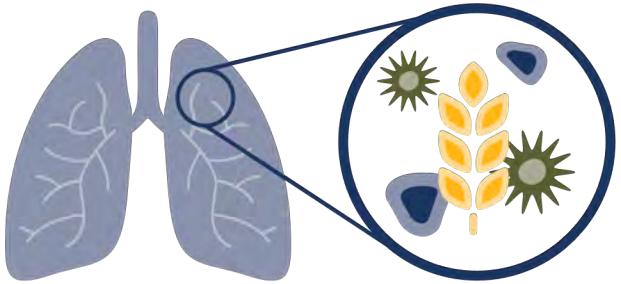
P. acnes (Sarcoidosis)	↓ pro-fibrotic proteins
S. Rectivirgula (CHP)	↓ tissue cytokines/chemokines and enzymes
Sclerodermatous GvHD (SSc-ILD)	↓ fibrosis
SKG mice (RA-ILD)	↓ immune infiltrates
Bleomycin-Induced Lung Fibrosis (IPF)	↓ inflammation / fibrosis

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

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

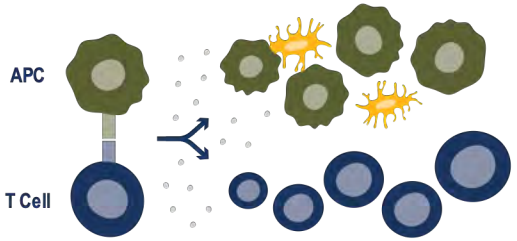
ATYR1923 Mechanism of Action in Inflammatory Lung Disease

Disease Trigger



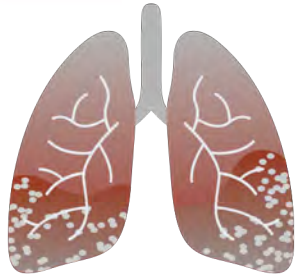
Organic; inorganic; infectious; autoimmune

Aberrant Immune Responses



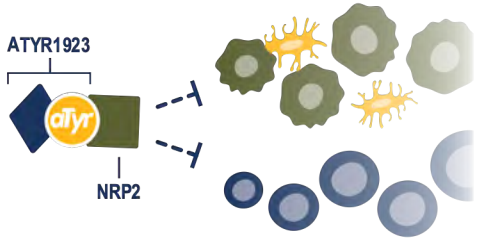
T-cell activation; Pro-inflammatory cytokine/chemokines triggering fibrotic pathways; NRP2 upregulation on immune cells

Lung Inflammation & Fibrosis



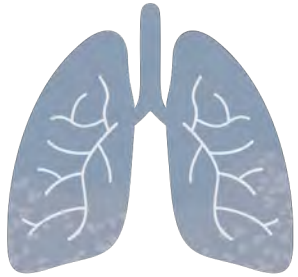
Persistent, unresolved inflammation in the lung can lead to fibrosis; patients experience chronic cough, dyspnea, mortality

