A New Path to Medicine

Ladenburg Thalmann 2019 Healthcare Conference

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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 we make regarding our projected cash expenditures; the potential therapeutic benefits of proteins derived from tRNA synthetase genes and our product candidates, including ATYR1923 and any other product candidates; 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; 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 Pharma

Company Overview

Accelerating Value Creation from New Biology

Platform of New Biology:

Discovery pipeline of novel therapeutic candidates based on proprietary knowledge of extracellular functions of tRNA synthetases (~300 protein compositions patented)

Lead Product Candidate: ATYR1923

Engineered, long acting, protein therapeutic, derived from the HARS gene, for the treatment of pulmonary sarcoidosis and other interstitial lung diseases

$2-3b[(1)] global opportunity

Financials:

Cash, cash equivalents and investments at $42.4m as of 6/30/2019

April 2019: $5m raise with Federated and Dr. Paul Schimmel, board member, at market, no discount or warrants

Clinical Milestones:

Initiated P1b/2a Trial – Q4 2018

- ❑ Interim Safety – Q4 2019
- ❑ Final Results – mid-2020[(2)]

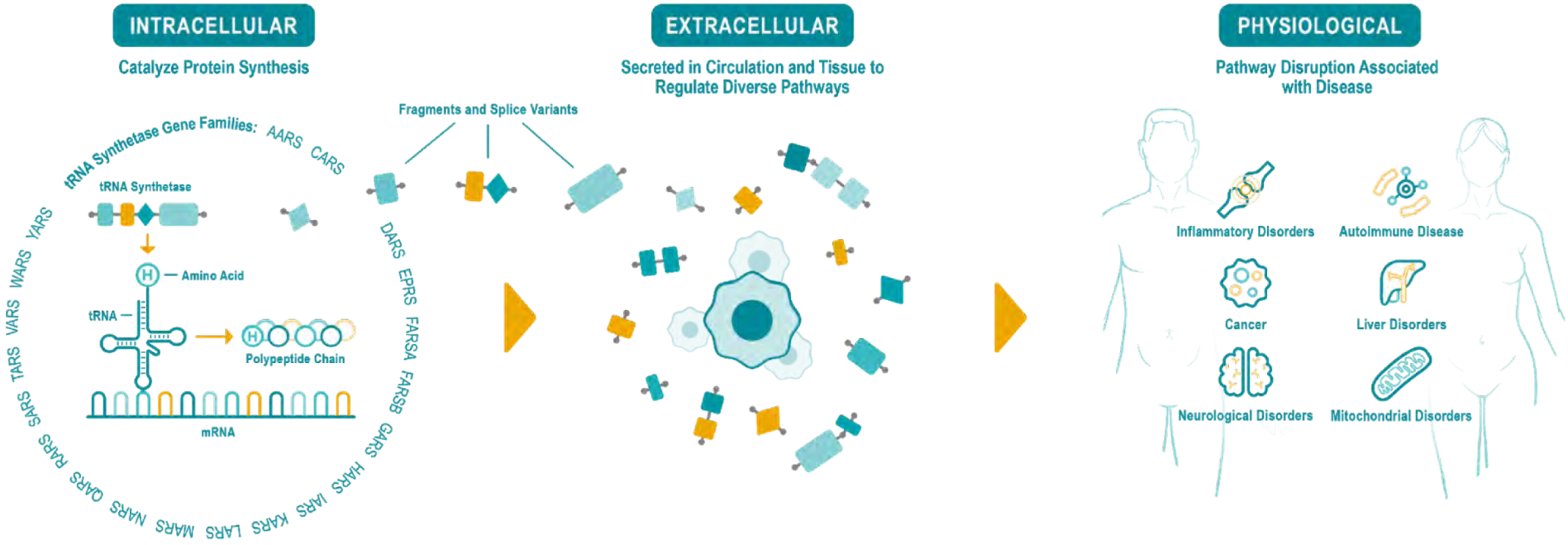
(1) aTyr estimates for inflammatory ILD: Pulmonary Sarcoidosis, CHP, CTD-ILD; excludes IPF

