

AVROBIO

Company Presentation
July 2020

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expected benefits and results of our implementation of the plato® platform in our clinical trials and gene therapy programs, the expected safety profile of our investigational gene therapies, timing and likelihood of success, plans and objectives of management for future operations, future results of anticipated products, the market opportunity for and anticipated commercial activities relating to our investigational gene therapies, and statements regarding the Company's financial and cash position and expected cash reserves. Any such statements in this presentation that are not statements of historical fact may be deemed to be forward-looking statements.

Any forward-looking statements in this presentation are based on AVROBIO's current expectations, estimates and projections about our industry as well as management's current beliefs and expectations of future events only as of today and are subject to a number of risks and uncertainties that could cause actual results to differ materially and adversely from those set forth in or implied by such forward-looking statements. These risks and uncertainties include, but are not limited to, the risk that any one or more of AVROBIO's investigational gene therapies will not be successfully developed or commercialized, the risk of cessation or delay of any ongoing or planned clinical trials of AVROBIO or our collaborators or of encountering challenges in the enrollment or dosing in such clinical trials, the risk that AVROBIO may not realize the intended benefits of our gene therapy platform, including the features of our plato platform, the risk that our investigational gene therapies or procedures in connection with the administration thereof will not have the safety or efficacy profile that we anticipate, the risk that prior results, such as signals of safety, activity or durability of effect, observed from preclinical or clinical trials, will not be replicated or will not continue in ongoing or future studies or trials involving AVROBIO's investigational gene therapies, the risk that we will be unable to obtain and maintain regulatory

approvals for our investigational gene therapies, the risk that the size and growth potential of the market for our investigational gene therapies will not materialize as expected, risks associated with our dependence on third-party suppliers and manufacturers, risks regarding the accuracy of our estimates of expenses and future revenue, risks relating to our capital requirements and needs for additional financing, risks relating to clinical trial and business interruptions resulting from the COVID-19 outbreak or similar public health crises, including that such interruptions may materially delay our development timeline and/or increase our development costs or that data collection efforts may be impaired or otherwise impacted by such crises, and risks relating to our ability to obtain and maintain intellectual property protection for our investigational gene therapies. For a discussion of these and other risks and uncertainties, and other important factors, any of which could cause AVROBIO's actual results to differ from those contained in the forward-looking statements, see the section entitled "Risk Factors" in AVROBIO's most recent Quarterly Report on Form 10-Q, as well as discussions of potential risks, uncertainties and other important factors in AVROBIO's subsequent filings with the Securities and Exchange Commission. AVROBIO explicitly disclaims any obligation to update any forward-looking statements except to the extent required by law.

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Note regarding future updates: The statements contained in this presentation reflect our current views with respect to future events, which may change significantly as the global consequences of the COVID-19 pandemic rapidly develop. Accordingly, we do not undertake and specifically disclaim any obligation to update any forward-looking statements.



A man with glasses, wearing a grey sweater and dark jeans, is walking from left to right. He is carrying a black bag. In the background, there are two large, stylized DNA double helix structures, one pink and one blue, set against a dark, textured background.





AVROBIO

**Our mission: Giving people with genetic
disease freedom for life**



Multiple programs in the clinic

12 patients dosed to date across three clinical trials









Investigational Gene Therapy		Proof-of-Concept	IND-Enabling	Phase 1/2	Commercial Rights
Fabry AVR-RD-01		Phase 2			AVROBIO
Gaucher AVR-RD-02		Phase 1/2			AVROBIO
Cystinosis AVR-RD-04		Phase 1/2			AVROBIO
Pompe AVR-RD-03		Preclinical			AVROBIO

IND: Investigational New Drug

Addressing multi-billion dollar market opportunity



CURRENT STANDARD OF CARE COSTS

Disease	Est. Cost Per Patient Per Year	Approx. 2019 Net Sales	Selected Companies
<i>Fabry</i>	\$320k	\$1.4B	SANOFI GENZYME  
<i>Gaucher</i>	\$250k-400k	\$1.4B	SANOFI GENZYME  
<i>Pompe</i>	\$500k	\$1.0B	SANOFI GENZYME 
<i>Cystinosis</i>	\$625k-700k*	\$0.2B	  

Sources: Rombach S et al, Orphanet J Rare Dis, 2013; van Dussen L et al, Orphanet J Rare Dis, 2014; WAC pricing from Redbook; 2019 Net Sales from company annual and other reports

* for Horizon's Procysbi oral therapy (delayed release cysteamine bitartrate)

Note: Shire acquired by Takeda in 2019

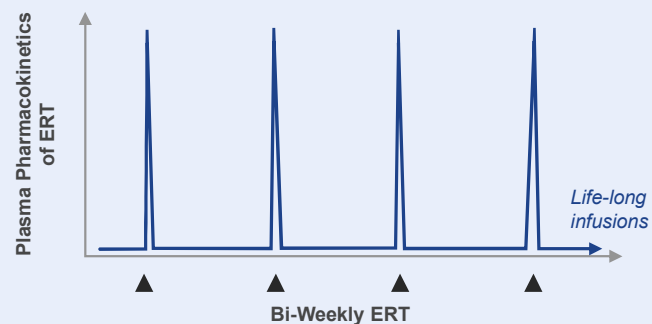
Lifelong treatments vs. potential single-dose therapy



DISEASE PROGRESSION CONTINUES

Enzyme Replacement Therapy (ERT)

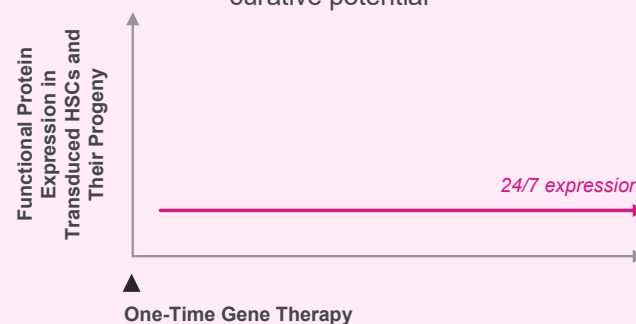
Temporary bolus of enzyme, not curative



DISEASE PROGRESSION COULD HALT OR REVERSE

AVROBIO Gene Therapy

Designed for 24/7 expression of protein, curative potential



Enzyme or protein level

Transient, intermittent elevation

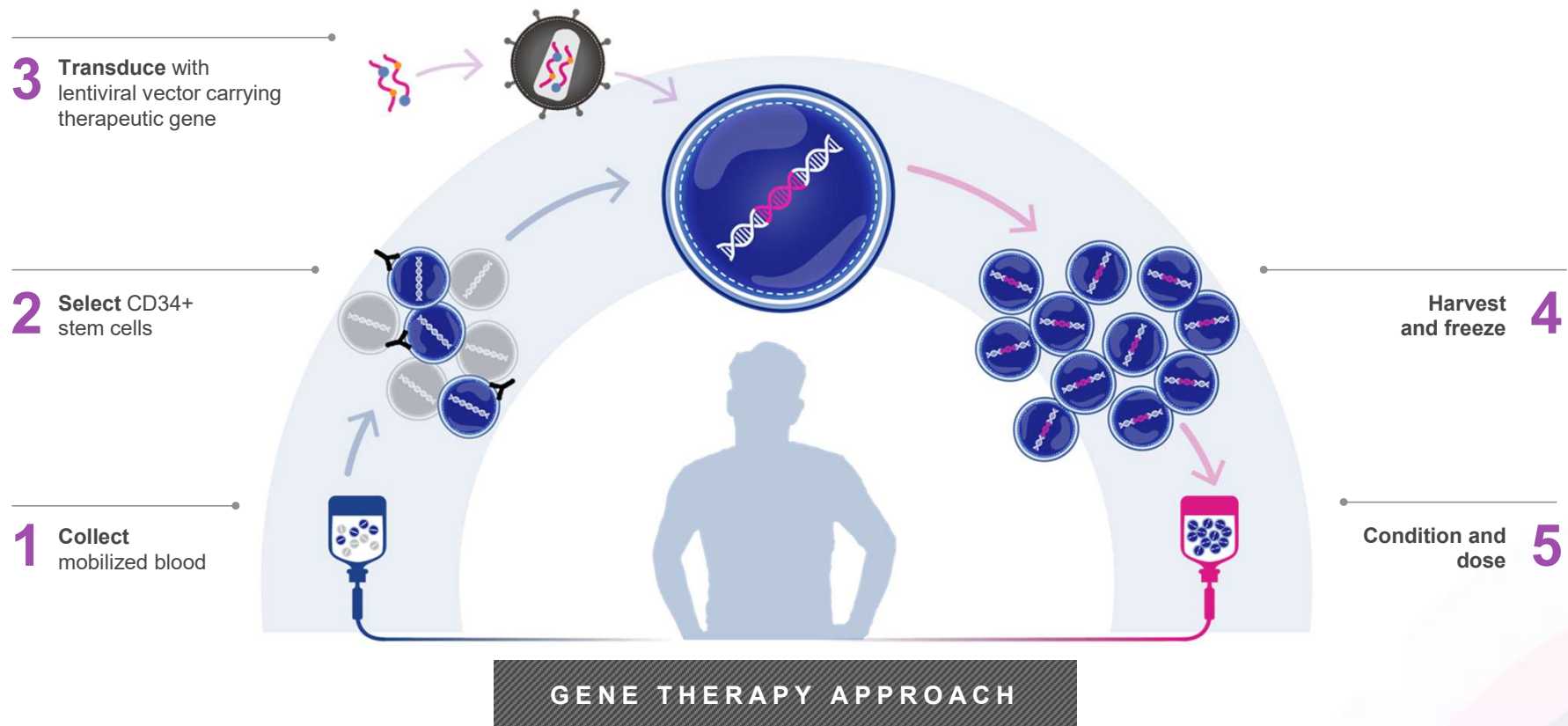
Long-term, continuous elevation

Treatment burden

Bi-weekly IV infusions

Single IV infusion

Established *ex vivo* lentiviral approach





Fabry Disease



AVR-RD-01

Goals for gene therapy in Fabry disease

UNMET NEEDS:



Kidney function

Unmet needs: proteinuria, polyuria, kidney failure



Cardiac function

Unmet needs: left ventricular hypertrophy, fibrosis, heart failure



Neuropathic pain

Unmet needs: pain and burning sensations in hands and feet, pain crises



CNS complications

Unmet needs: TIA/stroke, depression, impaired executive function, white matter hyperintensities



Everyday burden of illness and life expectancy

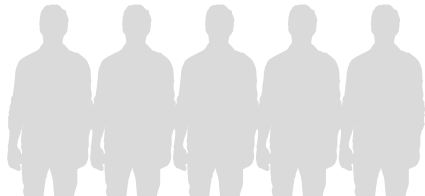
Unmet needs: fatigue, inability to sweat, joint pain, abdominal pain, diarrhea, vomiting, cloudy vision, hearing loss, tinnitus, rash, angiokeratomas, biweekly infusions, shortened lifespan





Two AVR-RD-01 Fabry clinical trials

9 patients dosed across Phases 1 and 2



PHASE 1

Investigator-Sponsored Trial*

Patients

n = 5 (fully enrolled)
On ERT > 6 months prior to enrollment
18 - 50 year-old males

Key Objective

Safety and preliminary efficacy

PHASE 2

AVRO – FAB-201 Trial

Patients

n = 8-12 (4 patients dosed to-date)
Treatment-naïve
16 - 50 year-old males

Key Objectives

Safety and efficacy

July 2019 data presented, unless otherwise specified

* Sponsored by FACTs team (Fabry Disease Clinical Research and Therapeutics) in Canada



Fabry FAB-201 Patient Characteristics

Treatment-naïve
Fabry patients

	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4
Age of symptom onset / diagnosis	10 / 19 years	36 / 37 years	13 / 13 years	9 / 9 years
Age dosed with AVR-RD-01	21 years	46 years	40 years	26 years
Mutation	c.1021G>A (p.E341K)	c.644A>G (p.N215S)	c.639+1G>T	c.833dupA
Primary disease signs and symptoms	<ul style="list-style-type: none">• Kidney disease• Chronic pain• GI symptoms• Decreased cold sensation	<ul style="list-style-type: none">• Cardiac disease• Peripheral neuropathy• Chronic pain• Increased tiredness• GI symptoms• Intermittent tinnitus• Mild high frequency hearing loss• Raynaud's syndrome	<ul style="list-style-type: none">• Kidney disease• GI symptoms• Peripheral neuropathy• Bilateral deafness• Tinnitus• Peripheral edema• Decreased cold sensation	<ul style="list-style-type: none">• Chronic pain• Peripheral neuropathy• Neuropathic shuffling gait• Lethargy• Temperature intolerance• Tinnitus• Hearing loss• GI symptoms
Leukocyte AGA enzyme activity at baseline (nmol/hr/mg protein)	0.10*	2.38**	0.58**	0.46**
Plasma lyso-Gb3 at baseline (nM)	202***	8***	147***	92***
Comment	IgA deposits in kidney biopsy	Cardiac variant, not a classic Fabry male		

* Mayo Lab, ref range ≥ 23.1 nmol/hr/mg

** Rupa Lab, ref range 24-56 nmol/hr/mg

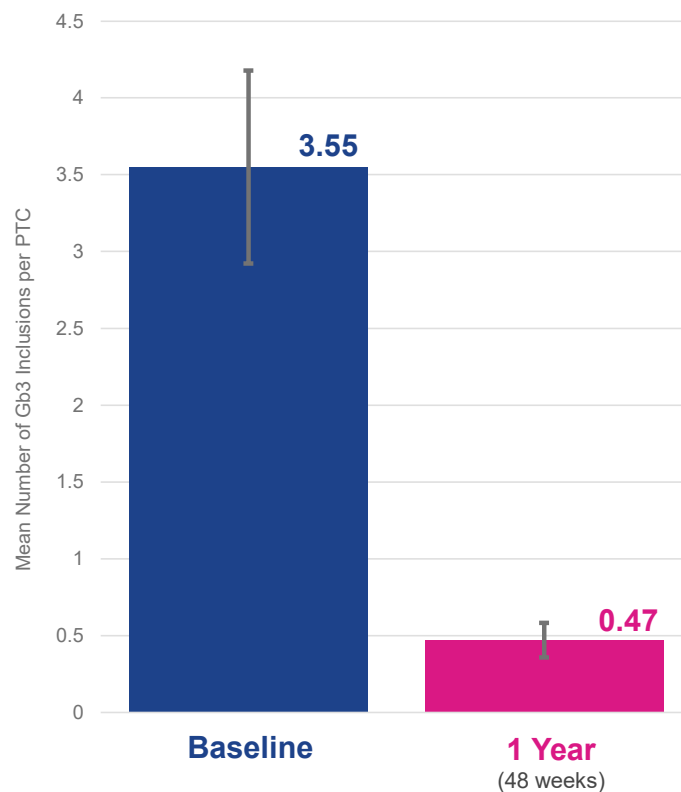
*** Reference value ≤ 2.4 nM

AGA: α -galactosidase A; Lyso-Gb3: Globotriaosylsphingosine; GI: Gastrointestinal; IgA: Immunoglobulin-A



Patient 1: 87% substrate reduction in kidney biopsy at 1 year

Average
number of **Gb3**
inclusions
per peritubular
capillary (PTC)



- Unpaired t-test for difference between $n=55$ PTCs at baseline vs. $n=101$ PTCs at 1 year; $p < 0.0001$
- Error bar represents the standard deviation

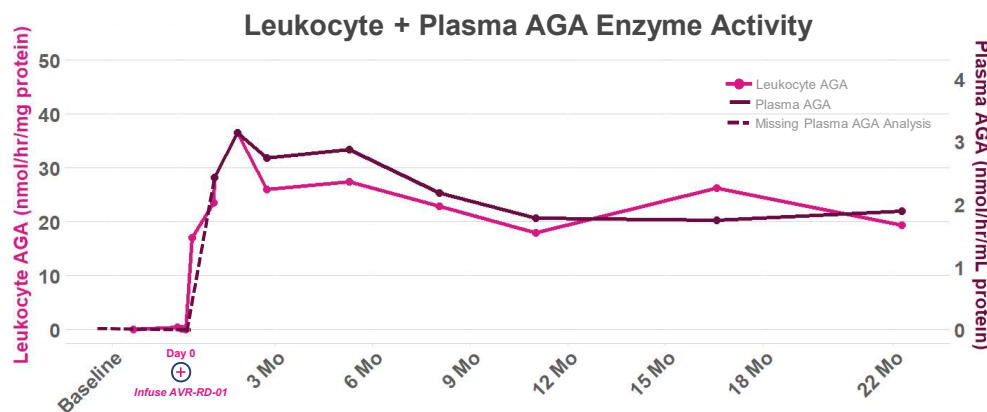
Baseline: The last available, non-missing observation prior to AVR-RD-01 infusion

Note: With respect to Fabry disease, Gb3 inclusions per PTC is interchangeable with GL-3 inclusions per KIC