ATYR1923 Dampens Immune Responses



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

Stabilized Lung



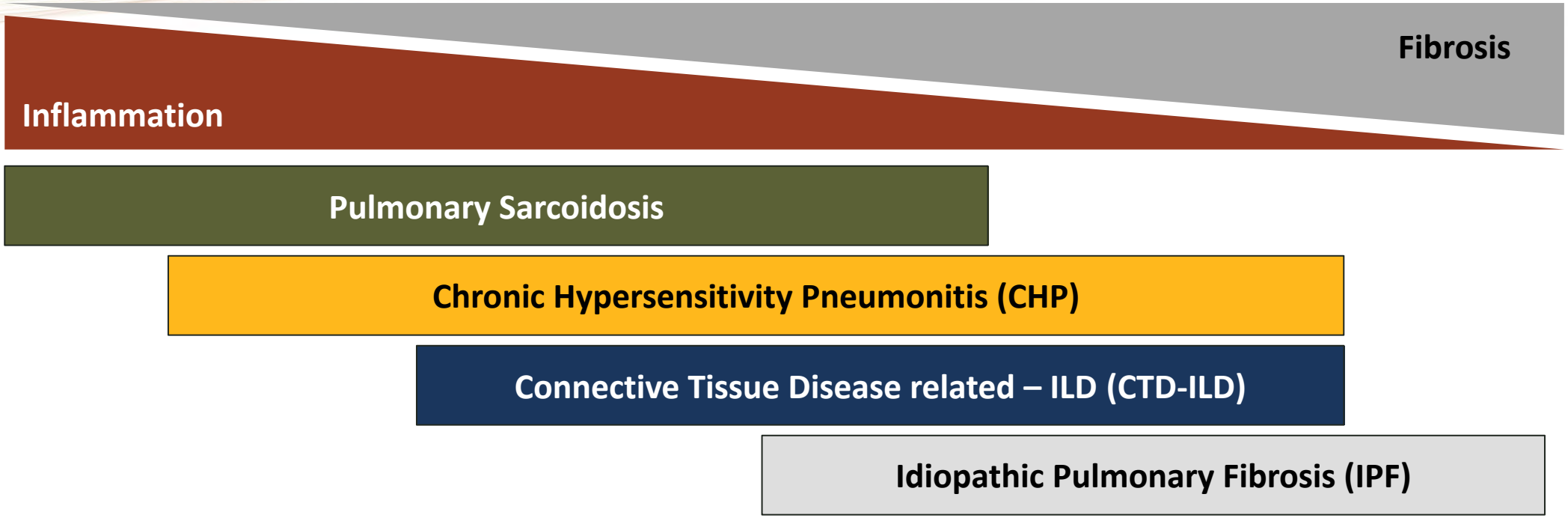
Reduced inflammation and fibrotic deposition; symptom relief, stabilized lung function*

*aTyr hypothesis

ATYR1923

Interstitial Lung Disease

ILDs Share Common Immune Pathology Leading to Fibrosis

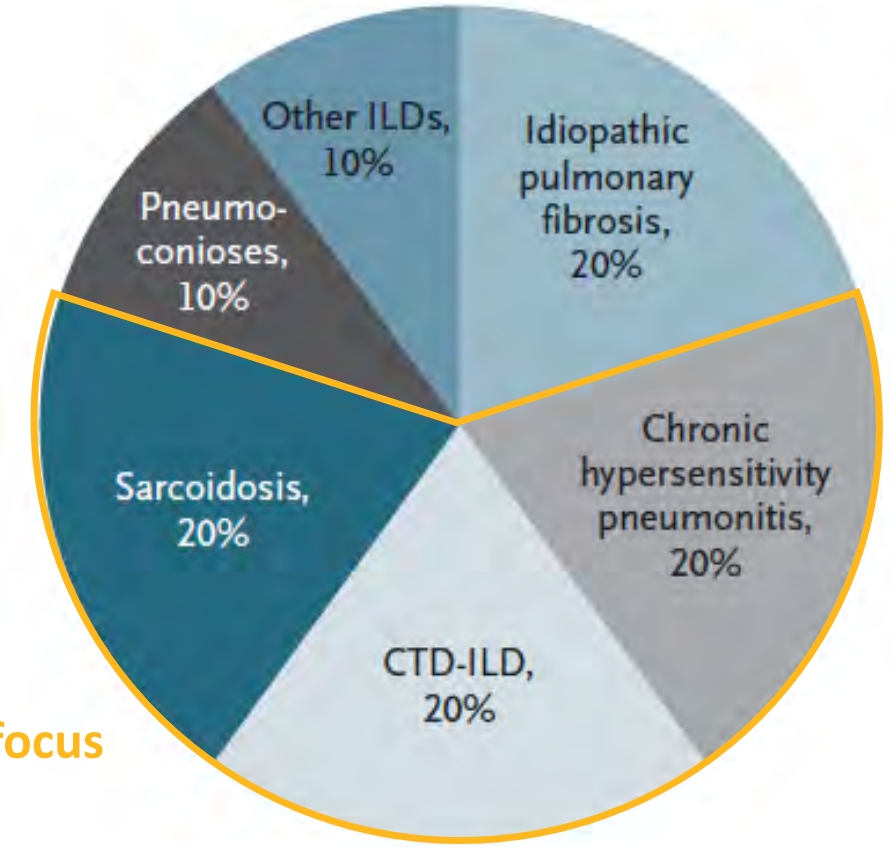


- ILDs lie on a spectrum of inflammation and fibrosis, but all share an immune pathology
- Progression to fibrosis is a key driver of morbidity and mortality
- By targeting aberrant immune response driving fibrosis, ATYR1923 has potential to improve outcomes in multiple ILDs