(2) Dependent on patient enrollment

Development Pipeline

PROGRAM	DISEASES	DISCOVERY	PRECLINCAL	PHASE 1	PHASE 1B/2	PHASE 2/3
ATYR1923	Pulmonary Sarcoidosis					
	Chronic Hypersensitivity Pneumonitis (CHP)					
	Connective Tissue Disease ILD (CTD-ILD)					
tRNA Synthetase Candidates	Undisclosed			CSL Behring		
NRP2 Candidates	Undisclosed					

Extracellular tRNA Synthetase Biology



aTyr

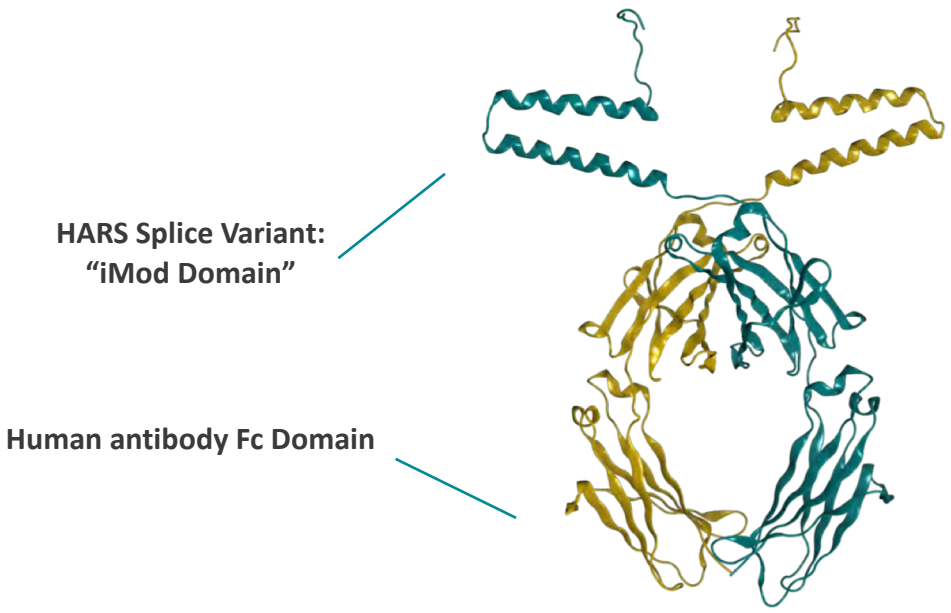
CSL Behring Collaboration

Goal	• Identify new IND candidates from up to four tRNA synthetases from aTyr's proprietary pipeline of novel proteins (non-HARS derived)
Terms	• CSL Behring to fund all R&D costs • aTyr eligible for up to $17m in option fees if CSL Behring advances all four programs ($4.25m per synthetase program) • aTyr grants CSL Behring an option to negotiate licenses for worldwide rights to each IND candidate that emerges from the collaboration
About CSL	• CSL Behring is a global biotherapeutics leader specializing in immunology, hematology and other rare and serious medical conditions • CSL Behring employs >22,000 people globally, and delivers its therapies to more than 60 countries
Status	• aTyr received first phase of funding totaling $630k, and of that recognized $94k of collaboration revenue in Q2 2019

ATYR1923

For the Treatment of Pulmonary Sarcoidosis

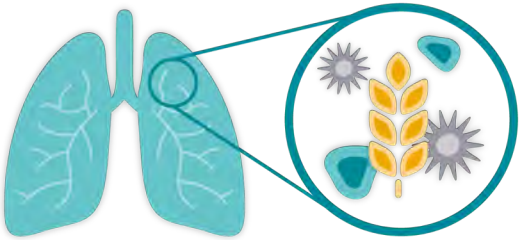
ATYR1923: Novel Engineered Protein Therapeutic



- iMod Domain of HARS enriched in the human lung
- Inhibits human T cell activation/cytokine release
- Binds selectively to Neuropilin-2 (NRP2)
- Regulates a number of immune cell-types, including: T cells, Neutrophils, Macrophages, Dendritic cells
- iMod Domain fused to Fc Domain to extend half-life
- Once-monthly IV dosing regimen