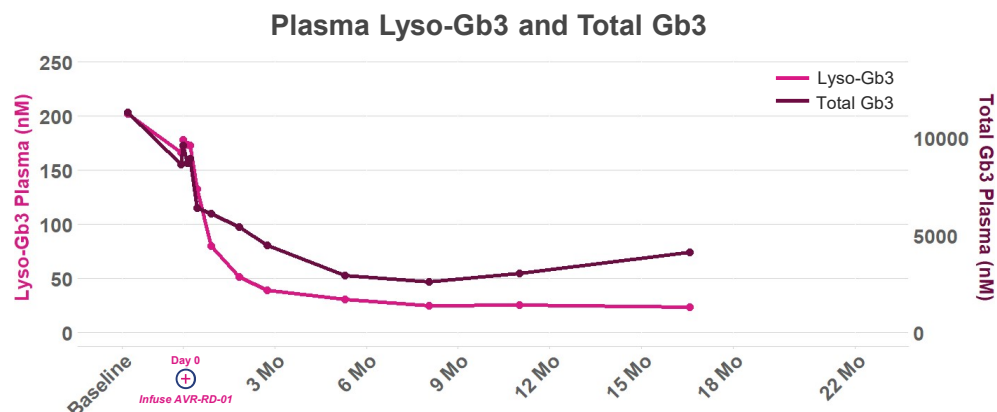
FAB-201-1: First patient in FAB-201 clinical trial

PTC: Peritubular Capillary; Gb3: Globotriaosylceramide; GL-3: Globotriaosylceramide; KIC: Kidney Interstitial Capillary

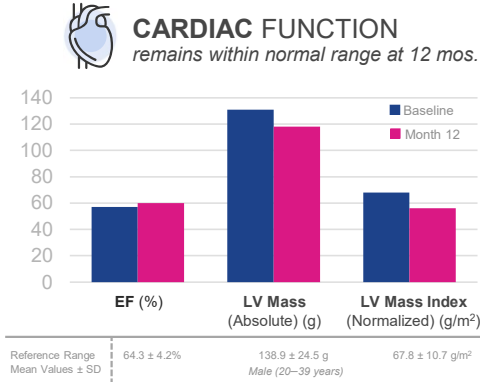
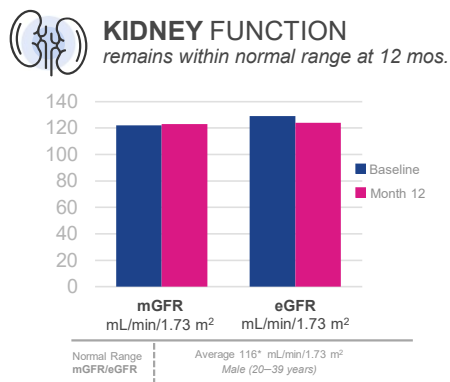
Patient 1: Multiple data trends sustained up to 22 months



*Lab A: Mayo Clinic Laboratories; Lab B: Rupa Laboratory; Lab A Reference Range: >23.1 nmol/hr/mg; Lab B Reference Range: 24–56 nmol/hr/mg
 †Reference Range: 5.1–9.2 nmol/hr/mg; AGA: α-galactosidase A

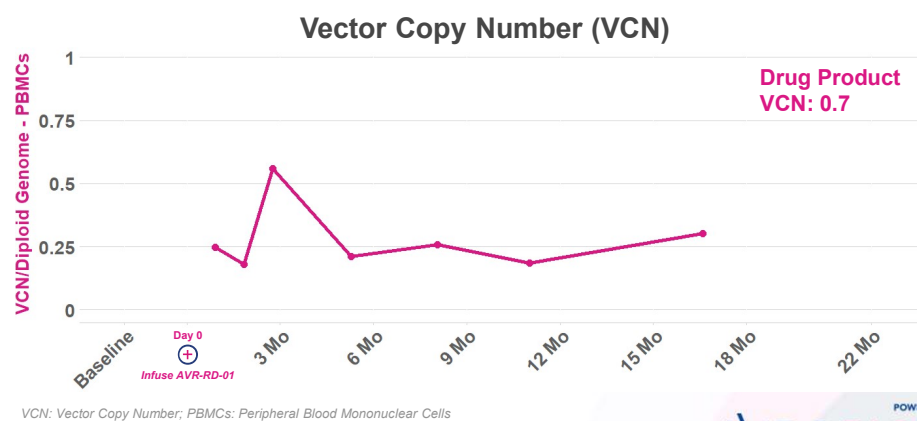


*Reference Value: 2.4 nM; †Reference Value: 4961 nM; 6012 nM before August 2018 (until Day 28 for Patient 1)
 Lyso-Gb3: Globotriaosylsphingosine; Gb3: Globotriaosylceramide



*Source: <https://www.kidney.org/atoz/content/gfr>
 mGFR: Measured Glomerular Filtration Rate; eGFR: Estimated Glomerular Filtration Rate

Source: Alfakih K et al, J Magn Reson Imaging, 2003
 EF: Ejection Fraction; LV: Left Ventricular

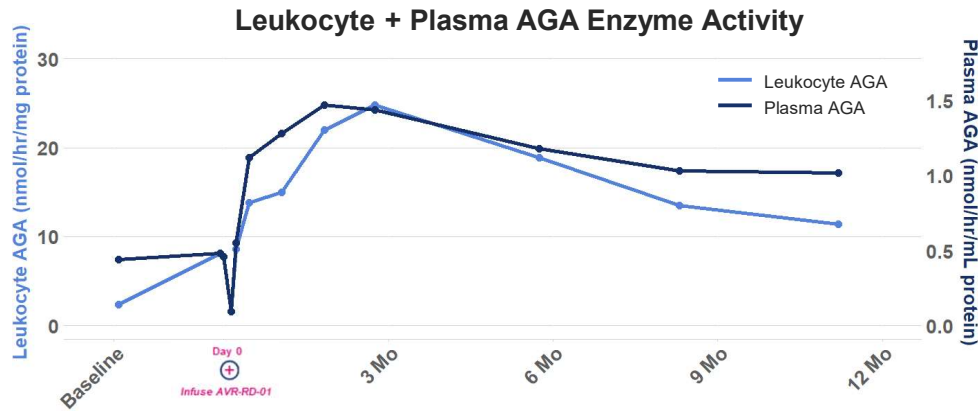


VCN: Vector Copy Number; PBMCs: Peripheral Blood Mononuclear Cells

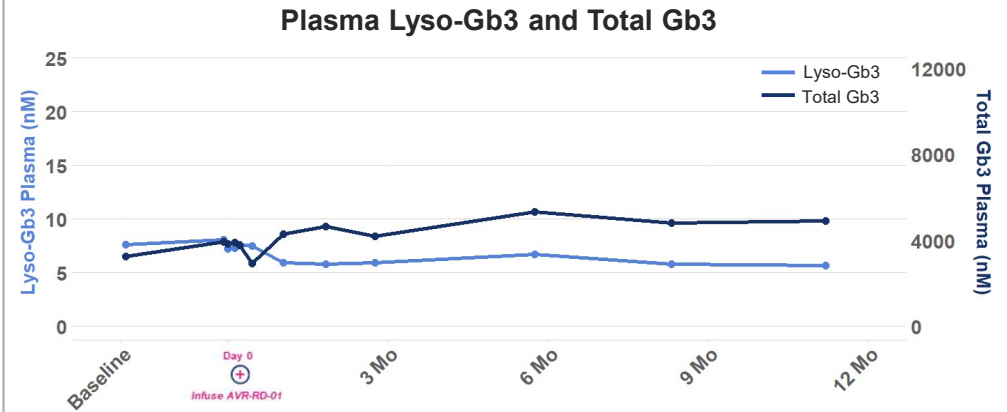
Note: Patient #1 had a skin biopsy score of 3 (severe accumulation) at baseline, a score of 2 (moderate accumulation) at 6 months and a score of 1 (mild accumulation) at 12 months
 Note: Visualization of multiple biomarkers adjusted to utilize the same statistical scaling ratio across biomarkers (as compared to prior presentation)



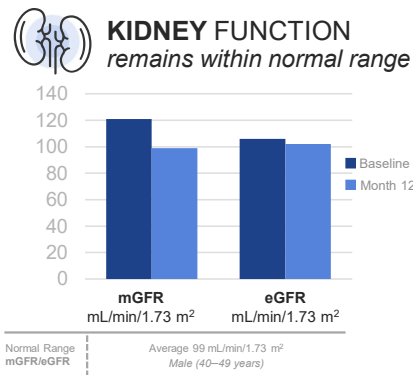
Patient 2: Multiple data trends sustained up to 1 year*



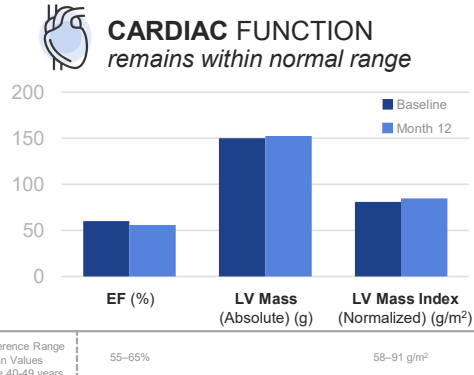
*Data from Rupa Laboratory; Reference Range: 24–56 nmol/hr/mg; †Reference Range: 5.1–9.2 nmol/hr/mL; AGA: α -galactosidase A



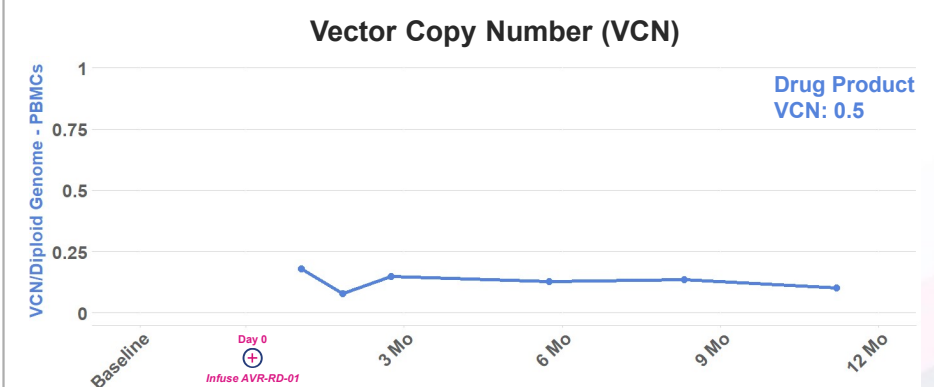
*Reference Value: 2.4 nM; †Reference Value: 4961 nM; Note: Patient #2 has normal substrate, consistent with late-onset cardiac variant phenotype
Lyso-Gb3: Globotriaosylsphingosine; Gb3: Globotriaosylceramide



Source: <https://www.kidney.org/atoz/content/gfr>
mGFR: Measured Glomerular Filtration Rate; eGFR: Estimated Glomerular Filtration Rate



Source: Alfakih K et al, J Magn Reson Imaging, 2003
EF: Ejection Fraction; LV: Left Ventricular



VCN: Vector Copy Number; PBMCs: Peripheral Blood Mononuclear Cells

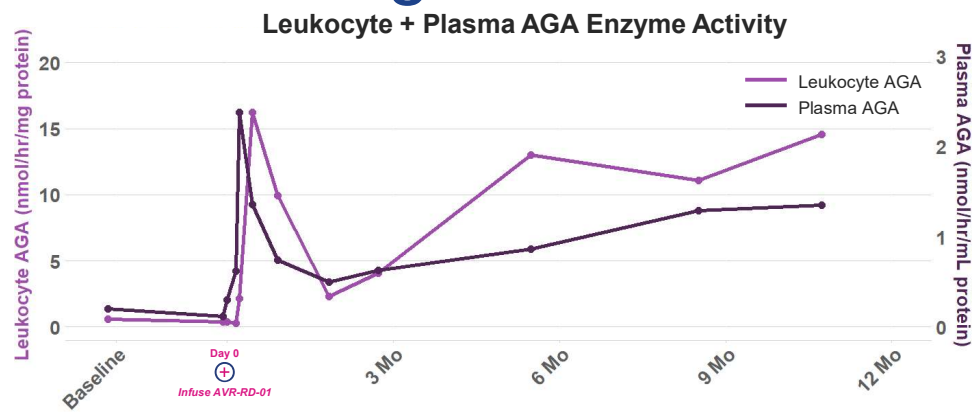
Note: As patient #2 is a cardiac variant of Fabry disease, this patient had a skin biopsy score of 0 (trace or no accumulation) at baseline and at 6 months

Note: Visualization of multiple biomarkers adjusted to utilize the same statistical scaling ratio across biomarkers (as compared to prior presentation)

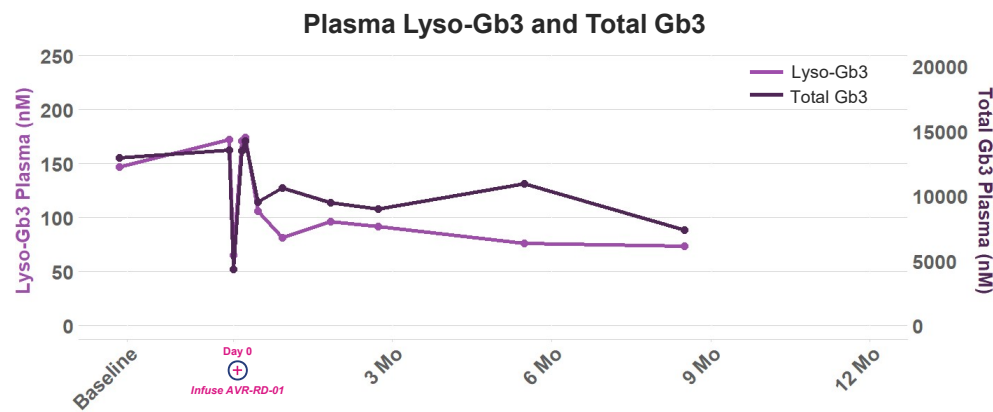
* Latest data points for this patient are at the 1-year follow-up which = 48 weeks per protocol



Patient 3: Data up to 1 year* suggest trend towards durable engraftment

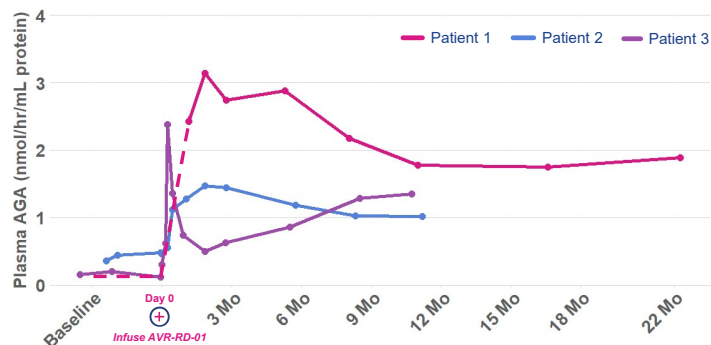


*Data from Rupa Laboratory; Reference Range: 24–56 nmol/hr/mg; †Reference Range: 5.1–9.2 nmol/hr/mL; AGA: α-galactosidase A



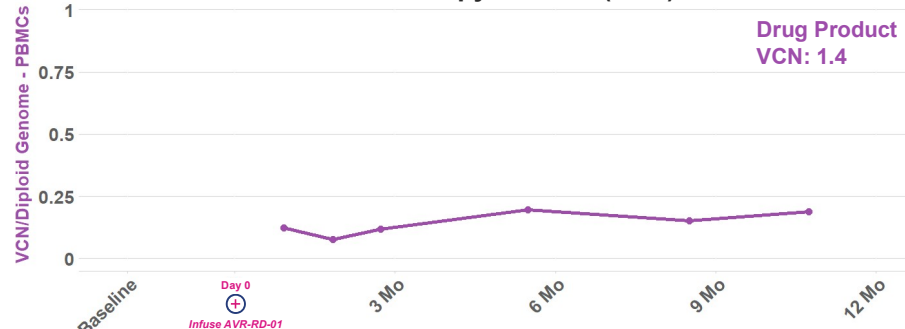
*Reference Value: 2.4 nM; †Reference Value: 4961 nM; Lyso-Gb3: Globotriaosylsphingosine; Gb3: Globotriaosylceramide

Plasma AGA Enzyme Activity



Reference Range: 5.1–9.2 nmol/hr/mL; AGA: α-galactosidase A

Vector Copy Number (VCN)



VCN: Vector Copy Number; PBMCs: Peripheral Blood Mononuclear Cells

Skin Biopsy Score (Patient 3)

Baseline	2
6 months	2

Note: Visualization of multiple biomarkers adjusted to utilize the same statistical scaling ratio across biomarkers (as compared to prior presentation)

*1-year follow-up = 48 weeks per protocol



Patients 1-4: Plasma and leukocyte enzyme activity sustained up to 22 months

Patient #4 dosed using plato[®]