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

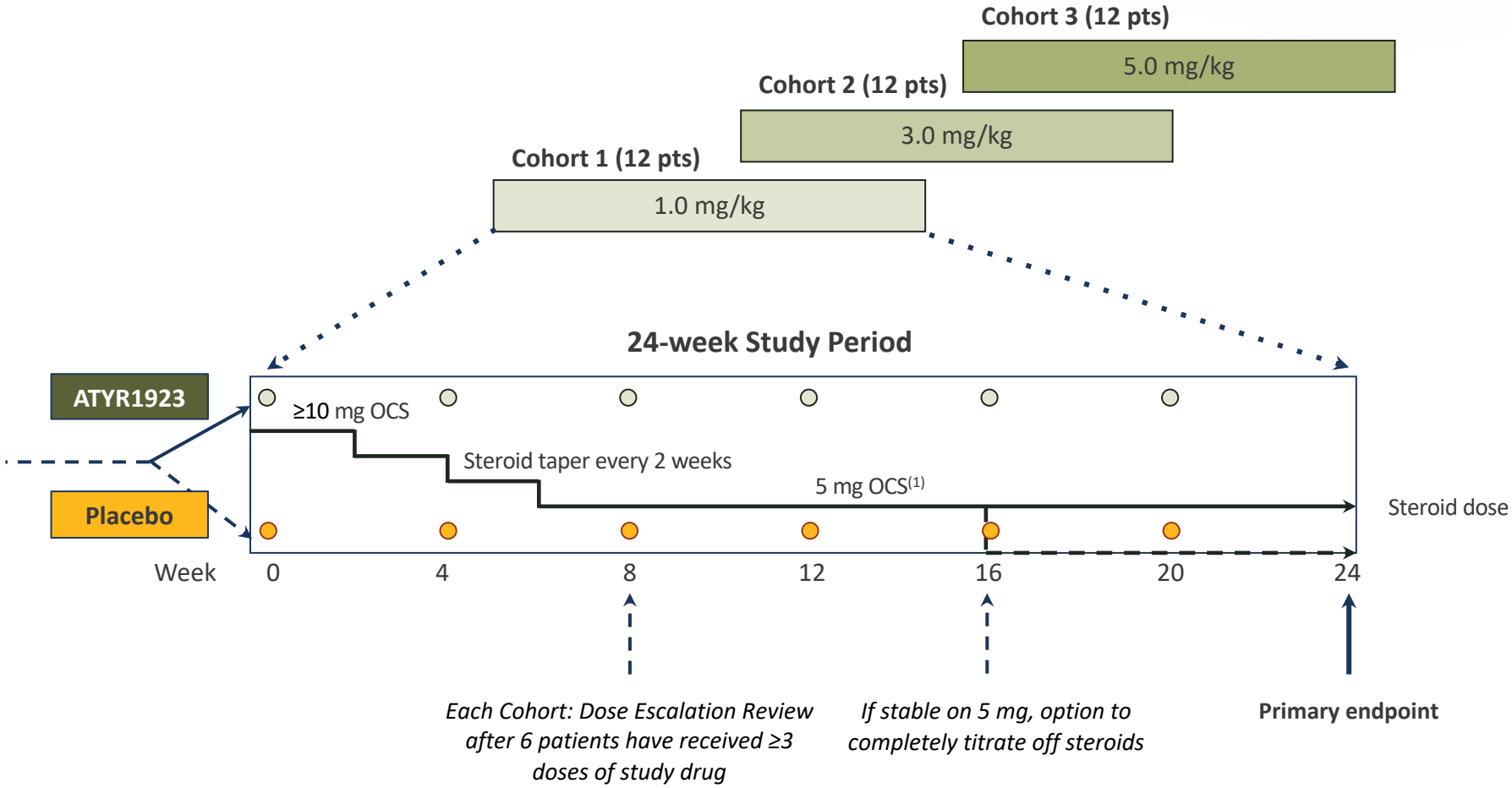
Culver et al. BMJ 2019; Baughman ATS Annals 2016