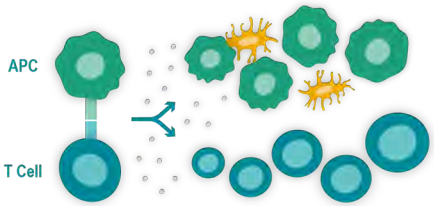
ATYR1923 Mechanism of Action in ILD

Disease Trigger



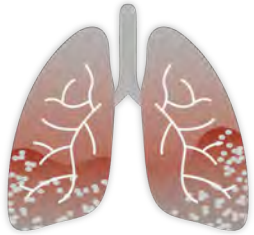
Organic; inorganic; infectious; autoimmune

Aberrant Immune Responses



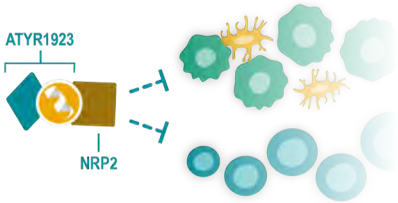
T-cell activation; Pro-inflammatory cytokine/chemokines triggering fibrotic pathways; NRP2 upregulation on immune cells

Lung Inflammation & Fibrosis



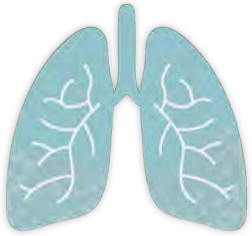
Persistent, unresolved inflammation in the lung can lead to fibrosis; patients experience chronic cough, dyspnea, mortality

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

aTyr

Pre-Clinical Translational Data Supports ILD Development

Bleomycin-Induced Lung Injury (IPF) – Mouse	• ATYR1923 reduced fibrosis and inflammation • Comparator: pirfenidone • Presented at ATS, May 2017
Bleomycin-Induced Lung Injury (IPF) – Rat	• ATYR1923 returned lung function to normal and reduced fibrosis and inflammation • Comparator: nintedanib • Presented at ATS, May 2018
Sclerodermatous chronic-graft vs host disease (SSc-ILD) – Mouse	• ATYR1923 reduced lung and skin fibrosis • Comparator: nintedanib • Presented at Scleroderma Foundation Patient Conference, July 2018
SSc-cGVHD (SSc-ILD); *P. acnes* (Sarcoidosis); *S. rectivirgula* (CHP); SKG (Ra-ILD) – Mouse	• ATYR1923 demonstrated stage-dependent anti-inflammatory and anti-fibrotic effect in various experimental models of ILD • Comparator: various • Presented at ATS, May 2019

ILDs Share Persistent Immune Engagement

Pulmonary Sarcoidosis
- Non-caseating granulomas (CD4+ T cell driven)
- SOC: steroids - cytotoxic agents - TNF inhibitors

Chronic Hypersensitivity Pneumonitis (CHP)
- Exaggerated immune response to environmental antigen
- No effective SOC

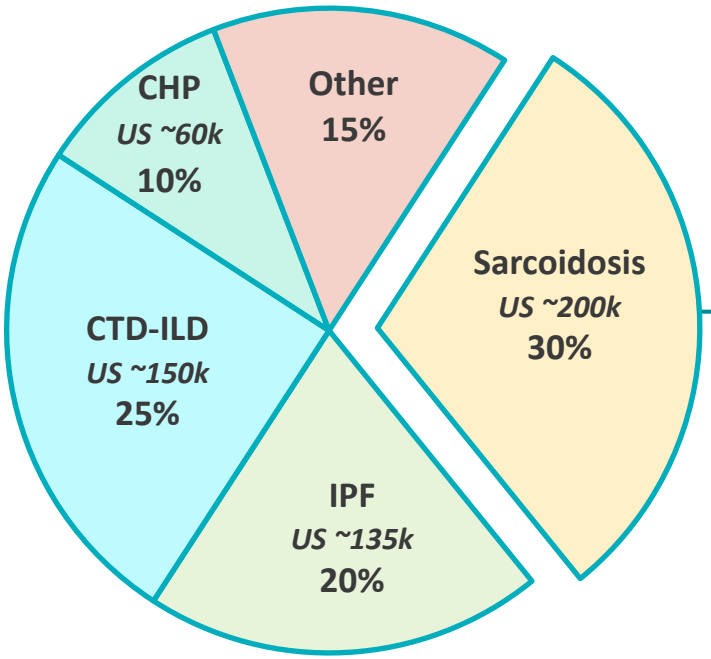
Connective Tissue Disease – ILD (CTD-ILD)
- >50% of Scleroderma patients and 10% RAs
- SOC: Mycophenolate mofetil or cyclophosphamide (2019 nintedanib approval) for Ssc-ILD