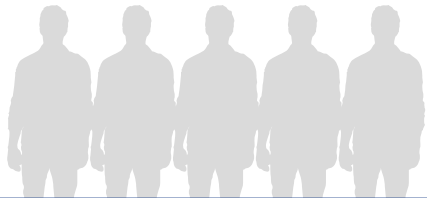


AGA: α -Galactosidase A



Two AVR-RD-01 Fabry clinical trials

9 patients dosed across Phases 1 and 2



PHASE 1

Investigator-Sponsored Trial*

Patients

n = 5 (fully enrolled)
On ERT > 6 months prior to enrollment
18 - 50 year-old males

Key Objectives

Safety and preliminary efficacy



PHASE 2

AVRO – FAB-201 Trial

Patients

n = 8-12 (4 patients dosed to-date)
Treatment-naïve
16 - 50 year-old males



Key Objectives

Safety and efficacy



Fabry Phase 1 Patient Characteristics

ERT-Treated Fabry Patients

	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4	PATIENT 5
Age of symptom onset / diagnosis	18 / 37 years	9 / 29 years	10 / 0 years	7 / 4 years	10 / 14 years
Years on ERT	11 years	6 years	4 years	11 years	2 years
Age dosed with AVR-RD-01	48 years	39 years	40 years	37 years	30 years
Mutation	c.962A>G (p.Q321R)	c.1033T>C (p.S345P)	c.427G>C (p.A143P)	c.427G>C (p.A143P)	(p.Y134S)
Primary disease signs and symptoms	<ul style="list-style-type: none"> • Kidney disease • Cardiac disease • GI pain • GI diarrhea • Angiokeratoma • Insomnia 	<ul style="list-style-type: none"> • Kidney disease • Cardiomyopathy • Hypohidrosis • Corneal verticillata • Peripheral neuropathy • GI symptoms • Angiokeratoma • Lymphedema • Acroparesthesia 	<ul style="list-style-type: none"> • Cardiac Disease • Tinnitus • Headaches • Dizziness • Acroparesthesia 	<ul style="list-style-type: none"> • Cardiac Disease • Hypohidrosis • Tinnitus • Corneal verticillata • Angiokeratoma • GI symptoms 	<ul style="list-style-type: none"> • Kidney disease • Hypertension • Hypohidrosis • Tinnitus • Migraines • Impaired hearing • Angiokeratoma • Sleep apnea • Asthma • Depression
Leukocyte AGA activity at baseline (nmol/hr/mg protein)	2.1*	1.1*	0.6*	2.2*	1.0*
Plasma lyso-Gb3 at baseline (nM)	25**	26**	59**	29**	16**
ERT discontinuation status	18 months after gene therapy dose		Did not resume ERT after gene therapy dose	6 months after gene therapy dose	

* Rutar Lab, ref range 24-56 nmol/hr/mg

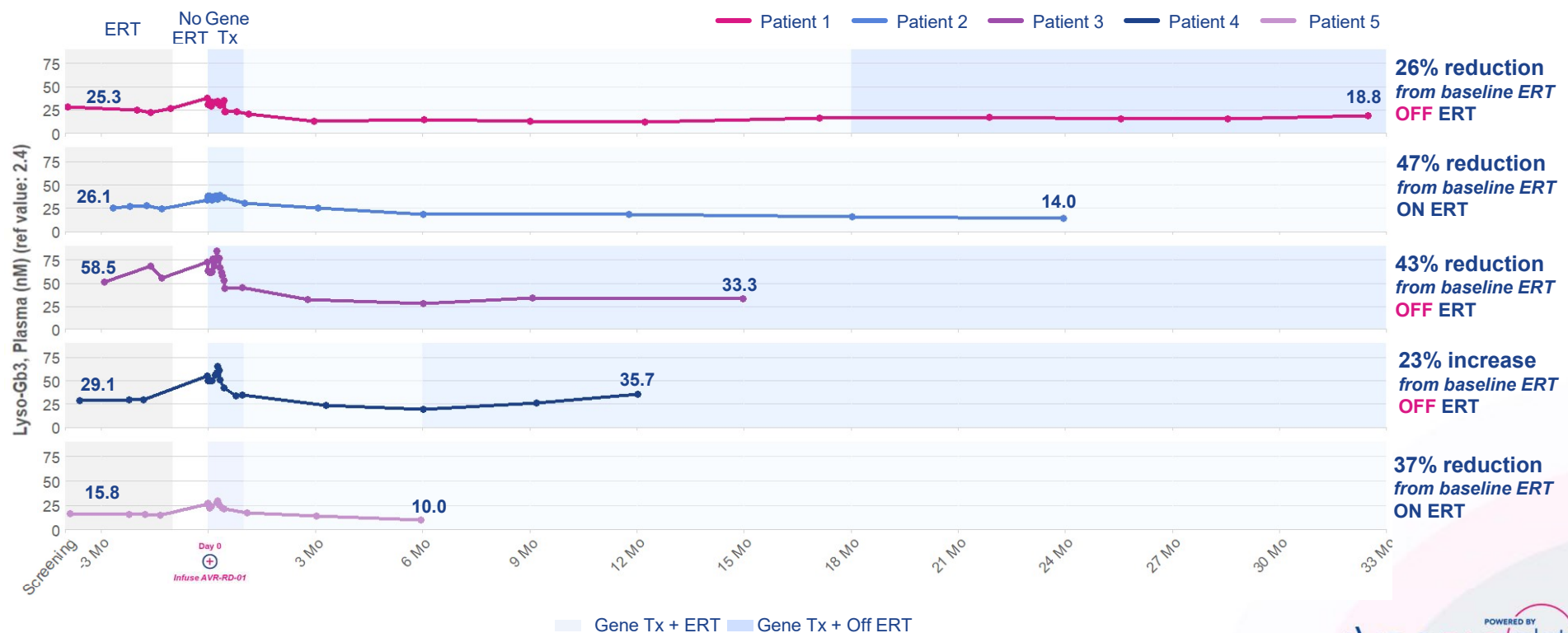
** Reference value ≤ 2.4 nM

Note: AGA: α-galactosidase A; ERT: Enzyme Replacement Therapy; GI: Gastrointestinal; Lyso-Gb3: Globotriaosylsphingosine



Patients 1-5: Plasma lyso-Gb3 reduction sustained up to 32 months

All patients who have discontinued ERT remain off ERT*



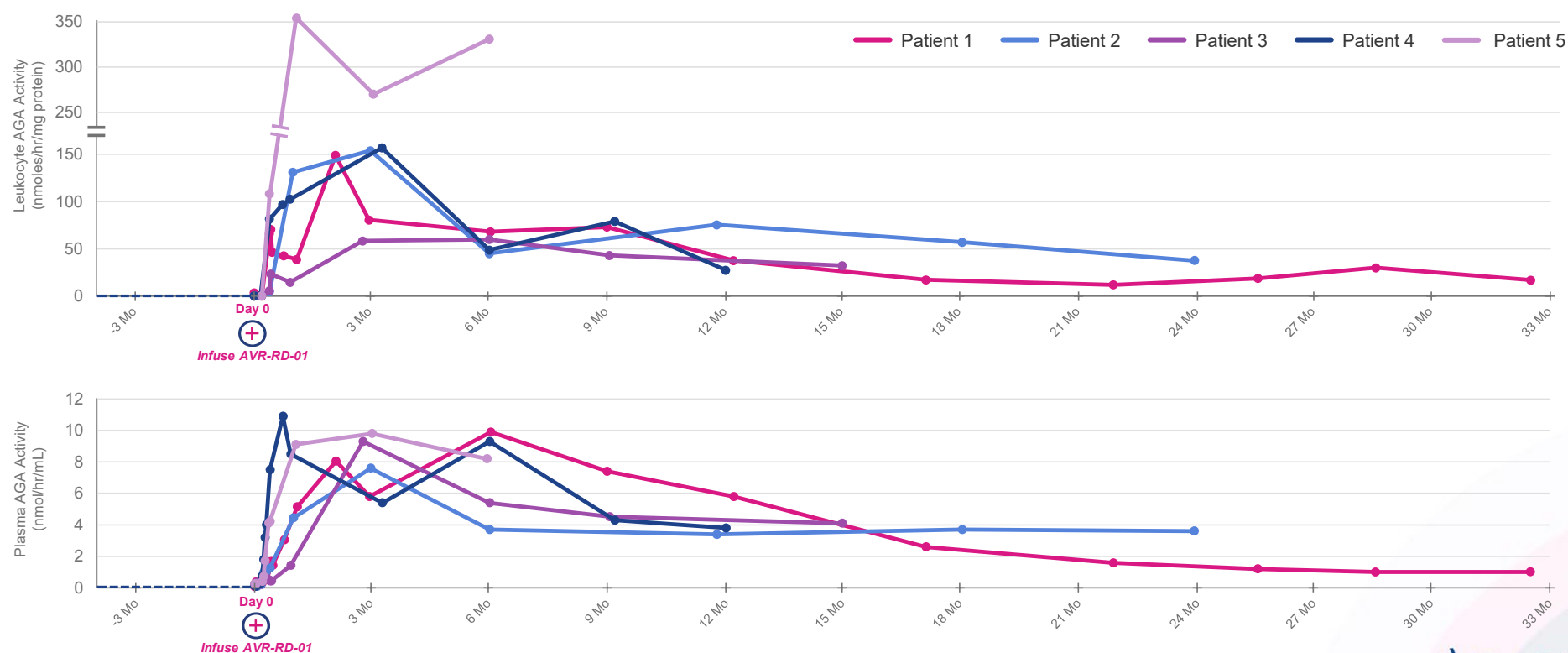
* As of April 27, 2020

Lyso-Gb3: Globotriaosylsphingosine; ERT: Enzyme Replacement Therapy; Tx: Therapy



Patients 1-5: Leukocyte and plasma enzyme activity sustained up to 32 months

Consistent trends across all patients, 4 patients > 1 year

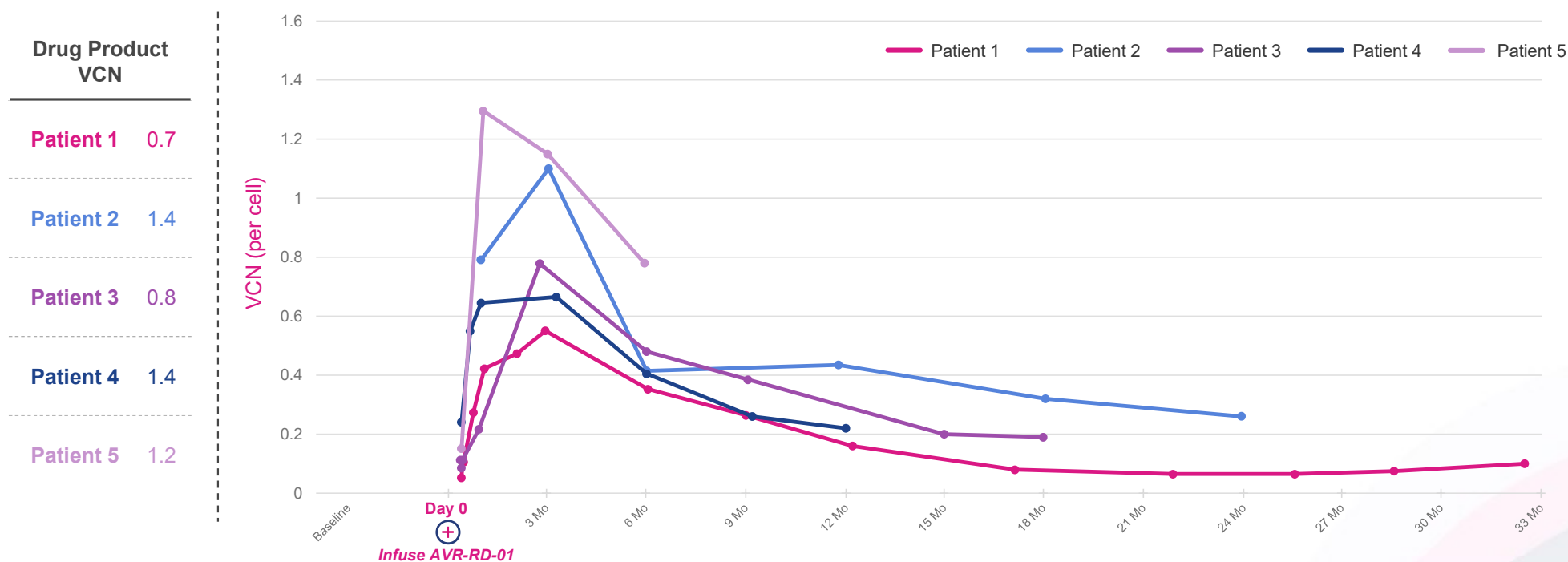


AGA: α -Galactosidase A



VCN stable at 32 months with consistent trend across all other patients

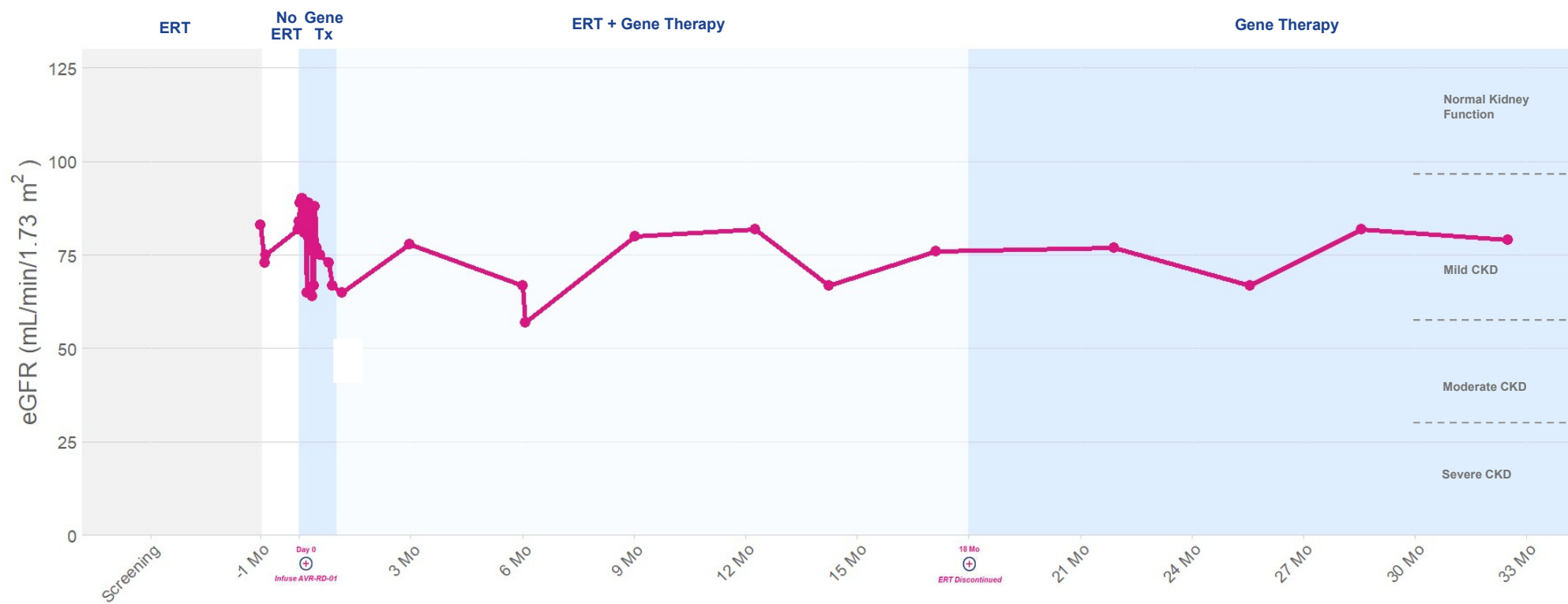
4 patients with 1+ years data



Note: 0.1 VCN is indicative of approx. 5-10% of all nucleated cells having an average of 1-2 copies of the transgene
VCN: Vector Copy Number



Patient 1: Kidney function stable at 32 months



eGFR: Estimated Glomerular Filtration Rate; ERT: Enzyme Replacement Therapy; TX: Therapy; CKD: Chronic Kidney Disease

Phase 1 Fabry (5 patients) and
FAB-201 (4 patients)

**No unexpected
safety events
or trends
identified**



No SAEs related to AVR-RD-01 drug product



AEs and SAEs reported

Phase 1 AEs (n = 128):

- Generally consistent with myeloablative conditioning, underlying disease or pre-existing conditions

FAB 201 AEs (n = 98):

- Generally consistent with myeloablative conditioning, underlying disease or pre-existing conditions
 - Grade 1 or 2 (n = 72)
 - Grade 3 or 4 (n = 30)

Phase 1 SAEs (n = 2):

- Febrile neutropenia (grade 3)
- Thrombophlebitis (grade 2)

FAB 201 SAEs: (n = 4)