Phase 1b/2a Study in Pulmonary Sarcoidosis Ongoing

Design	• Randomized (2:1), double-blind, placebo-controlled, multiple ascending dose • 6 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

Target enrollment completed
Data expected Q3 2021

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: $1.2b 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

Currently conducting Phase 1 study to evaluate the safety, pharmacokinetics and immunogenicity in Japanese healthy volunteers

ATYR1923

COVID-19 Related Severe Respiratory Complications

Phase 2 Study in COVID-19 Related Severe Respiratory Complications

Rationale	• COVID-19 associated lung inflammation is driven by pathways effected by ATYR1923's mechanism of action
Objective	• Evaluate safety and preliminary efficacy of ATYR1923 in subjects hospitalized with COVID-19-related severe respiratory complications
Design	• Randomized, double-blind, placebo controlled, single dose (not powered for statistical significance)
Population	• 32 adult patients with severe respiratory complications related to COVID-19 infection requiring supplemental oxygen but not mechanically ventilated (WHO score 4, 5)
Doses	• Randomized 1:1:1 - Single dose of 1.0 or 3.0 mg/kg ATYR1923 or Placebo
Endpoints	• Primary: Safety and Tolerability • Secondary: Time to recovery (WHO score ≤3 or hospital discharge without supplemental oxygen); proportion of patients achieving recovery within a week; all cause mortality • Exploratory: Clinical biomarkers; 60 day follow up

Topline data reported January 2021
Full data set, including biomarker analysis, expected Q1 2021

Highlights of Topline Results for Safety and Key Recovery Metrics

Study Met Primary Safety Endpoint in Moderate to Severe Hospitalized Patients

- ATYR1923 was generally safe and well-tolerated in both the 1.0 and 3.0 mg/kg treatment groups
- Adverse events were mostly mild or moderate in severity and there were no drug-related SAEs

Preliminary Signal of Activity Seen in 3.0 mg/kg Cohort(1)

- 3.0 mg/kg cohort experienced a median time to recovery of 5.5 days (95% CI: 3,6) compared to 6 days (95% CI: 2,12) in placebo group
- 83% vs 56% of patients achieved recovery by day 6 in the 3.0 mg/kg ATYR1923 and placebo groups, respectively

(1) Study was not powered for statistical significance

Key Insights from Preliminary Demographics and Baseline Characteristics

- Demographics and baseline disease characteristics were largely balanced except for some key risk factors which were disproportionately randomized to ATYR1923 groups:
  - More patients over the age of 65
  - More patients with severe hypoxia
  - More baseline comorbidities and more patients with multiple baseline comorbidities
- Imbalances suggest a sicker patient population in ATYR1923 treatment groups and may have contributed to an overperformance in the placebo arm
- All patients in the study received remdesivir and/or dexamethasone