Idiopathic Pulmonary Fibrosis (IPF)
- Irreversible fibrotic disease
- SOC: Nintedanib or pirfenidone (>$2.2b combined 2018 net revenue)

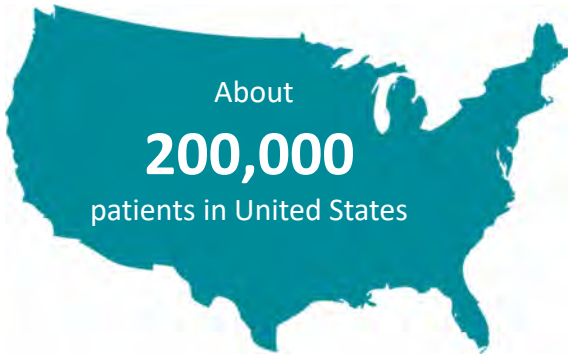
Slide adapted from Dr. Steven Nathan, Medical Director, Advanced Lung Disease and Transplant Program at Inova Fairfax Hospital, Falls Church, VA

Sarcoidosis: A Major Form of ILD

ILD Patient Distribution



$2-3b Global Opportunity(1)



50% require systemic therapy

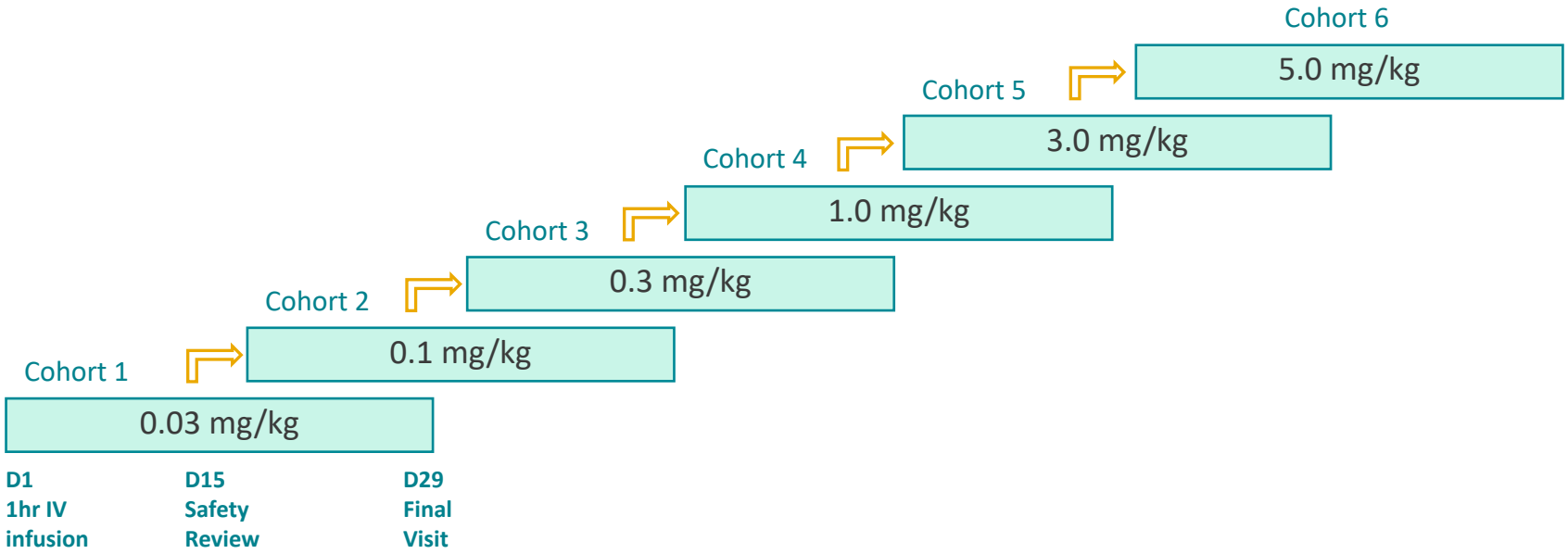
30% with chronic progressive disease despite currently available treatment