Pre-treatment and prior to conditioning

- Seizure (grade 2)

Post-treatment

- Dehydration, nausea, vomiting (grade 3)
- Febrile neutropenia (2 patients, grade 3 & 4)



Anti-AGA antibodies

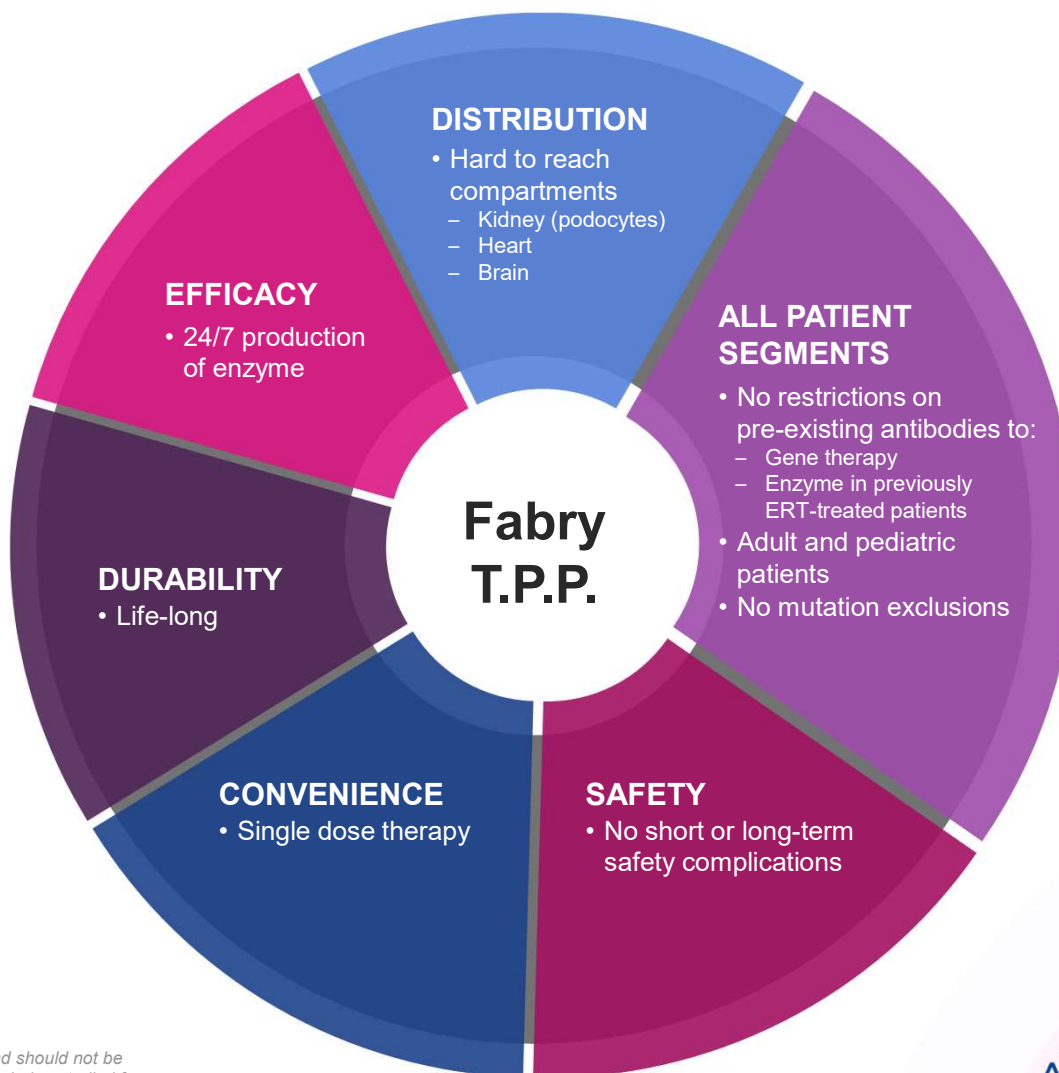
- Pre-existing low titers detected in 4 patients



Note: Safety data cut November 26, 2019
AE: Adverse Event; SAE: Serious Adverse Event
NOTE: AVR-RD-01 is an investigational gene therapy

Fabry disease target product profile (T.P.P.)

Potential attributes intended to support first-line use



ERT: Enzyme Replacement Therapy

Note: Potential attributes represent desired target product profile, and are not intended, and should not be interpreted, to be attributes of AVROBIO's current investigational gene therapies, which are being studied for safety and efficacy and have not been approved by the FDA or any other regulatory body.

Building commercial capabilities

44+ product launches, including 1 gene therapy



Holly May

Chief Commercial Officer



- Led commercial teams for LSDs at SanofiGenzyme
- Head of Commercial at SOBI, a rare disease company



Jose Gomez

SVP, Global Market Access & Value



- Led global strategic marketing and global market access functions at AveXis
- Led market access, global strategic pricing and reimbursement functions for LSDs at Shire



Sean Ring

VP, Head of Commercial Operations



- Extensive orphan drug commercial strategy and launch expertise
- Built out market development and commercial ops at Editas, Zafgen, Cubist, Shire, Biogen



Ramesh Arjunji

VP, Global Health Economics and Outcomes Research / Value Demonstration



- Led value demonstration for insurers globally at AveXis
- Significant access and reimbursement responsibilities at leading global biotech companies





Cystinosis



AVR-RD-04

Goals for gene therapy in cystinosis



UNMET NEEDS:



Kidney function

Unmet needs: renal Fanconi syndrome, proteinuria, chronic kidney disease, kidney failure



Vision

Unmet needs: corneal cystine accumulation, photophobia, involuntary eyelid closure



Endocrine disorders

Unmet needs: softening/weakening of bones, bone pain, rickets, long bone deformations, hypophosphatemia, delayed growth, hypothyroidism, pancreatic insulin insufficiency, diabetes, infertility



CNS complications

Unmet needs: myopathy, hypotonia, tremors, difficulty swallowing, neurodevelopmental issues (speech and walking delay and cognitive impairment)



Everyday burden of illness and life expectancy

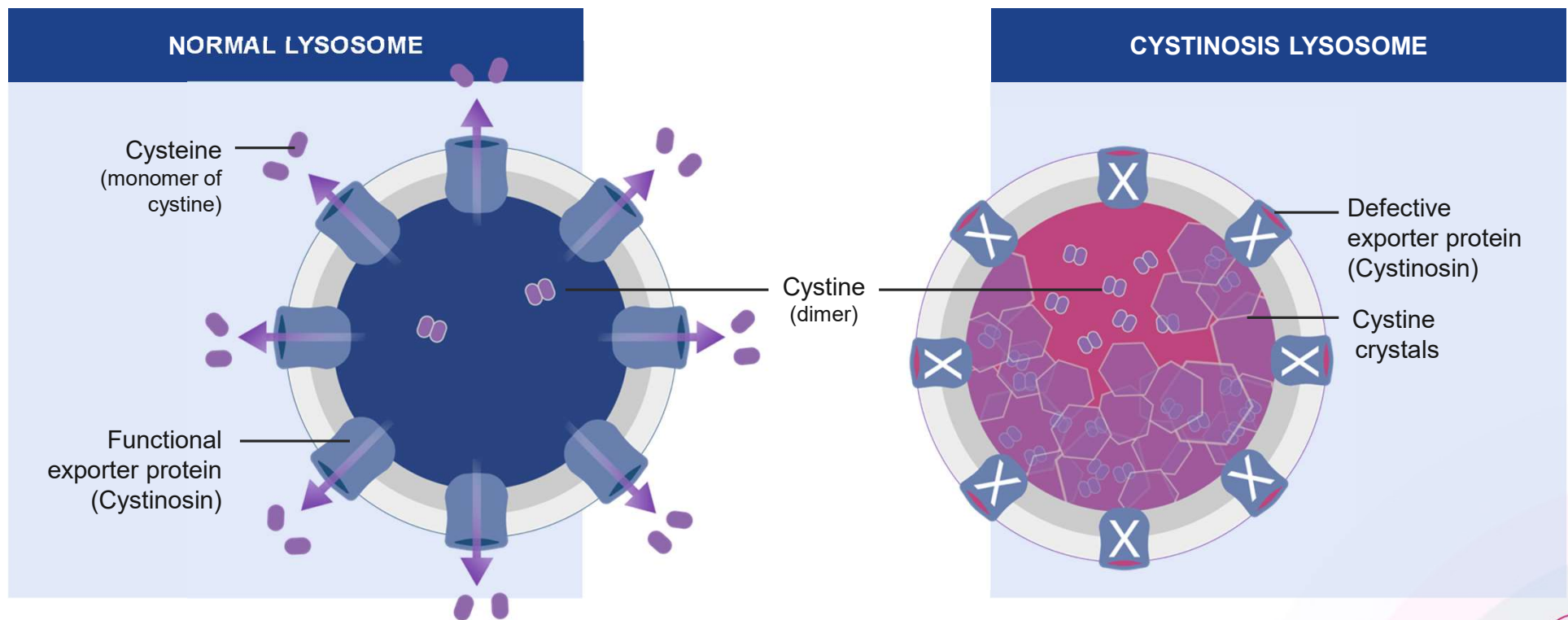
Unmet needs: medications multiple times per day that cause GI discomfort and sulfur body and breath smell, shortened lifespan

Sources: Ariceta G et al, Nephrol Dial Transplant, 2015; Elmonem M et al, Orphanet Journal of Rare Diseases, 2016; Gahl et al, NEJM, 2002; Bois et al, J Med Genet, 1976
CNS: Central Nervous System; GI: Gastrointestinal



Cystinosis caused by defective gene that encodes cystinosisin, an exporter protein

Cystine crystals build up in lysosomes causing tissue and organ damage



Drug product-derived macrophages restore normal cystine recycling

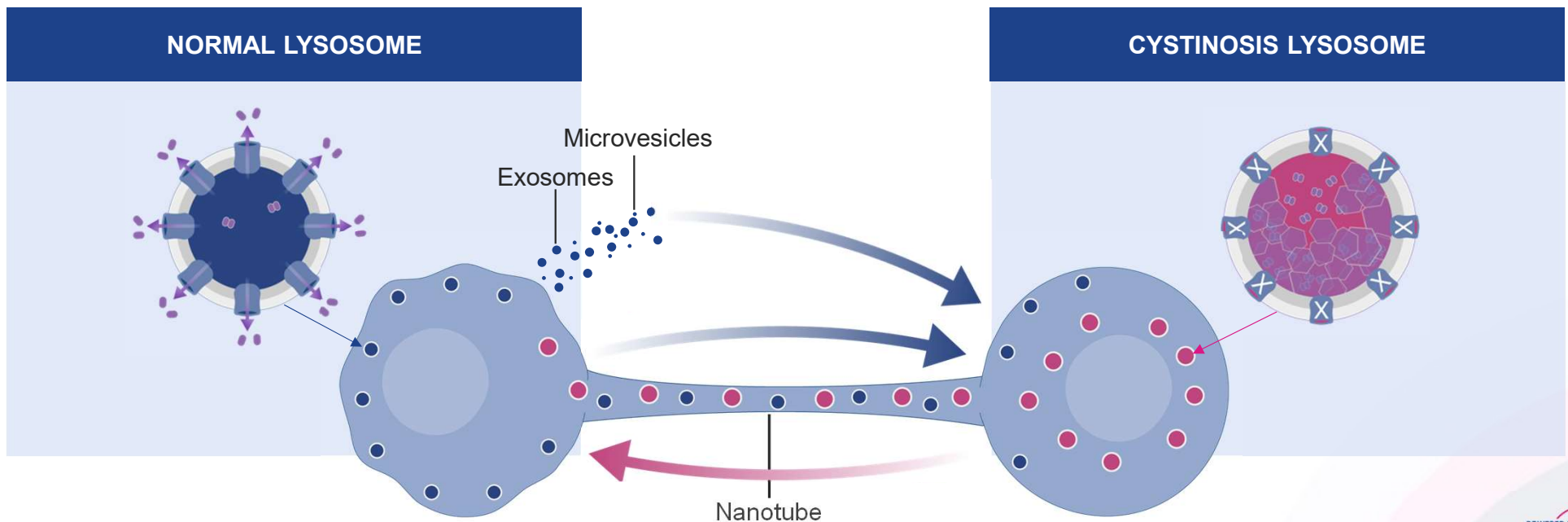


Mechanisms of action

Macrophages with CTNS transgene restore cystine recycling to CTNS^{-ve} cells via:

1. Tunneling nanotubes – transfer of corrected lysosomes, cystinosin, CTNS mRNA
2. Exosomes / Microvesicles – transfer of cystinosin, CTNS mRNA

Net result: Corrected lysosomes in cells throughout the body



Sources: Naphade, Stem Cells, 2015. Harrison, Molecular Therapy, 2013.
CTNS: cystinosin, lysosomal cystine transporter; mRNA: Messenger Ribonucleic Acid

Allogeneic transplant demonstrated stabilized renal function, corrected polyuria and improved photophobia



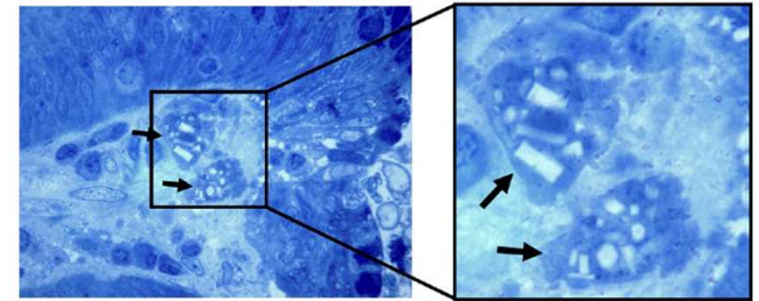
Allogenic HSC Transplant

University Hospital Leuven

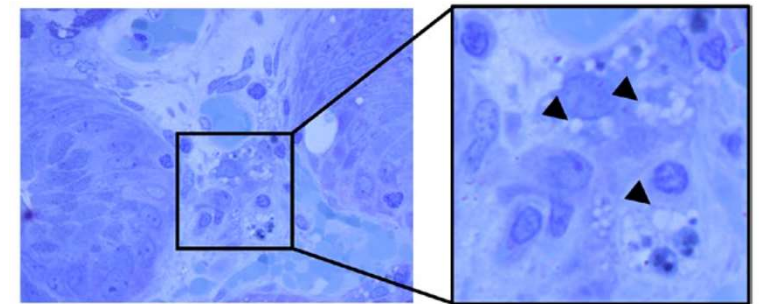
- 16 year old male
- Diagnosed at 2.7 years old, started on cysteamine
- Age 15 years – cysteamine toxicity
- Age 16 years – fully matched HLA transplant
- Acute GvHD
- **First few months**
 - Kidney function stabilized
 - Polyuria resolved
- **6 months**
 - Photophobia score reduced from 5 (unable to open eyes even inside dark room) to 0 (no photophobia)

Cystine crystal reduction (31%) in macrophages in gastric mucosa at 30 months post transplant

BEFORE
TRANSPLANT



30 MONTHS
POST
TRANSPLANT



Arrows/arrowheads point to tissue macrophages



Investigator-sponsored* study of AVR-RD-04 in cystinosis patients

Two patients dosed



PHASE 1/2

Investigator-Sponsored Trial*

Patients

Up to 6 patients

Adults and adolescents

Cohorts 1-2 ≥ 18 years; Cohort 3 ≥ 14 years

Male and Female

On oral and ophthalmic cysteamine



Key Objectives

Safety and efficacy

* Sponsored by University of California, San Diego
Note: AVR-RD-04 aka CTNS-RD-04



Cystinosis AVR-RD-04 Phase 1/2 Patient Characteristics

	PATIENT 1
Age of symptom onset / diagnosis	0 year / 8 months
Age dosed with AVR-RD-04	20 years
Gender	Male
Mutation	Allele 1: LDM ₁ Allele 2: Nt1035 (insC)
Primary disease signs and SoC treatment related symptoms, including	<ul style="list-style-type: none">• Fanconi syndrome• Polyuria• Corneal abnormalities• Mild photophobia• Vomiting
Granulocyte Cystine levels at baseline (nmol half cystine per mg protein)*	7.8
Comments	NO kidney transplant <ul style="list-style-type: none">• Cysteamine 1125 mg p.o. every 12 h/day since 2009; discontinued prior to AVR-RD-04 infusion• Cysteamine eyedrops 4-5x/day• Concomitant medications not listed

Phase 1/2 Cystinosis

**No unexpected
safety events
or trends
identified**



No AEs or SAEs related to AVR-RD-04 drug product



No SAEs reported



AEs reported

- Consistent with myeloablative conditioning and underlying disease
- N = 22 (moderate = 9, mild = 13)

Pre-treatment and prior to conditioning (n = 6, not all events listed)

- Diarrhea, hypokalemia, dizziness
- Dehydration, vomiting

Post-treatment (n = 16, not all events listed)