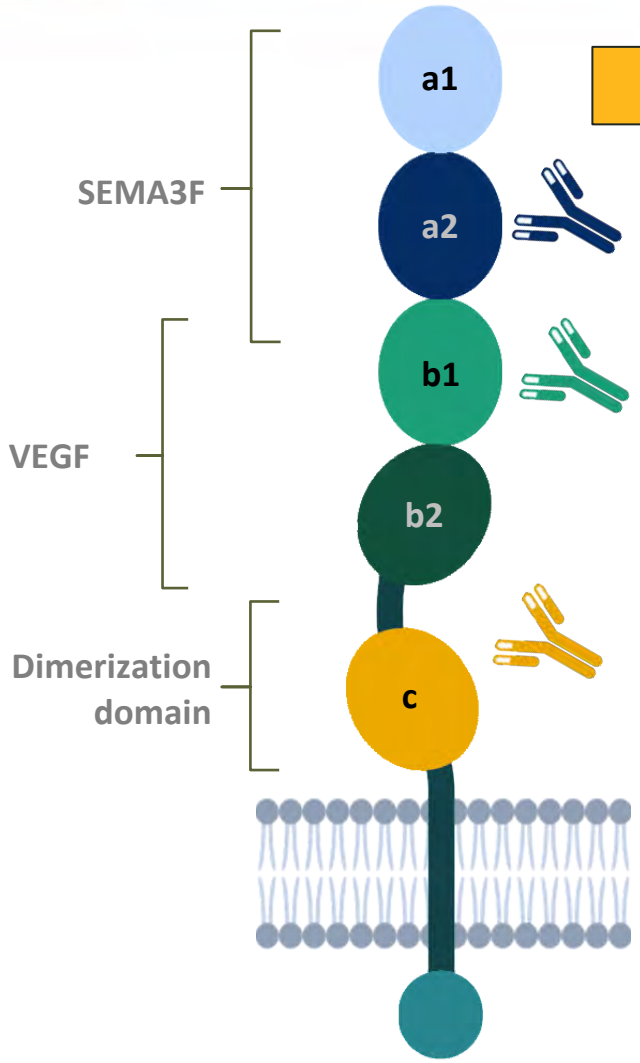
NRP2 Antibodies

Regulating Diverse Disease Pathways

NRP2: A Novel Therapeutic Target

- NRP2 is a potentially novel drug target for cancer and inflammatory disorders
- Acts as a co-receptor for VEGF, semaphorins and certain chemokines (e.g., CCL19)
- Highly expressed on certain tumors and upregulated on immune cells during inflammation
- Tumor expression is associated with worse outcomes in many cancers
- aTyr has developed a panel of antibodies to selectively target different NRP2 epitopes for diverse therapeutic applications
- aTyr anti-NRP2 monoclonal antibodies exhibit superior specificity and sensitivity compared to commercially available antibodies

aTyr is Developing Humanized NRP2 Antibodies Targeting Diverse Pathways



aTyr lead antibodies(1)

α-NRP2-14

ATYR2810

CCR7 Ligand Blockers

(1) Distinct from ATYR1923 interaction with NRP2

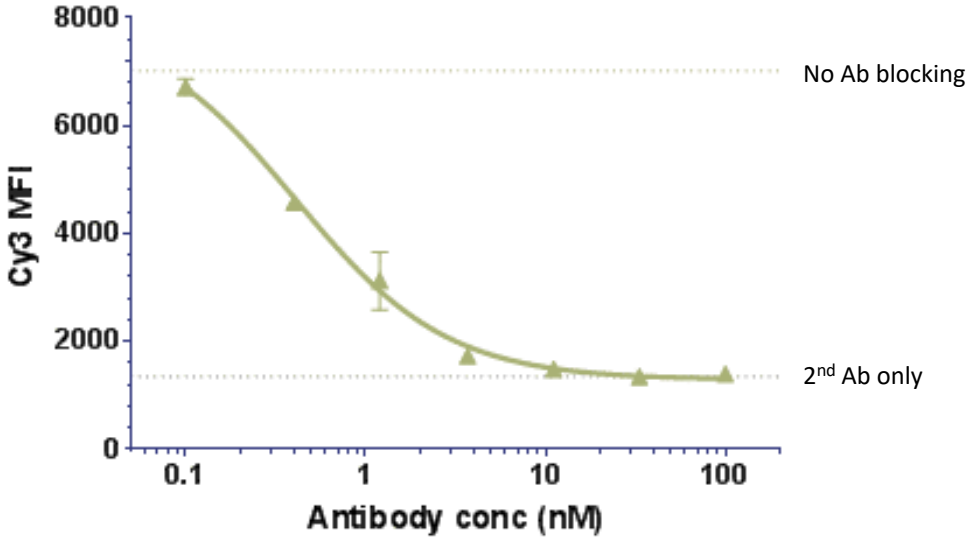
ATYR2810: Lead Anti-Neuropilin-2 Antibody IND Candidate for Cancer

- ATYR2810 is a humanized monoclonal antibody that specifically and functionally blocks the interaction between NRP2 and VEGF
- 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
- Preclinical data in models of triple-negative breast cancer suggest that ATYR2810 could potentially be effective in certain aggressive solid tumors (1)
  - Blocks VEGF-C binding to NRP2
  - Shows tumor inhibitory effects
  - Increases sensitivity to chemotherapy