(1) aTyr estimates for inflammatory ILD: Pulmonary Sarcoidosis, CHP, CTD-ILD; excludes IPF

PK Profile Supports Potential Once-Monthly Dosing

Phase 1 Healthy Volunteer Study Completed in Australia

- Positive data announced in June 2018
- Randomized, double-blind, placebo-controlled, single ascending dose (N=36 HVs)
- ATYR1923 was generally well-tolerated with no significant adverse events



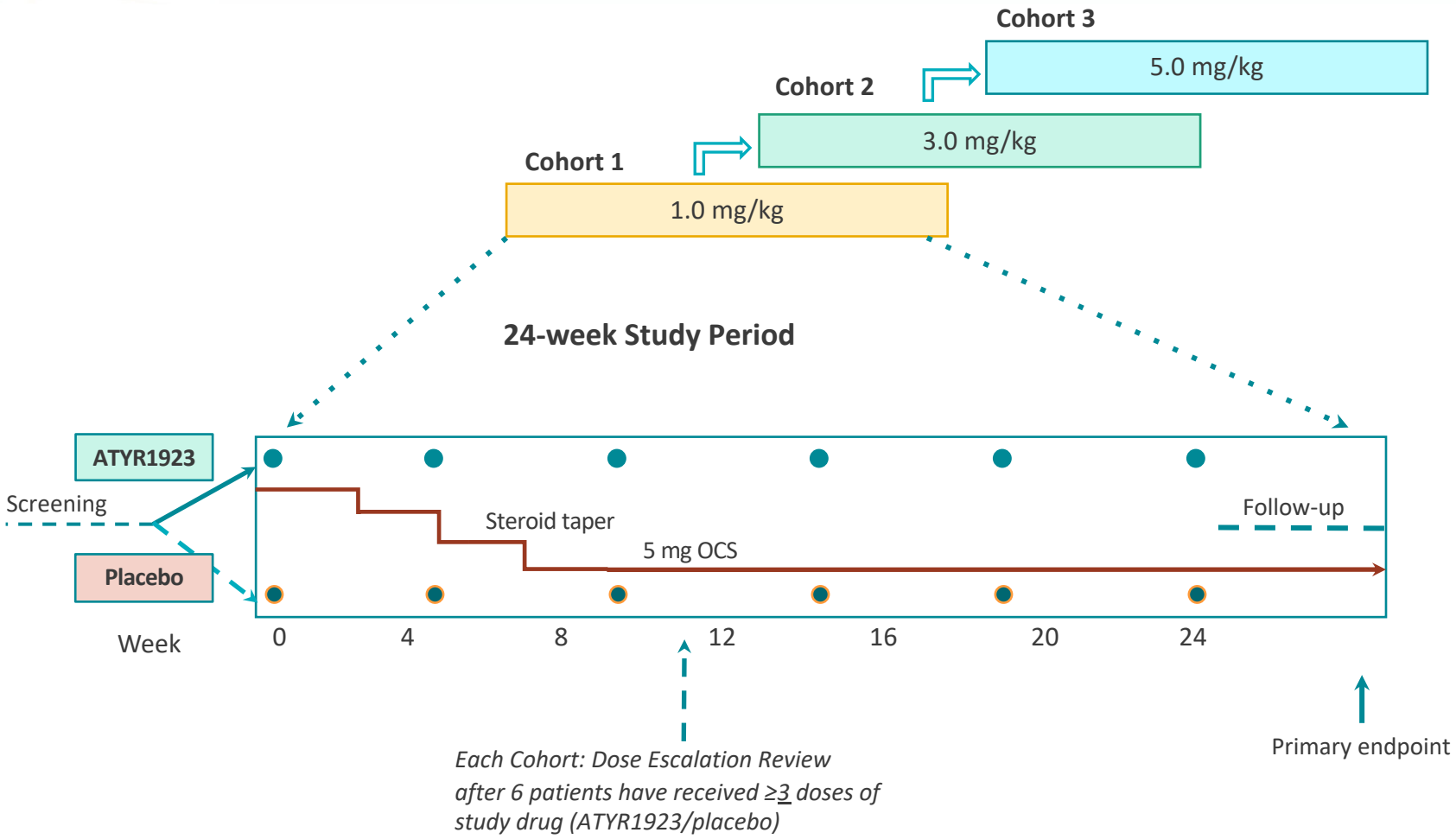
ATYR1923 Phase 1b/2a Study in Pulmonary Sarcoidosis