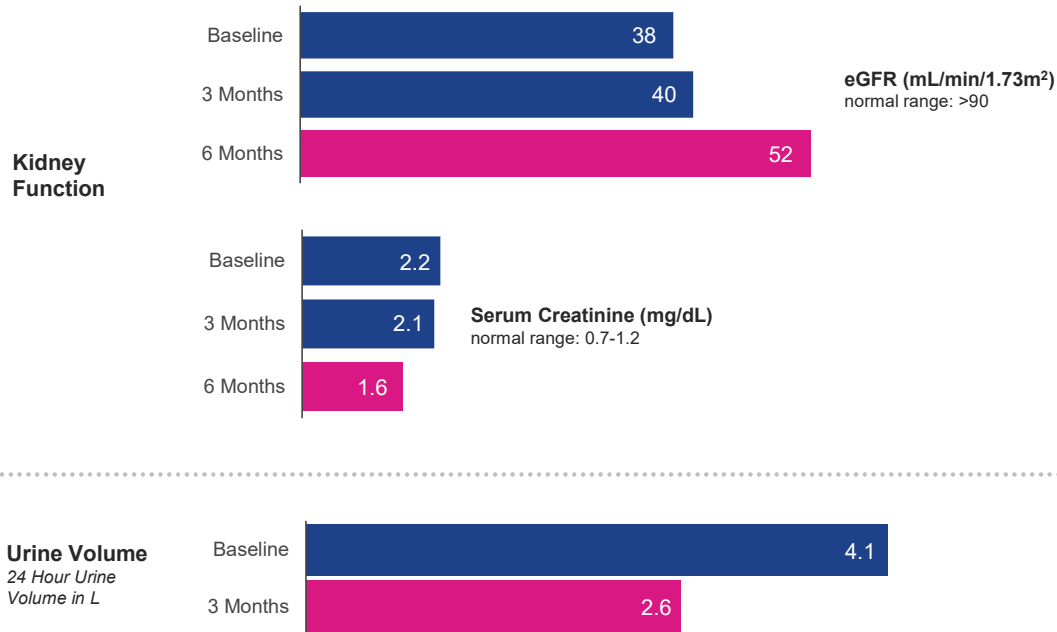
- Alopecia, intermittent diarrhea, vomiting
- Mucositis, intermittent febrile neutropenia, intermittent epistaxis
- Intermittent blurry vision, intermittent hypokalemia, mucocoeles
- Thrombocytopenia

Note: Safety database cut as of January 27, 2020 for first patient dosed in the trial
AE: Adverse Event; SAE: Serious Adverse Event



Patient 1: Initial data indicate positive trends across multiple measures

CLINICAL LAB MEASURES



BIOMARKER ENDPOINTS



- Experimental *in vivo* confocal microscopy
- Two skin areas, behind the ear and 'optional', averaged
- Analysis and quantification (3D Image-Pro software)

VCN (vcn/dg) (Drug Product = 2.1)

1 Month	2.9
2 Months	3.0
3 Months	2.0

Average Granulocyte Cystine Level (μmol half cystine/g protein)

Baseline	7.8
1 Month	1.3
2 Months	1.5
3 Months	1.5

Asymptomatic Heterozygous Carrier Granulocyte Cystine Range: 0.2 – 1.9 μmol half cystine/g protein

Source: Gertsman I et al., Clinical Chemistry, 2016

VCN: Vector Copy Number; CTNS: Cystinosis, Lysosomal Cystine Transporter; mRNA: Messenger Ribonucleic Acid; eGFR: Estimated Glomerular Filtration Rate; SCr: Serum Creatinine

*Data obtained using a novel experimental methodology utilizing *in vivo* confocal microscopy, to image crystals in the skin behind the ear



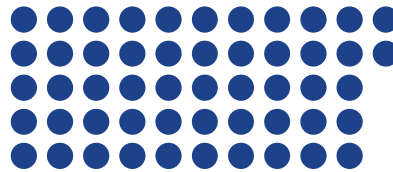
Patient 1: Reduced treatment burden at 6 months

Number of Medications and Supplements

(max per day)

**Before
Gene Therapy**

ON Cysteamine



52

**After Gene
Therapy**

(at 6 months
post-gene therapy)

OFF Cysteamine



20

NOTE: Investigational gene therapy



Gaucher Disease



AVR-RD-02

Goals for gene therapy in Gaucher Type 1 Disease

UNMET NEEDS:



Bone-related manifestations

Unmet needs: bone pain, avascular necrosis, bone crisis, osteoporosis, fractures, joint destruction, skeletal abnormalities



Hemoglobin levels and platelet counts

Unmet needs: anemia, thrombocytopenia, easy bruising, bleeding



Hepatosplenomegaly

Unmet needs: enlarged liver, enlarged spleen



CNS complications

Unmet needs: Increased risk of GBA-Parkinson's disease



Everyday burden of illness, and life expectancy

Unmet needs: fatigue, pain, lung disease, biweekly infusions, shortened lifespan



Sources: Grabowski G et al, *Online Metabolic and Molecular Bases of Inherited Disease*, 2018; Weinreb N et al, *AJH*, 2008; Pastores G et al, *Semin Hematol*, 2004
CNS: Central Nervous System; GBA: gene coding for glucocerebrosidase

Long-term follow-up study highlights significant unmet need in Gaucher Type 1



Despite standard-of-care ERT, **disease progression** continues and **unmet need** remains.

Incomplete therapeutic response is common:

- **60%** of patients failed to achieve at least one of the six therapeutic goals evaluated after 4+ years of ERT¹
- A clinically significant percentage of patients continue to exhibit **bone pain, organomegaly and cytopenia** after 10 years of ERT²
- **25%** of patients continue to suffer from physical limitations after two years of ERT, primarily due to bone disease³

Persistence after 10 years ERT [†]	Non-splenectomized Patients	Splenectomized Patients
Anemia	12.4%	8.8%
Thrombocytopenia*	22.7%	0.7%
Splenomegaly*	38.3%	N/A
Hepatomegaly*	14.3%	18.8%
Bone Pain	42.9%	62.5%
Bone Crisis	7.4%	16.7%

* Higher persistence rates observed when more severe manifestations were present at baseline

[†] Persistence refers to the presence of anemia, bone pain, bone crisis, or at least moderate thrombocytopenia, splenomegaly, or hepatomegaly, present after 10 years of ERT among those with baseline involvement of these parameters (from a registry of 757 GD1 patients; Weinreb et al., 2013).

Following 10 years of treatment, ~26% of patients were receiving between 45-150 U/kg EOW, and 96% of these individuals were receiving doses between 45-90 U/kg EOW.

Sources: ¹Weinreb N et al. *Amer J Hematol*, 2008; ²Weinreb N et al. *J Inherit Metab Dis*, 2013; ³Giraldo P et al. *Qual Life Res*, 2005.

GD1: Gaucher Disease Type 1; SOC: Standard of Care; ERT: Enzyme Replacement Therapy; EOW: Every Other Week

GuardOne: Phase 1/2 study in Gaucher Type 1 patients



First patient dosed



PHASE 1/2
AVR-RD-02 Trial

Patients

n = 8 - 16

Type 1 Gaucher

Treatment naïve or on ERT

16 - 35 year-old

Male and Female



Key Objectives

Safety, Engraftment, Efficacy,
ERT-independence



Pompe disease



AVR-RD-03



Goals for gene therapy in Pompe Disease

TO PREVENT OR IMPROVE:



Pulmonary function

Unmet needs: respiratory insufficiency, chronic respiratory infections, sleep apnea, artificial ventilation



Physical endurance and strength

Unmet needs: proximal myopathy, progressive muscle weakness in diaphragm, trunk and lower limbs, wheel-chair bound



CNS complications

Unmet needs: neuromuscular control, reduction in executive function, cognitive impairment



GI complications

Unmet needs: macroglossia (childhood onset), difficulty chewing and swallowing, GI symptoms, including irritable bowel-like symptoms



Everyday burden of illness, and life expectancy

Unmet needs: fatigue, hepatomegaly, independent living, biweekly infusions, shortened lifespan

Sources: Barba-Romero M et al, Rev Neurol, 2012; Dasouki M et al, Neurol Clin, 2014; Hagemans M et al, J Neurol, 2007; Musumeci O et al, Eur J of Neurol, 2018

Pompe lentiviral gene therapy program advancing

Integrated three-part approach



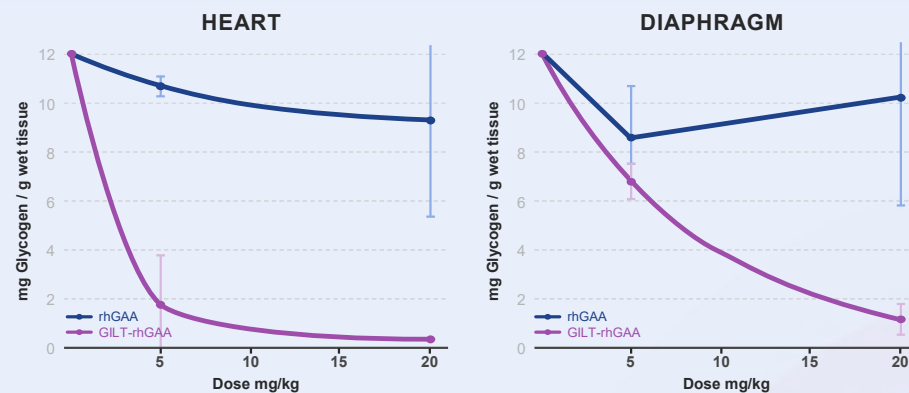
THE CHALLENGE

- Pompe requires **20x more ERT** than Fabry or Gaucher
- Requires GAA activity restored to **muscle and CNS**

GILT-tagged Recombinant Human (rh)GAA impacts levels of stored glycogen compared to non GILT-tagged Recombinant Human (rh)GAA in a Pompe mouse model

AVROBIO's APPROACH

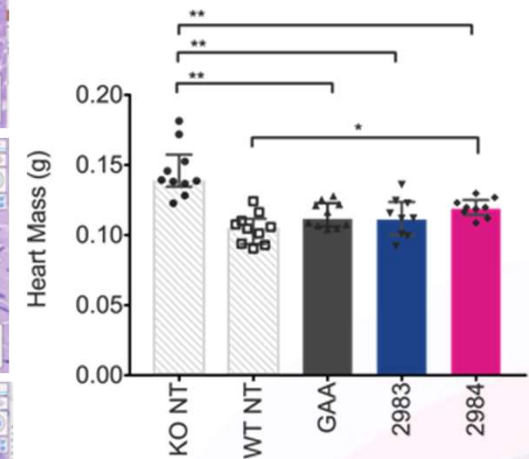
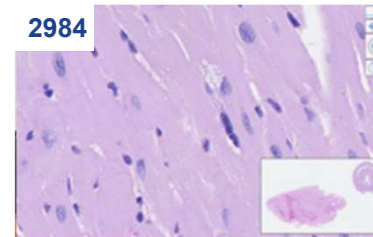
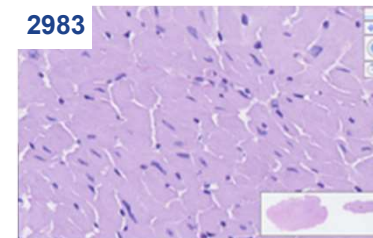
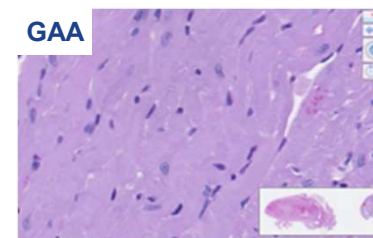
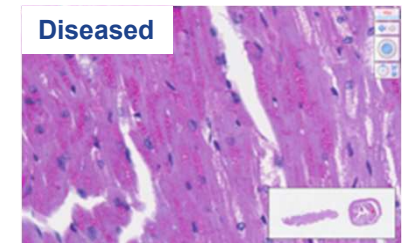
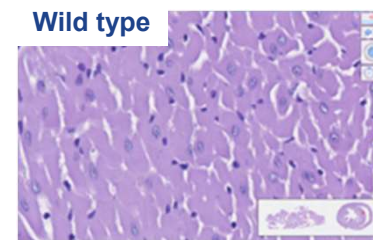
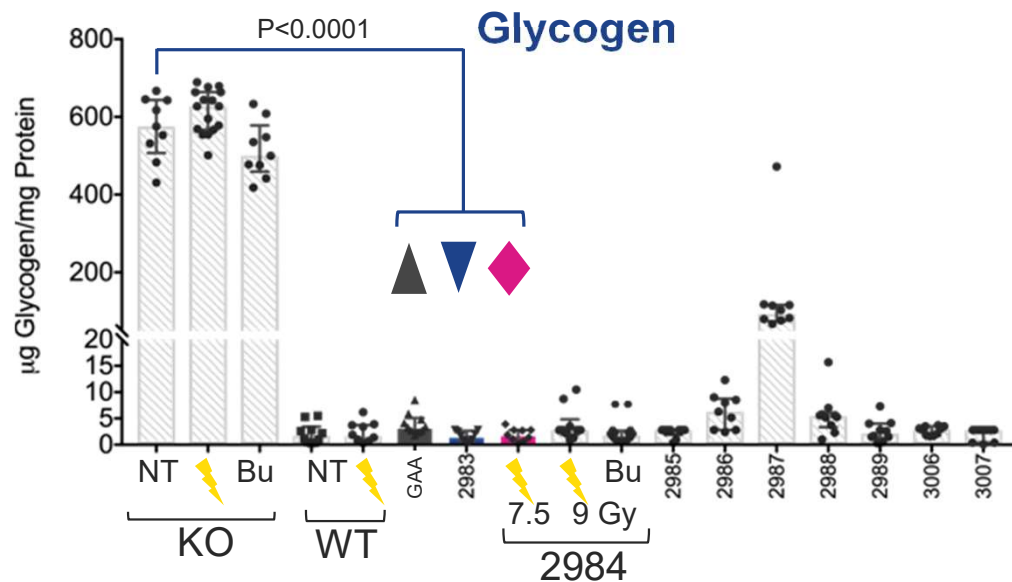
- Potent transgene promoter
- GILT uptake tag
- Bu90-TDM for CNS impact



• GILT: Glycosylation-Independent Lysosomal Targeting

• Sources: Burton B et al, J Pediatr, 2017; Aulsems M et al, Eur J Hum Genet, 1999; Gungor D et al, Orphanet J Rare Dis, 2011; Maga JA et al, J of Bio Chem, 2013; Bartelink, Lancet Haematol, 2016.

