AVROBIO Freedom from a lifetime of disease

Corporate Presentation September 2019

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AVROBIO

Developing gene therapies designed to cure rare diseases

- Deep pipeline targeting lysosomal storage disorders (LSDs) where SoC ~\$4B 2018 net sales
- Compelling Fabry data across Phase 1 and Phase 2 trials
- Gaucher and cystinosis expected to enter the clinic this year
- Powered by plato[™] our commercial-stage manufacturing platform
- Management comprised of cell, gene and rare disease industry leaders
- Multiple 2H 2019 milestones anticipated



Cell, gene and rare disease industry leaders



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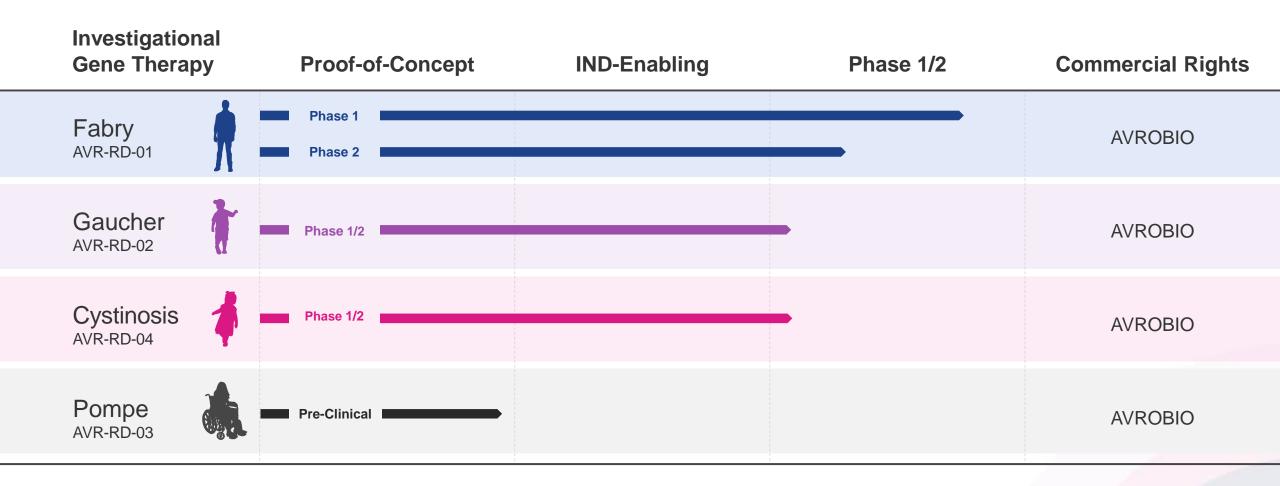




Steady stream of clinical programs



4 clinical trials up and running





Addressing multi-billion dollar markets



CURRENT STANDARD OF CARE COSTS

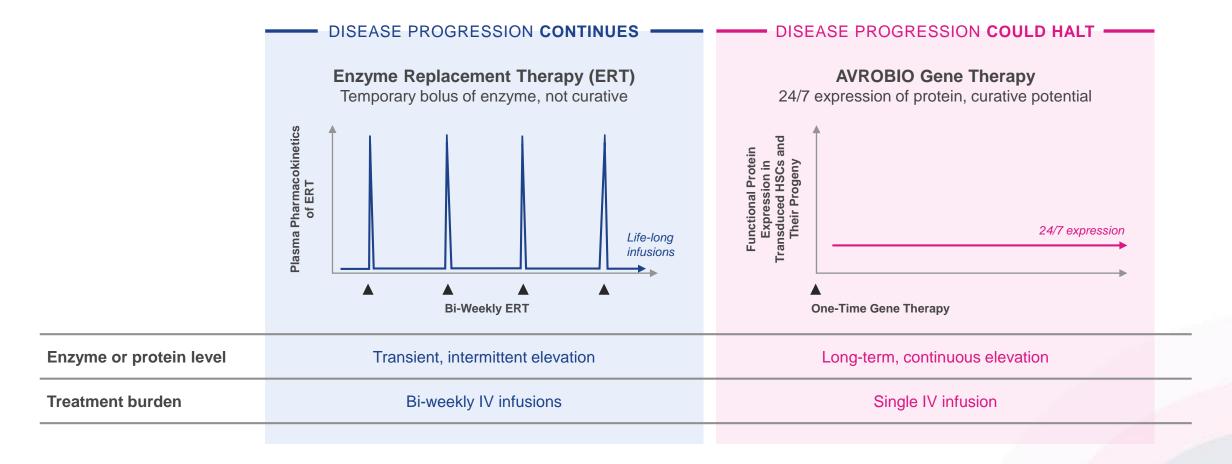
Disease	Est. Cost Per Year	Approx. 2018 Net Sales	Selected Companies
Fabry	\$320k	\$1.4B	SANOFI GENZYME Shire
Gaucher	\$250k-400k	\$1.4B	SANOFI GENZYME Shire
Pompe	\$500k	\$1B	SANOFI GENZYME 🧳
Cystinosis	\$625k-700k*	\$0.2B	HORIZON III Mylan° RECORDATI

Sources: Rombach S et al, Orphanet J Rare Dis, 2013; van Dussen L et al, Orphanet J Rare Dis, 2014; WAC pricing from Redbook; 2018 Net Sales from company annual and other reports *= for Horizon's Procysbi oral therapy (delayed release cysteamine bitartrate)