Design	• Randomized, double-blind, placebo-controlled, multiple ascending dose
Population	• Histologically confirmed pulmonary sarcoidosis • Requiring ≥10 mg prednisone (steroid) treatment; capable of steroid taper • Symptomatic/active disease at baseline by ^{18F}-FDG-PET/CT, Pulmonary Function Tests
Dosing	• 3 sequential cohorts, 12 patients each • 2:1 randomization • ATYR1923 doses: 1.0, 3.0, and 5.0 mg/kg
Duration	• 24-week study period • Steroid taper phase down to 5.0 mg by week 8 • 16-week maintenance phase
Sites	• Up to ~15 leading pulmonary sarcoidosis centers • Collaboration with the Foundation for Sarcoidosis Research

ATYR1923 Phase 1b/2a Study Endpoints

Primary	• Safety and tolerability of multiple ascending IV ATYR1923 doses
Secondary	• 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 Study Schema



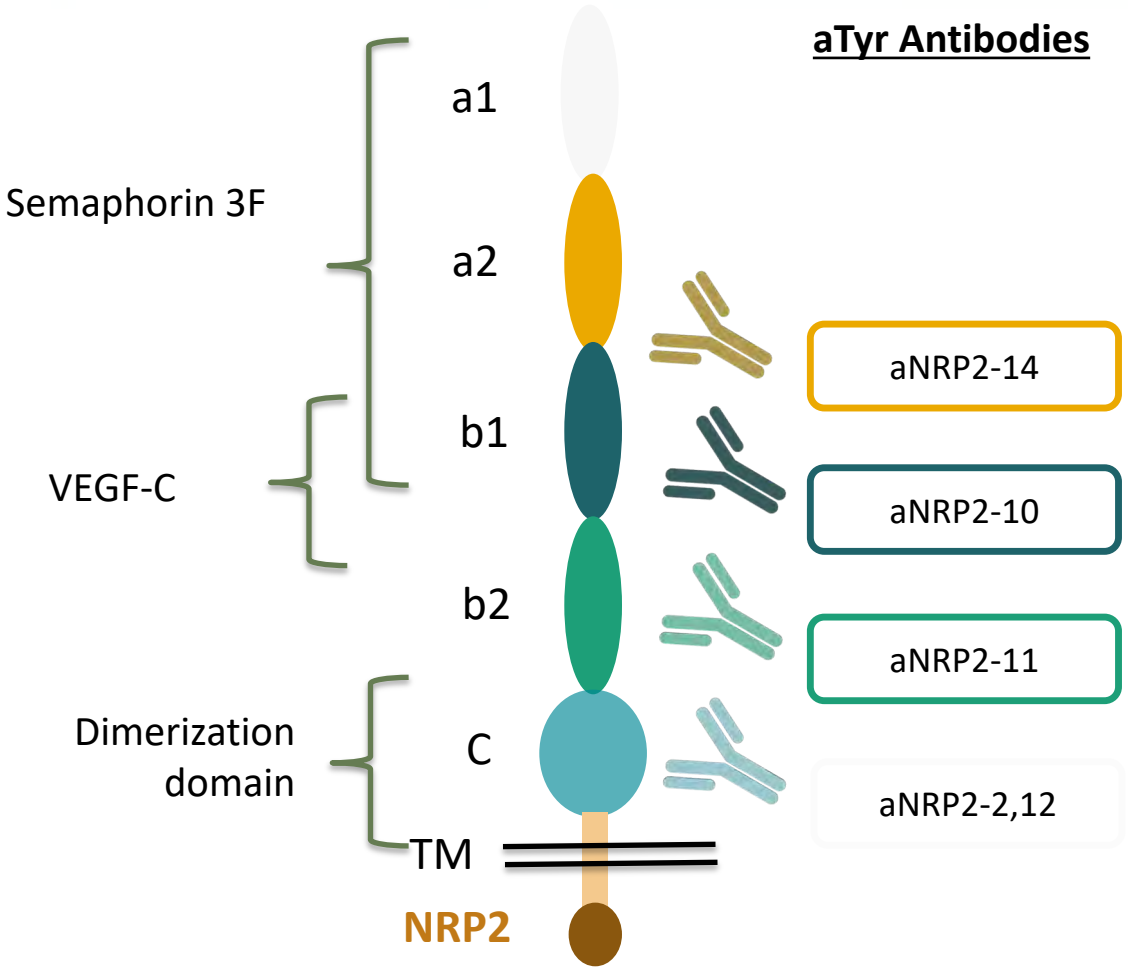
ATYR1923 Phase 1b/2a Study in Pulmonary Sarcoidosis