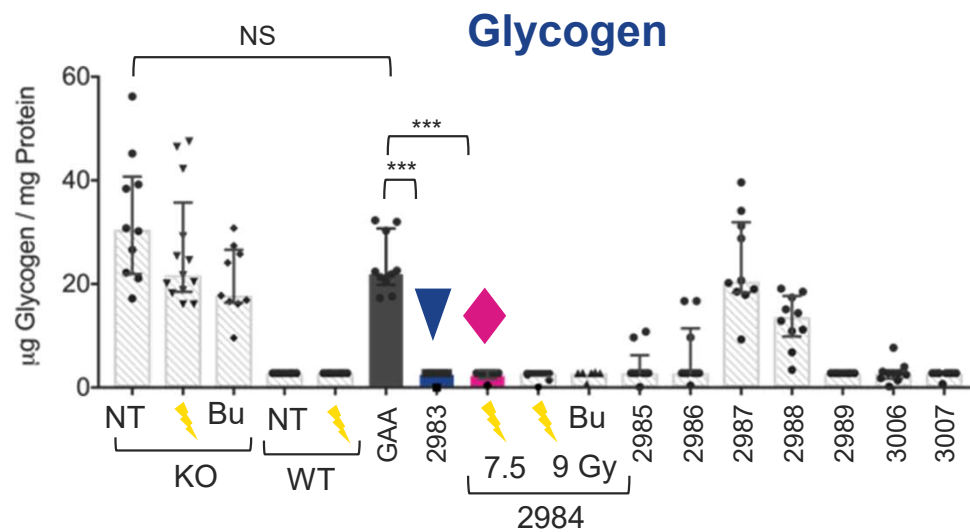
GILT and GILT mutant v1 reduce glycogen by >99% in heart



* $P < 0.01$
 ** $P < 0.001$

Glycogen and GILT and GILT mutant v1 similar to wildtype mice

GILT tag is essential for glycogen clearance in CNS



*** P<0.001

	Cerebrum	Spinal cord
WT		
KO		
GAA		
2983		
2984		



plato[®]

—
AVROBIO's foundation designed to
scale gene therapy worldwide


***State-of-the-art technologies including
automated manufacturing platform***

+ Optimized
for performance

+ Redefines manufacturing
best practices

plato® : Three upgrades designed to optimize potency, safety and durability



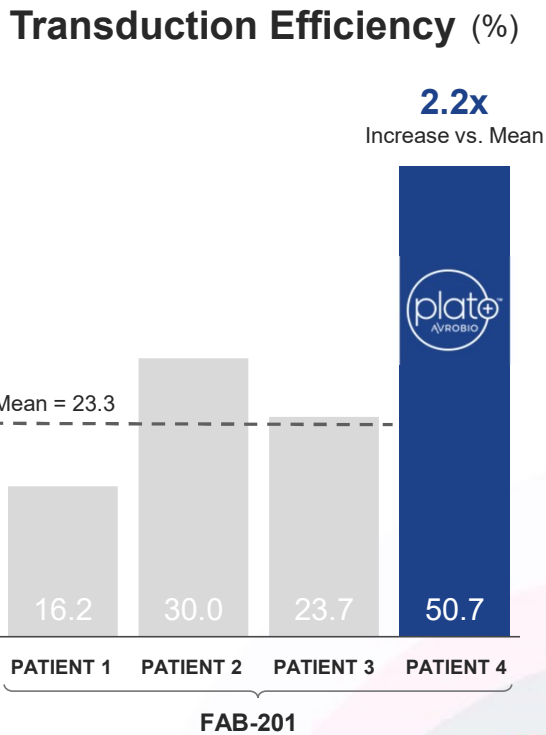
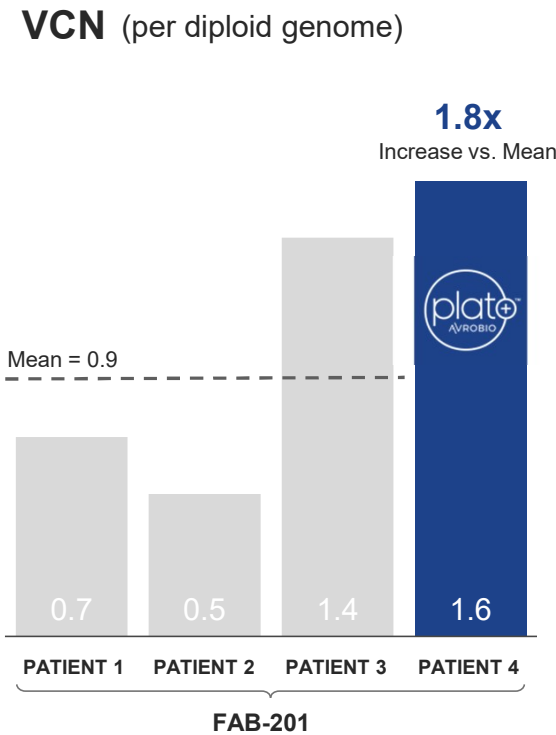
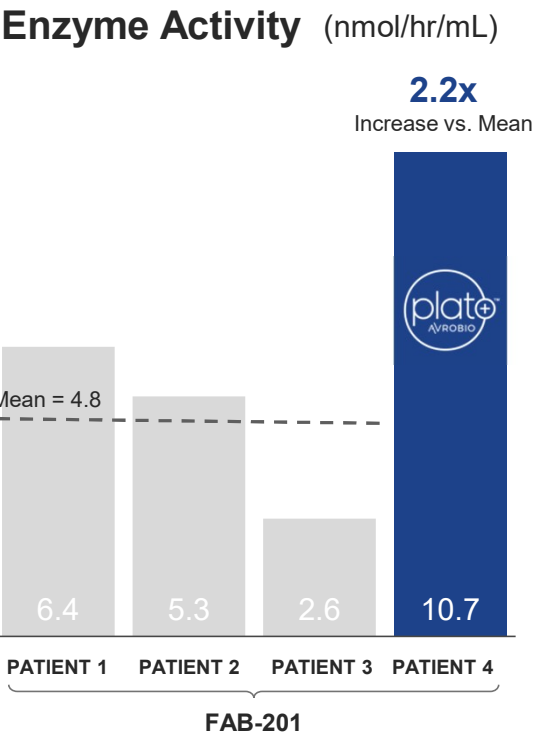
 UPGRADES	Increase enzyme activity	Increase transduction efficiency	Increase VCN	Increase marrow space / engraftment	Increase consistency and safety
					*

Upgrades designed to increase Vector Copy Number (VCN), enzyme activity, chimerism and durability

* TDM (therapeutic drug monitoring)



VECTOR UPGRADE:
Metrics compared to academic process
FAB-201 patient #4 drug product data with plato®



VCN: Vector Copy Number; FAB-201: AVR-RD-01 Study
NOTE: Data is from drug product

VECTOR UPGRADE:

Metrics compared to academic process

FAB-201 and AVR-RD-04 drug product data

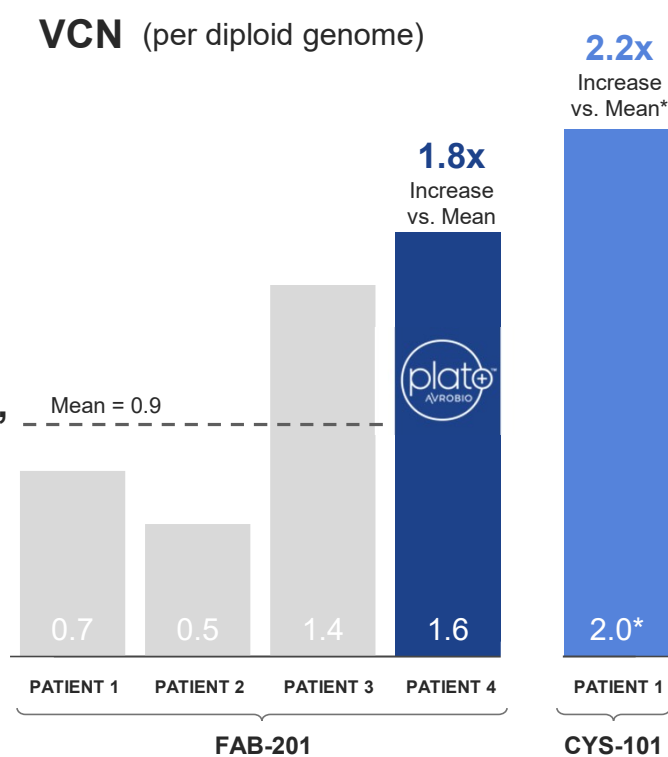
FAB-201 with plato[™]

- 4-plasmid vector (LV2)
- Bu TDM conditioning
- Automated manufacturing

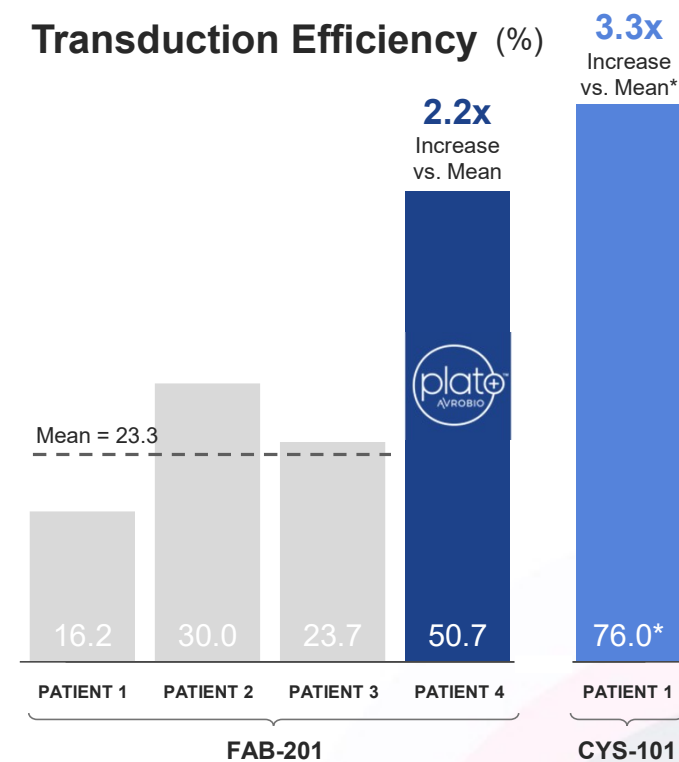
AVR-RD-04 with “plato[™]-like”

- 4-plasmid vector
- Bu TDM conditioning
- Manual manufacturing

VCN (per diploid genome)



Transduction Efficiency (%)



BU TDM: Busulfan Therapeutic Drug Monitoring; VCN: Vector Copy Number; FAB-201: AVR-RD-01 Study; CYS-101: AVR-RD-04 Study; LV: Lentiviral Vector

* Manufactured at UCLA using UCLA's assays and methodologies

NOTE: Data is from drug product

PRECISION CONDITIONING UPGRADE:

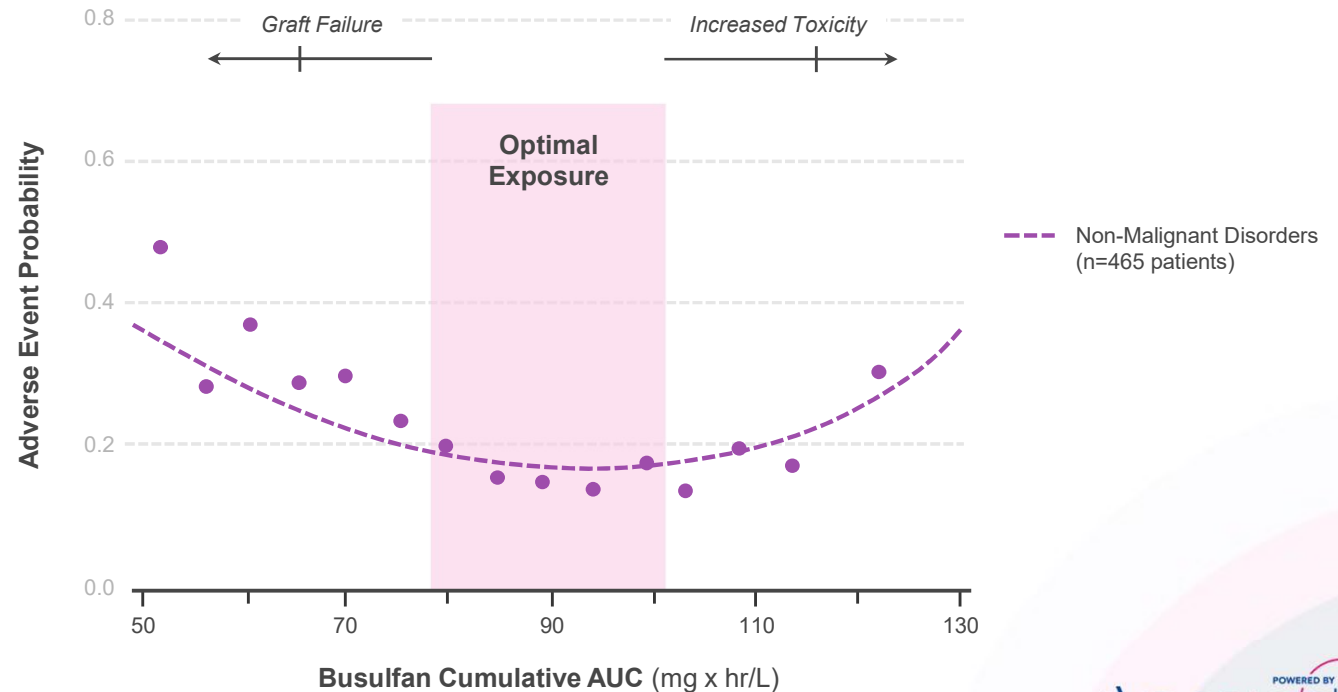
Targeted busulfan intended to balance optimal engraftment with enhanced safety

Meta-analysis of 465 patients identified optimal exposure

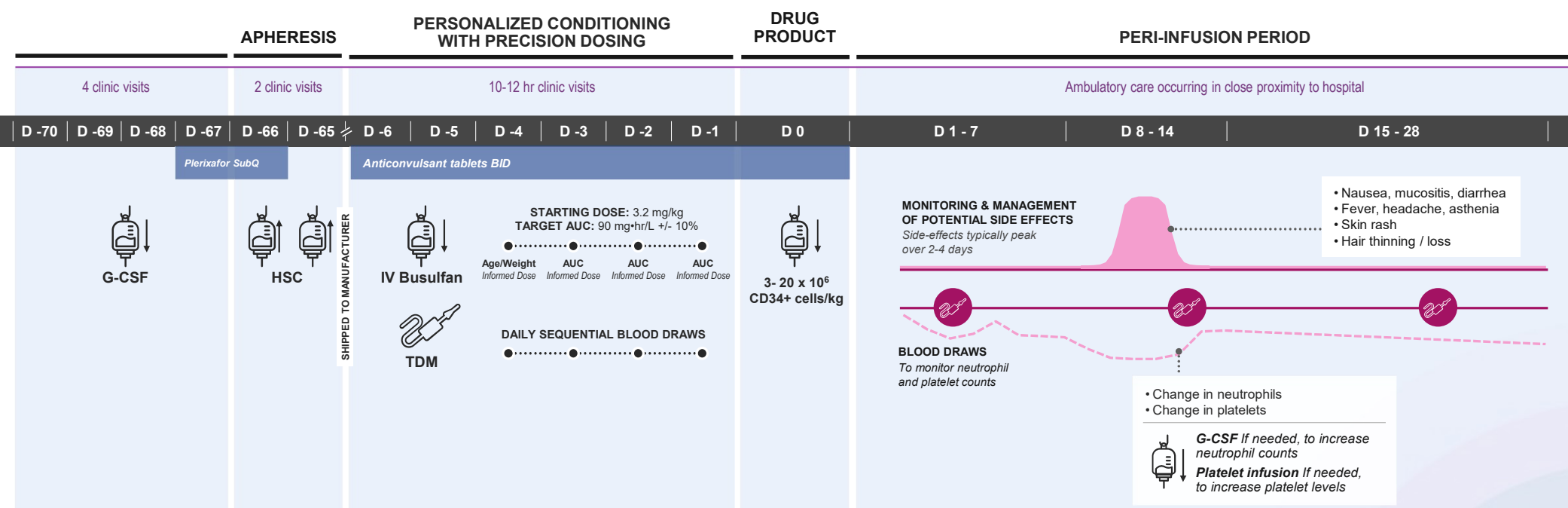


Optimized precision dosing designed to enhance tolerability

Lowest rate of adverse events in the Bu90 range



PRECISION CONDITIONING UPGRADE: Precision dosing via state-of-the-art patient therapeutic drug monitoring (TDM)



G-CSF: granulocyte colony stimulating factor; PERI-INFUSION PERIOD: time from infusion to discharge; TDM: therapeutic drug monitoring; HSC: hematopoietic stem cell

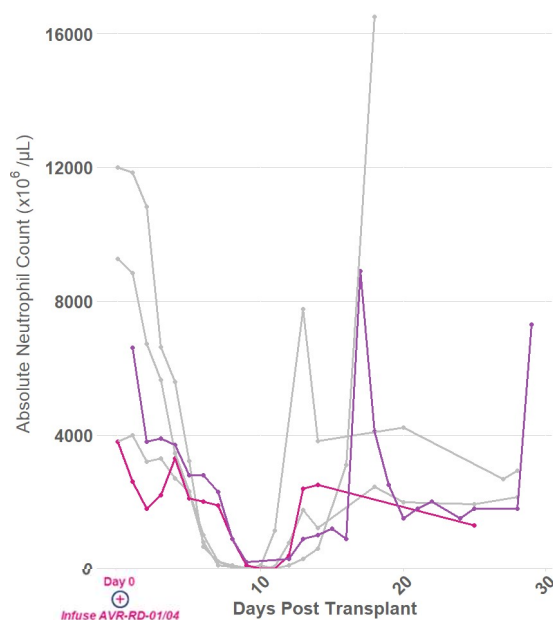
Notes: Illustrative only. AEs will vary patient by patient, see busulfan label for a complete list of side-effects. Ambulatory care based on oncology setting with higher intensity conditioning

PRECISION CONDITIONING UPGRADE:

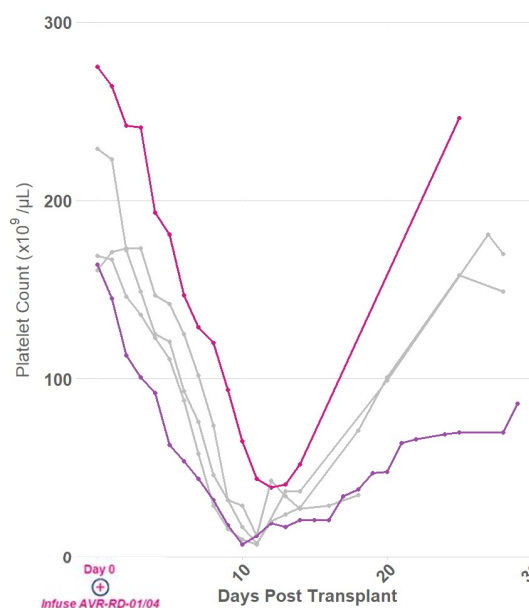
Rapid neutrophil and platelet recovery with minimal lymphocyte depletion using Busulfan TDM