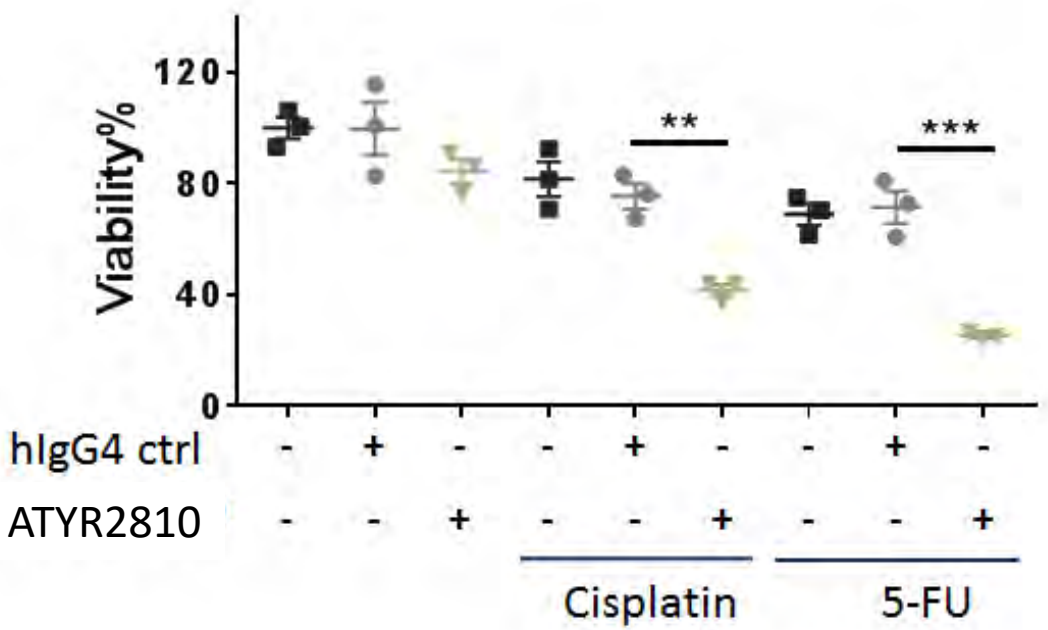
(1) Domain-Specific Antibodies to Neuropilin 2 Implicate VEGF-C and not Semaforin 3F in Breast Cancer Stem Cell Function. American Association for Cancer Research, 2020

Early Pre-clinical Data Support Development in Oncology

Blocks VEGF binding to NRP2



Increases Sensitivity to Chemotherapy in Triple-Negative Breast Cancer Model



AACR Virtual Meeting II – June 22-24, 2020; *p < 0.05, **p < 0.01, ***p < 0.001, ****p < 0..0001

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)
- Recent discovery of new receptor targets for two tRNA synthetases in cancer and inflammation

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 1b/2a clinical study in pulmonary sarcoidosis completed enrollment in US – positive interim safety data reported Dec 2019
  - Kyorin collaboration for ILD in Japan with total deal value up to $175m; conducting Phase 1 study
  - Phase 2 trial in COVID-19 patients with severe respiratory complications completed– positive topline results reported January 2021
- Preclinical program: ATYR2810
  - Lead anti-NRP2 antibody IND candidate for cancer shows anti-tumor effects in triple-negative breast cancer model
- Discovery stage programs in cancer, inflammation and immunology
  - NRP2 antibody research program for distinct therapeutic applications
  - New receptor targets identified for two tRNA synthetases in cancer and inflammation
- Cash, cash equivalents, and investments at $36.1m as of September 30, 2020

Upcoming Catalysts

ATYR1923	• Phase 1b/2a results in pulmonary sarcoidosis patients expected Q3 2021 • Kyorin's Phase 1 in healthy volunteers to support trials for ILD in Japan initiated in Q3 2020 • Phase 2 full data set in COVID-19 patients expected Q1 2021
ATYR2810	• IND enabling activities for the first anti-NRP2 antibody
NRP2 Antibodies	• Potential new pipeline opportunities internally and through academic collaborations
tRNA Synthetase Candidates	• Presentation of scientific findings related to new receptor targets for two tRNA synthetases

Thank You