Status	• Patient enrollment ongoing • Evaluating additional sites
Timelines	• Interim safety data: Q4 2019 • Study completion: mid-2020(1)
Possible Future Development	• Registrational trial in Pulmonary Sarcoidosis • Initiate P2 studies in other types of interstitial lung disease (e.g. CTD-ILD; CHP)

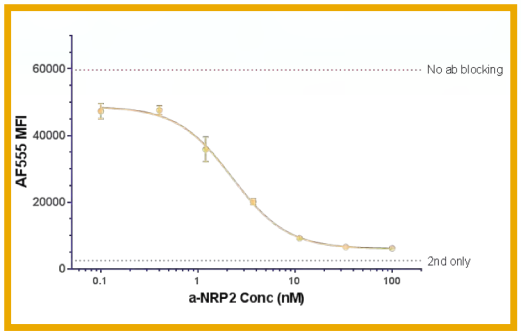
(1) Dependent on patient enrollment

NRP2 Biology

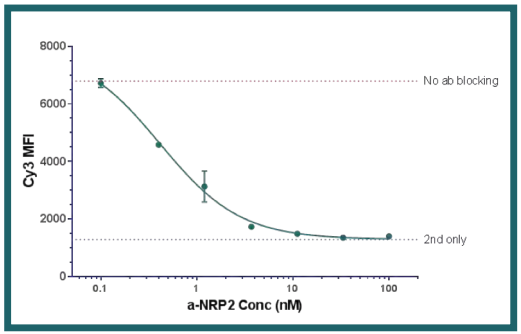
aTyr NRP2 Blocking Antibodies

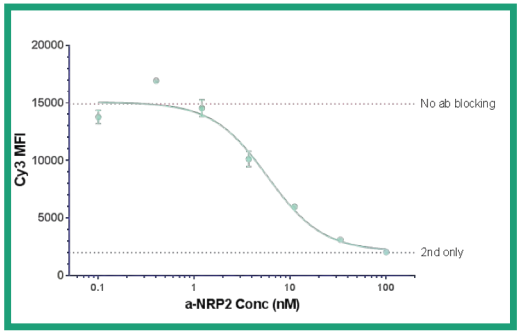


Sema3F Blocking



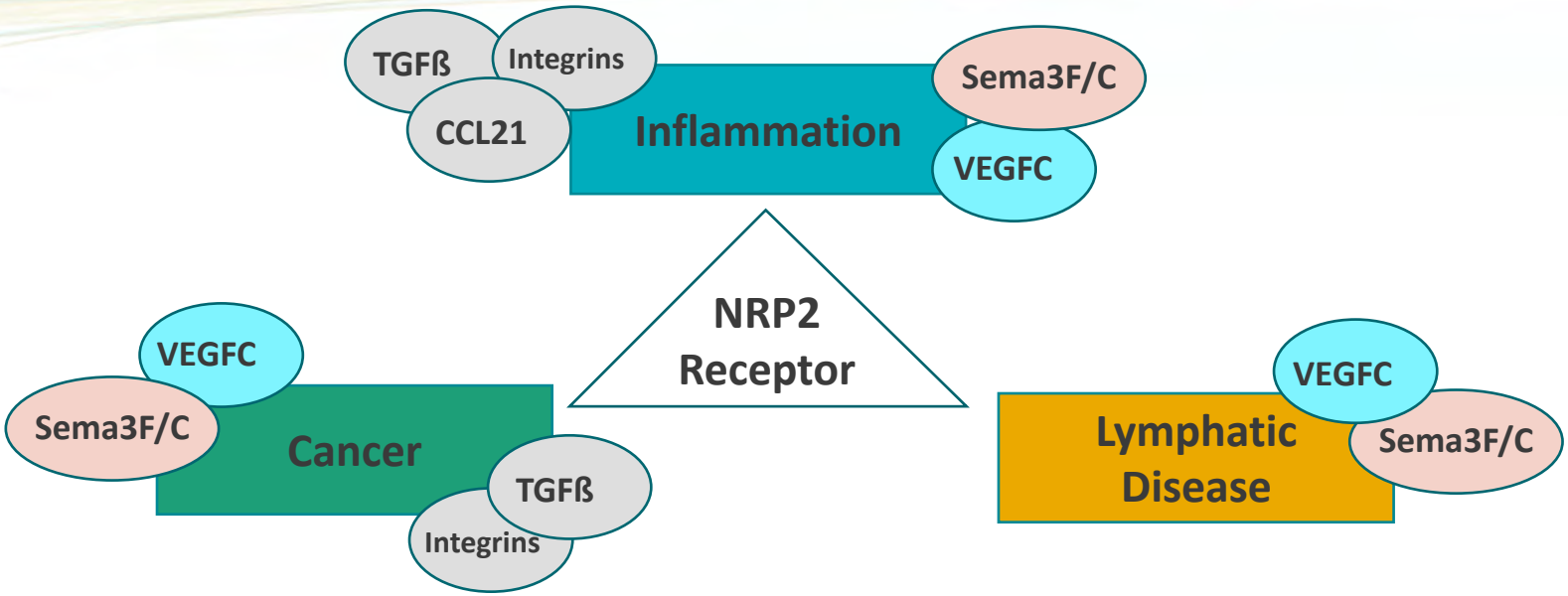
VEGF-C Blocking





aTyr

NRP2 Receptor Biology Associated with Diverse Pathways



- Implicated in cancer, inflammation and lymphatic disease
- Co-receptors for semaphorins and VEGF family molecules
- Overexpressed in various tumors, tumor expression linked to poor prognosis
- Critical for cancer cell migration, metastasis, EMT, lymphangiogenesis

aTyr Pharma

Company Value Drivers

Upcoming Catalysts

ATYR1923	❑ Interim Phase 1b/2a safety data Q4 2019 ❑ Phase 1b/2a results mid-2020(1) ❑ Potential expansion into Phase 2 studies for CHP and CTD-ILD
CSL R&D	❑ aTyr eligible for up to $17m in option fees ❑ Option granted to CSL to negotiate licenses for worldwide rights to each IND candidate that emerges from the collaboration
NRP2 Antibody Candidates	❑ Potential new pipeline opportunities through academic and industry collaborations

(1) Dependent on patient enrollment

Building Value…for Patients and Shareholders

- ✓ Platform of new biology
  - ✓ tRNA synthetase biology
  - ✓ ~300 protein compositions patented
  - ✓ NRP2 antibody program
- ✓ Robust clinical program: ATYR1923
  - ✓ Understanding of MOA
  - ✓ Translational studies in multiple ILD models
  - ✓ Phase 1b/2a clinical study in pulmonary sarcoidosis
- ✓ Supported by top tier investors
- ✓ Cash, cash equivalents, and investment at $42.4m as of 6/30/2019

Thank You