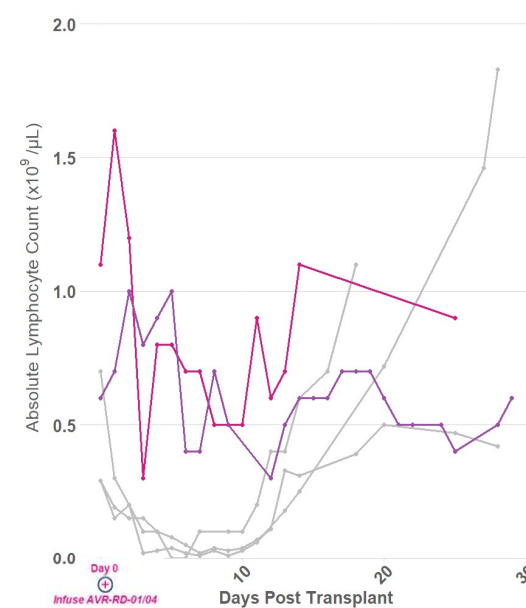
Absolute Neutrophil Count (ANC)



Platelet Count



Absolute Lymphocyte Count



— Cystinosis Patient 1: Busulfan — Fabry Patients 1 – 3: Mel — Fabry Patient 4: Bu90-TDM

Fabry: Patients #1-3 Melphalan 100mg/m²; Patient #4 Busulfan 'AUC 90'; Cystinosis: Patient #1 Busulfan 'AUC 90'

Threshold levels for prophylactic supportive care in HSC Tx: ANC <0.5 x 10⁹ per liter (AABB); Platelets <10 X 10⁹ cells/L (AABB)

NOTE: Neutrophil counts - G-CSF administration post gene therapy: Pt 1: 7 Doses, Day 7 – 14, Pt 2: 11 Doses, Day 7 – 17, Pt 3: 6 Doses, Day 7 – 12, Pt 4: 5 Doses, Day 8 – 12

NOTE: Platelet counts - Platelet Transfusion: Pt 1: Day 10; Pt 2, 3: Day 11, Pt 4: no transfusion

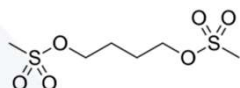
TDM = Therapeutic Drug Monitoring; G-CSF = Granulocyte-colony stimulating factor

PRECISION CONDITIONING UPGRADE:

Designed to access “hard-to-reach” compartments

BRAIN

Busulfan crosses blood-brain barrier and eliminates resident microglia cells making space for gene-modified cells

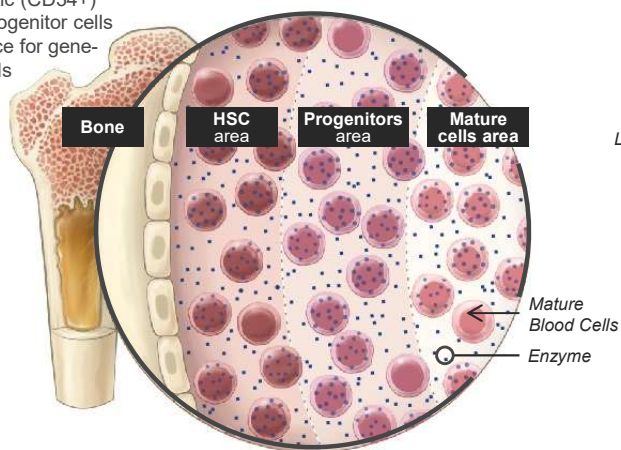


IN THE BONE MARROW

Busulfan eliminates hematopoietic (CD34+) stem and progenitor cells making space for gene-modified cells

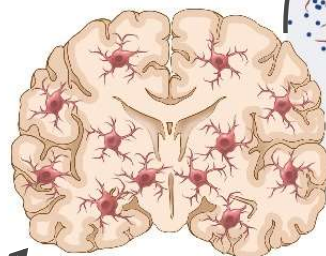
TRANSDUCE
CD34+ CELLS

BONE MARROW

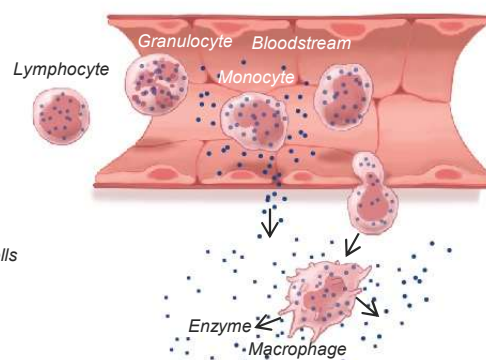


MICROGLIA

Potential for widespread microglia engraftment throughout the brain

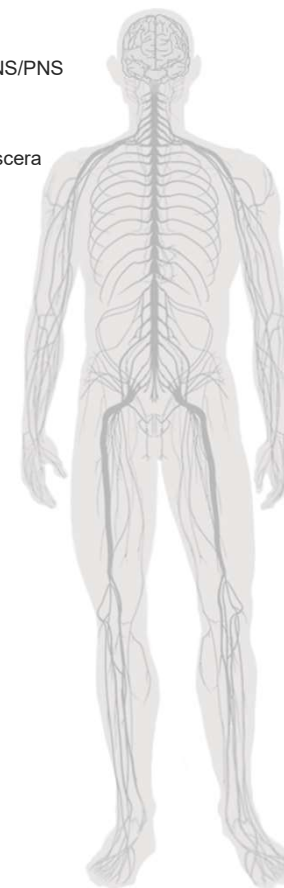


PERIPHERAL TISSUE

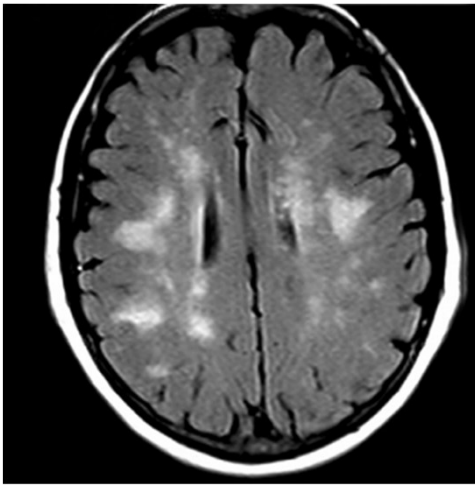


CNS/PNS

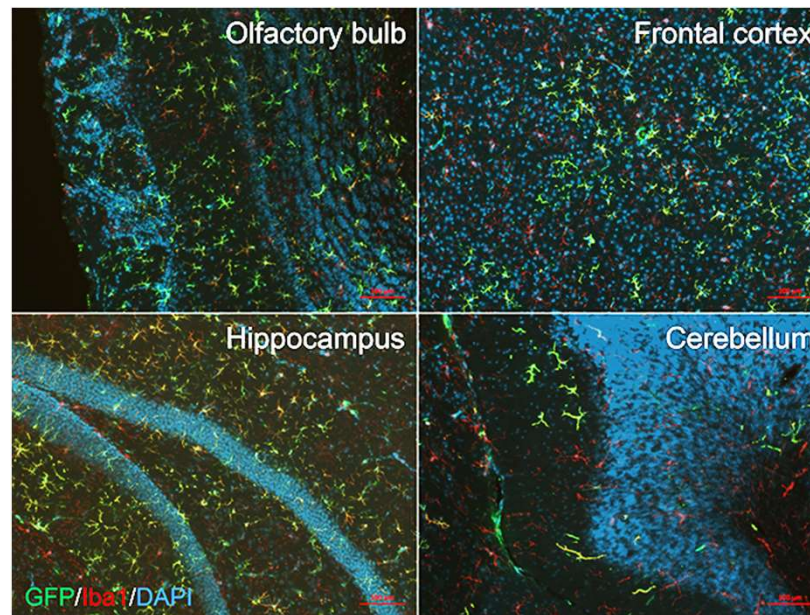
Viscera



PRECISION CONDITIONING UPGRADE: Designed to access “hard-to-reach” compartments, including the brain



MRI: 54 year old with Fabry disease demonstrating white matter lesions (WMLs)



Global microglial coverage of mouse brain at 4 months post gene-modified HSC transplantation

- Widespread engraftment in regions critical for cognitive, motor, olfactory, and visual function
- Engrafted microglia/microglia-like cells have comparable morphology and classical lineage markers with endogenous microglia

Source: Buechner S, J. Neurol, Neurosurg, Psychiatry, 2008

MRI: Magnetic Resonance Imaging; ERT: Enzyme Replacement Therapy; WMLs: White Matter Lesions; HSC: Hematopoietic Stem Cell

AUTOMATION UPGRADE:

Automated, scalable manufacturing system

Designed to elevate quality and overcome historic CMC bottlenecks



Expanded Scale

Potential to reach thousands of patients per year



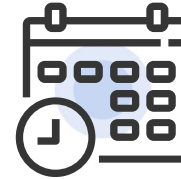
Broader Reach

Portable platform designed for flexible global production using low grade clean rooms



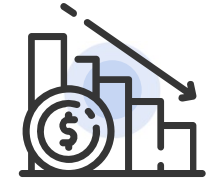
High Quality

Automated, closed system designed to improve quality and consistency



Enhanced Convenience

Cryopreservation simplifies logistics and patient scheduling



Lower Costs

Designed to create efficiencies in vector design / scalable cell and vector production

AUTOMATION UPGRADE:

Designed to deliver large-scale manufacturing

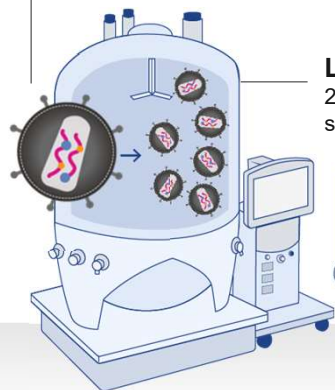
Differentiated, cost-effective approach



1 Vector production

HIGH VOLUME / TITRE

Vector with disease-specific transgene



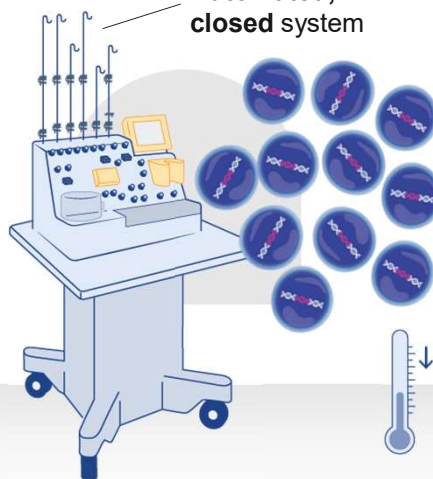
Large bioreactor
200 liter serum-free suspension culture

↓ **Frozen in aliquots**
to streamline supply chain

2 Drug product production

INCREASE CONSISTENCY

Automated, closed system

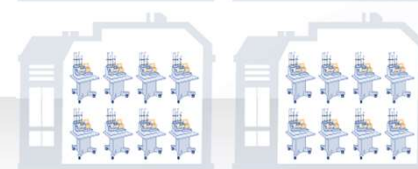
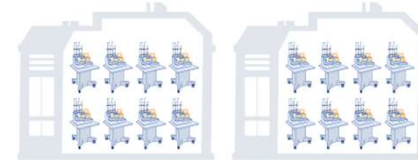
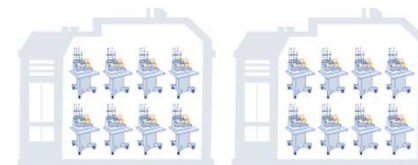


CD 34+ hematopoietic stem cells

↓ **Cryopreserved**
to enable convenient dosing

3 Scalable, global production suites

COST-EFFECTIVE SCALE-OUT



Illustrative

* European manufacturing capabilities planned for 2H 2020; manufacturing capabilities currently in place in U.S. & Australia

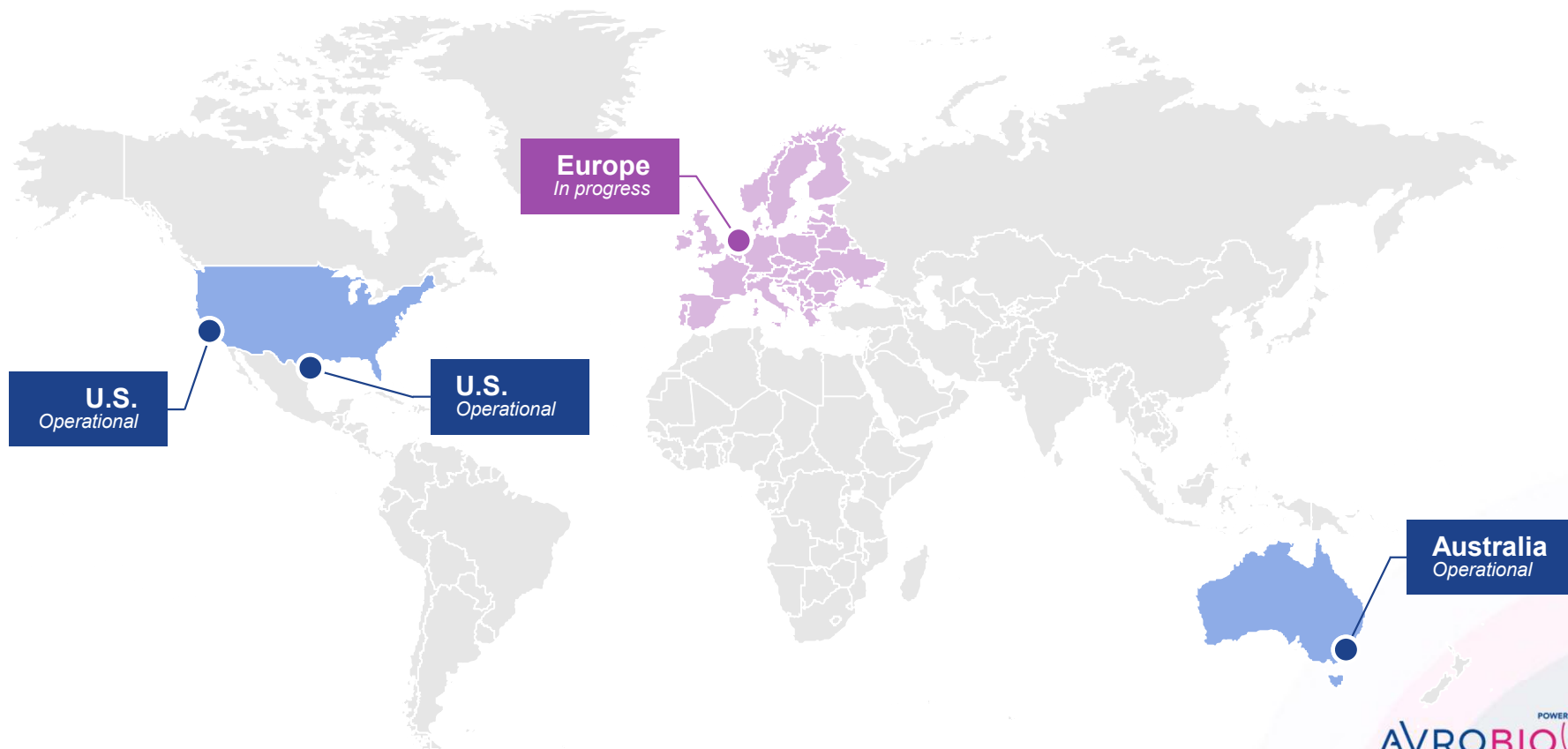
plato®
UPGRADE

3

AUTOMATION UPGRADE:

Global manufacturing established

Automated systems operational in 3 sites with 4th in progress



POWERED BY
AVROBIO (plato®)

AUTOMATION UPGRADE:

Poised to manufacture at scale

Designed to optimize potency and safety, and overcome historic CMC bottlenecks



VECTOR



2,400 PATIENTS
ANNUALLY

~50 patients per run

~12 runs per year per suite
(200 L scale bioreactor runs (10⁹ titre))

4 production suites



DRUG PRODUCT

2,400 PATIENTS
ANNUALLY



100 patients per unit per year

8 automated units per suite

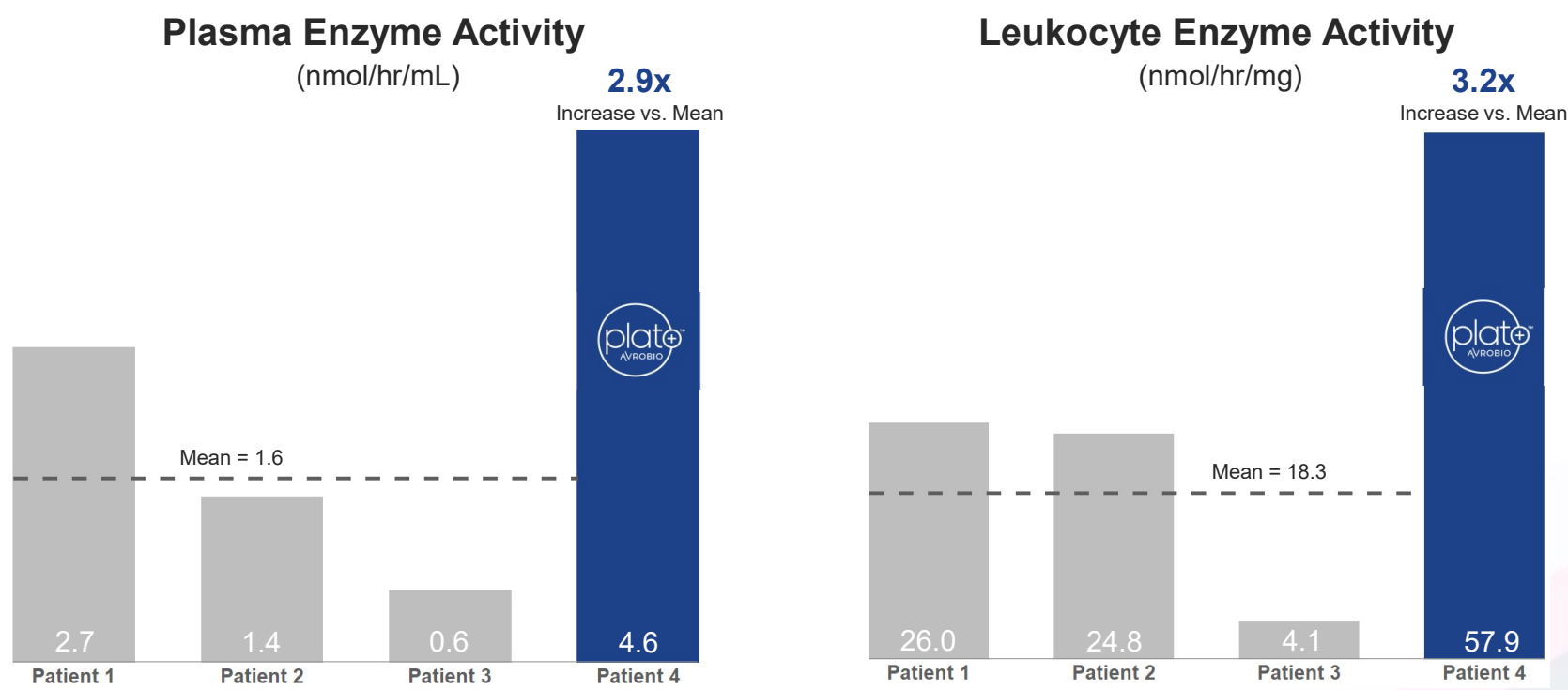
3 global production suites



Illustrative



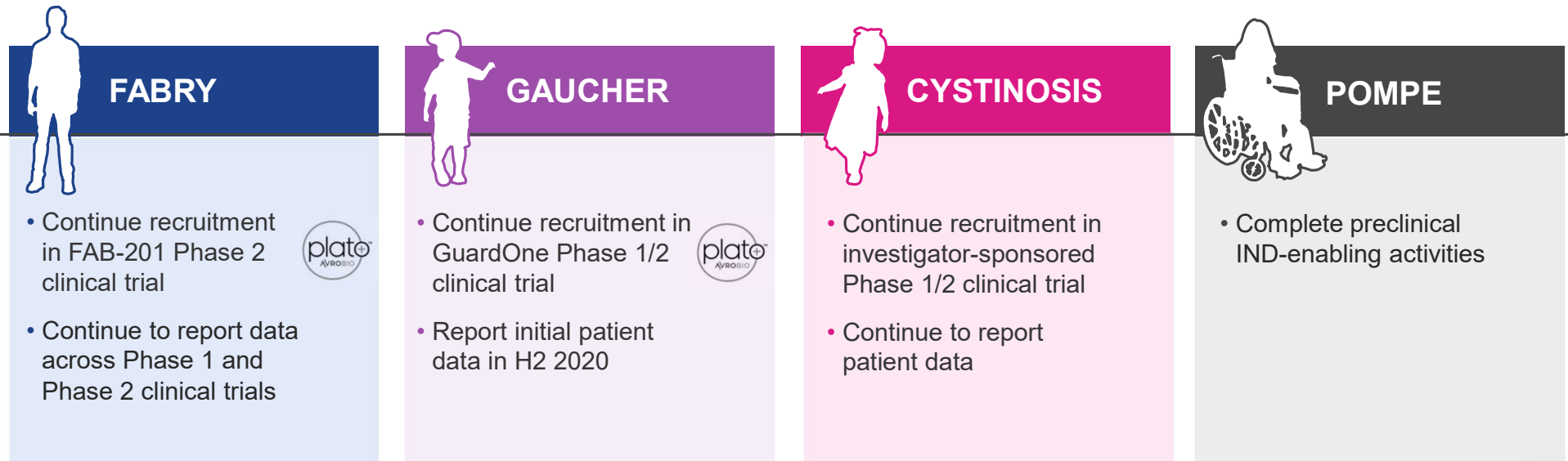
3 UPGRADES IN PLACE:
plato[®] metric compared to academic process
FAB-201 THREE MONTH data for patient #4 with plato[®] vs. patients #1-3





Milestones anticipated across the pipeline in 2020

Clinical activities and timelines subject in all respects to ongoing and evolving COVID-19 pandemic*



AVROBIO to hold first R&D Day in 2020

* For additional information, see the Company's Quarterly Report on Form 10-Q filed with the SEC on May 7, 2020.



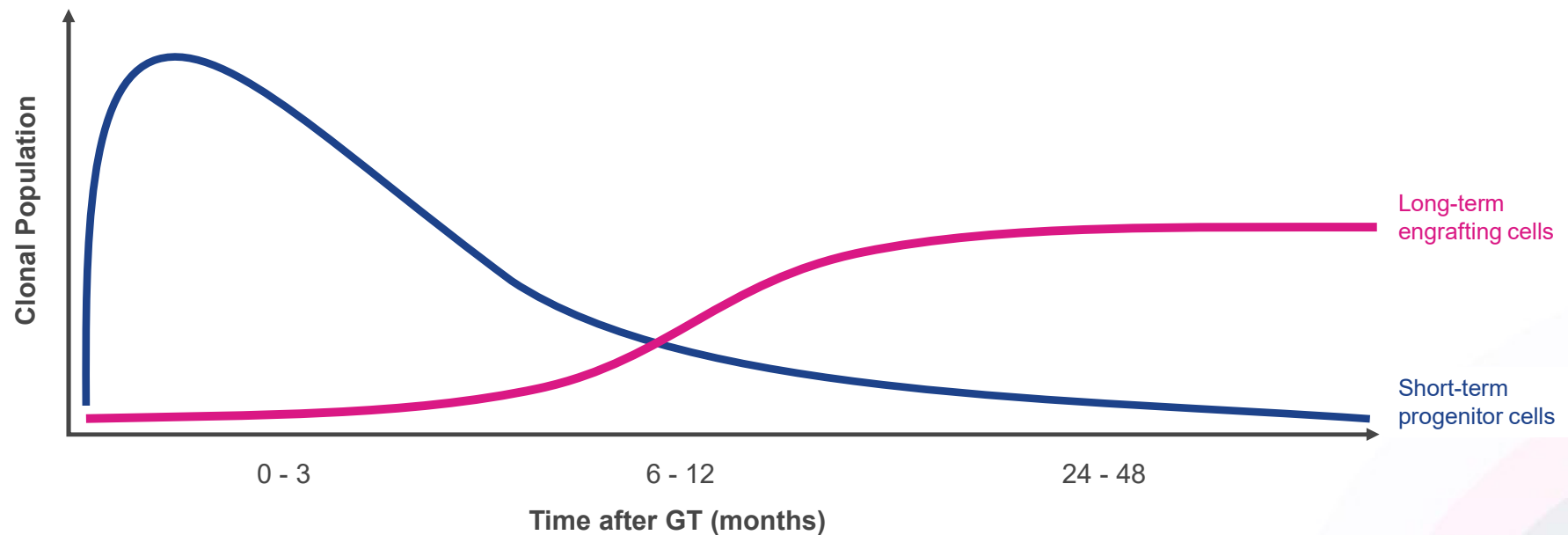


Appendix

Hematopoietic reconstitution occurs in two distinct phases

A few thousand long-term engrafting cells stably sustain levels of transgene product

First wave of short-term progenitor cells start to exhaust with progressive takeover by a smaller population of long-term engrafting cells

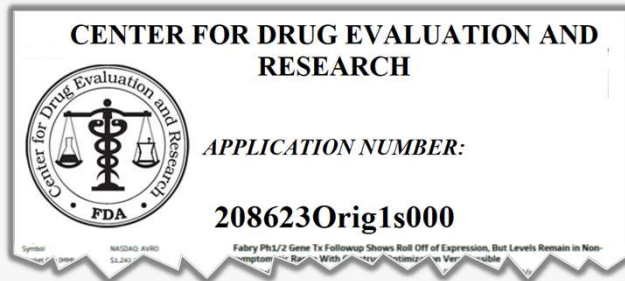


Source: Biasco L et al, Cell Stem Cell, 2016



Precedent for use of kidney biopsy data for FDA approval of drug candidate for Fabry disease

Migalastat approved on % reduction in GL-3 inclusions per KIC as compared to placebo



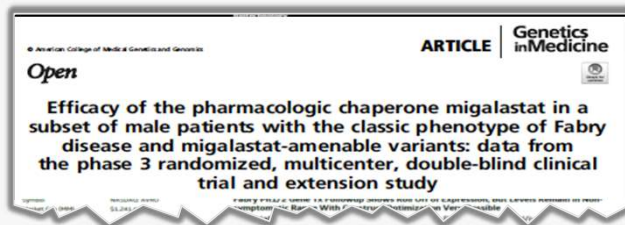
45 Amenable patients* (16 males / 29 females)

Group	Migalastat (BL -M6)	Placebo (BL -M6)
Males (N=16)	5/7 (71%) -1.10 (-1.94, -0.02)	4/9 (44%) -0.03 (-1.00, 1.69)
Patients with baseline GL-3 ≥ 0.3 (N=17; 9 males, 8 females)	7/9 (78%) -0.91 (-1.94, 0.19)	2/8 (25%) -0.02 (-1.00, 1.69)
Patients with baseline GL-3 < 0.3 (N=28; 7 males, 21 females)	6/16 (38%) -0.02 (-0.10, 0.26)	7/12 (58%) -0.05 (-0.16, 0.14)

7/9 males $\geq 50\%$ reduction
(at 6 months from baseline)

Treatment Group	n	Baseline Median (min, max)	Month 6 Median (min, max)	Change from Baseline Median (min, max)
Average number of GL-3 inclusions per KIC (N=13)				
Galafold	7	3.6 (0.2, 6.0)	2.6 (0.1, 6.0)	-0.7 (-1.7, 1.2)
Placebo	6	1.8 (0.1, 2.8)	2.0 (0.05, 4.3)	-0.04 (-0.5, 1.5)

28% average reduction
(at 6 months from baseline)



Classic Fabry patient level data

0-6 months randomized clinical trial and 6-12 months open label extension

	Male Patients with the Classic Phenotype													
	Migalastat (Months 0-24)							Placebo (Months 0-6) → Migalastat (Months 6-24)						
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
PTC GL-3 inclusions at BL	0.16	0.03	n/a	5.69	1.22	n/a	2.88	2.41	1.55	0.16	0.03	0.11	0.94	0.88
Change in PTC GL-3 inclusions from BL to M6	-0.08	0.01	n/a	-1.77	-1.10	n/a	-1.25	1.21	-0.21	0.01	0.09	-0.07	1.94	-0.83
Change in PTC GL-3 inclusions from BL/M6 to M12	-0.12	n/a	n/a	-1.92	n/a	n/a	-0.81	-0.94	-1.13	-0.09	-0.05	n/a	-2.28	0.06

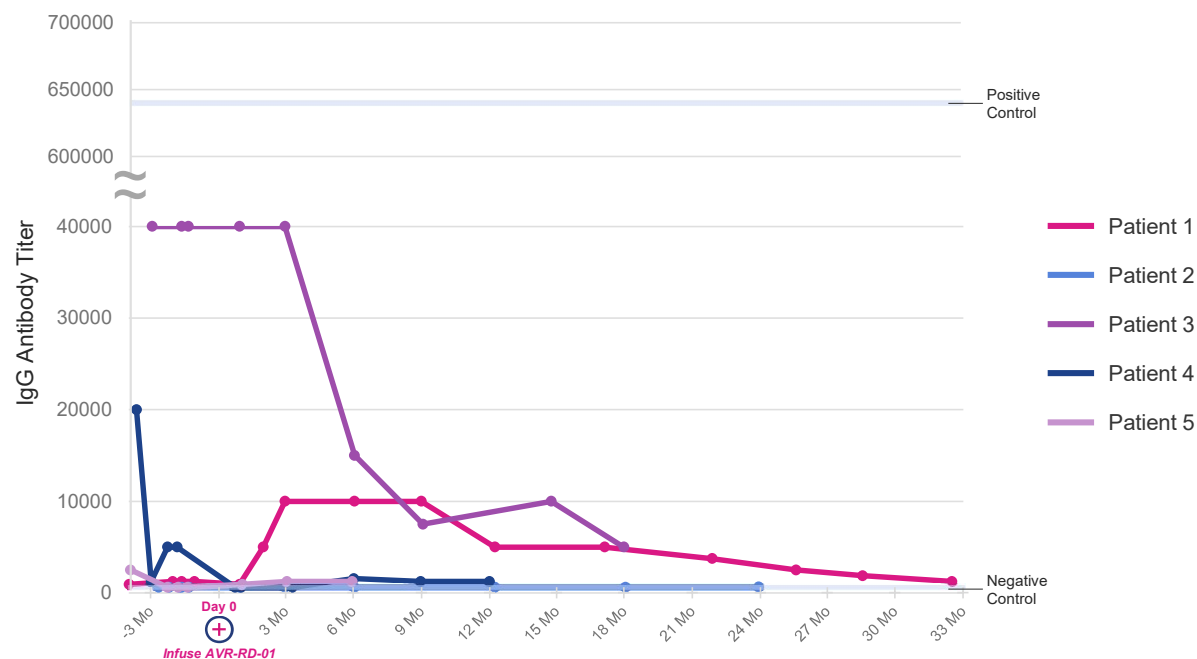
46% average reduction
(average of patients with 12 month data)

- Classic Fabry disease (AGA activity <1%)
- **NOTE:** For informational purposes; differences exist between trial designs and subject populations; AVROBIO has not conducted any head-to-head trials comparing migalastat to AVR-RD-01

Reduction of pre-existing anti-ERT drug IgG antibodies following AVR-RD-01

Suggests potential as a therapeutic option independent of pre-existing antibodies

Fabry Disease Phase 1 IgG Antibody Titer



Similar Results Observed in Other Studies

San Raffaele Telethon Institute for Gene Therapy (SR-TIGET)

Change in pre-existing antibodies reported for Hurler disease (MPS-1)

- Ex vivo LV-CD34+ gene therapy with conditioning
- N = 6
- Evaluable patients (5/6) demonstrated sustained, supraphysiologic blood IDUA activity
- 4/5 prior ERT (rhIDUA) exposure (5-28 months)
- 4/5 pre-existing ERT-induced IgG antibodies
- 6/6 anti-rhIDUA IgGs undetectable 2 months post gene therapy

Source: Gentner B et al., Blood, 2019

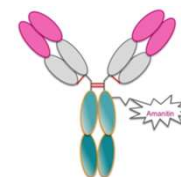
ERT: Enzyme Replacement Therapy; IgG: Immunoglobulin G; MPS-1: Mucopolysaccharidosis Type 1; IDUA: Iduronidase; SR-TIGET: San Raffaele Telethon Institute for Gene Therapy; LV: Lentiviral; rhIDUA: Recombinant Human alpha-L-Iduronidase

New collaborations advancing leadership in lentiviral gene therapy



Fully Automated Bu-TDM Immunoassay

- AVROBIO and Saladax announced agreement to develop and validate Saladax's fully automated nanoparticle immunoassay kit
- Designed to work on most automated hospital analyzers
- Regular technician, 24/7 analysis possible with results anticipated in minutes using only microLs of blood
- Designed to analyze 10-100s samples per machine/hour
- Expected to eliminate Bu degradation errors as assay conducted in real-time at the point of care
- Scalable



Antibody-Drug Conjugate

- AVROBIO and Magenta announced research & clinical collaboration agreement to evaluate Magenta's preclinical CD117-targeted antibody conjugate to amanitin (MGTA-117) in conjunction with AVROBIO investigational gene therapies
- Designed to deplete only hematopoietic stem and progenitor cells
- Has shown promising data in non-human primates
- MGTA-117 currently in IND-enabling studies
- Each party retains commercial rights to its own programs