AVROBIO POWERED BY

Life-long treatments vs. potential single dose cure



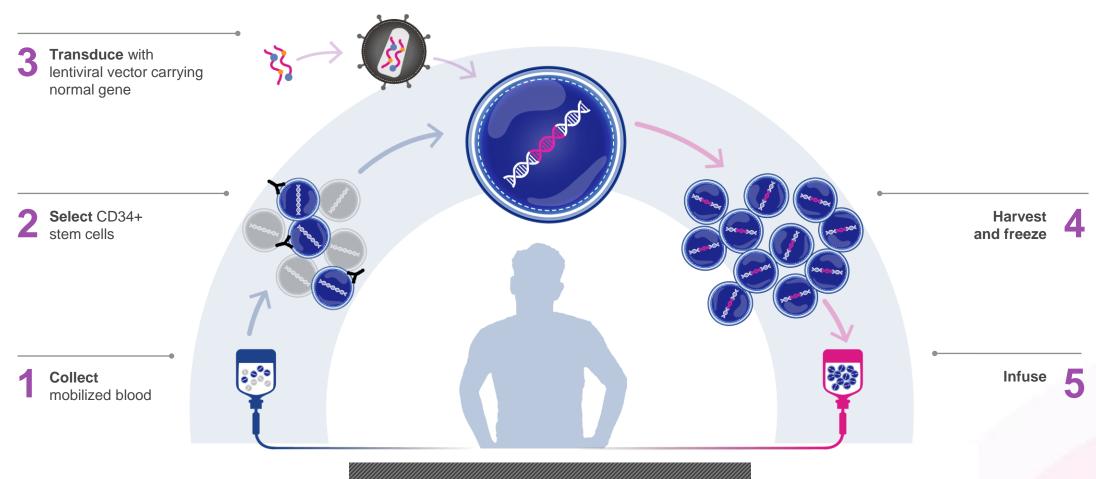




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One platform applied across our portfolio

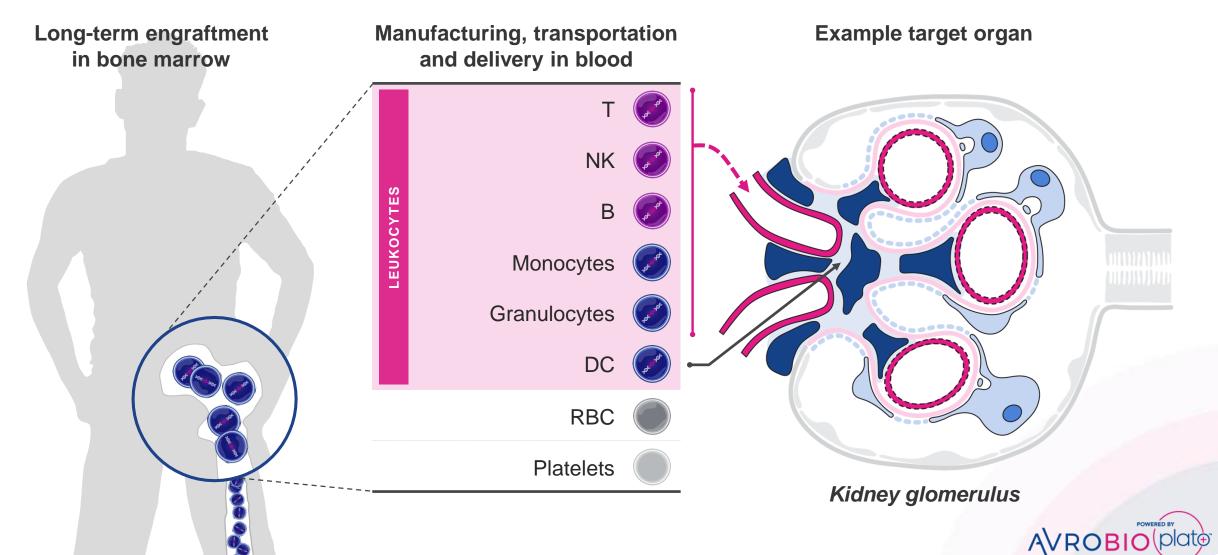




GENE THERAPY PLATFORM

Endogenous enzyme delivered to tissues via multiple cell lineages





Two AVR-RD-01 Fabry clinical trials



8 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 (3 patients dosed to-date)

Treatment-naive

16 - 50 year-old males

Key Objectives

Safety and efficacy



FAB-201 Primary and secondary endpoints



FAB-201 Primary efficacy endpoint



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

- Biopsy at 1 year vs. baseline
- FDA-recognized endpoint in Fabry





Primary safety endpoints



AEs, SAEs Clinical labs, ECG, vital signs Antibodies, RCL, ISA

Secondary efficacy endpoints



ORGAN AND SYSTEM FUNCTION

Kidney function Cardiac function GI distress Pain



PATIENT WELL-BEING

Clinical status
Quality of life



BIOMARKERS

Toxic metabolite – lyso-Gb3 in plasma, urine Substrate – Gb3 in plasma, urine, skin Enzyme – AGA in leukocytes, plasma VCN





Gb3, also referred to as GL-3: a type of fat that builds in cells, resulting in damage to kidneys, heart and brain

Peritubular capillaries (PTCs), also referred to as kidney interstitial capillaries (KICs) convey blood after filtration in the glomeruli, enabling it to eventually exit the kidneys and return to the circulatory system



FAB-201 - Patient Characteristics

	PATIENT 1	PATIENT 2	PATIENT 3		
Age symptom onset / diagnosis	10 / 19 years	36 / 37 years	13 / 13 years		
Age dosed with AVR-RD-01	21 years	21 years 46 years 4			
Mutation	c.1021G>A (p.E341K)	c.644A>G (p.N215S)	c.639+1G>T		
Primary disease signs and symptoms	Kidney diseaseChronic painGI symptomsDecreased cold sensation	 Cardiac disease Peripheral neuropathy Chronic pain Increased tiredness GI symptoms Intermittent tinnitus Mild high frequency hearing loss Raynaud's syndrome 	 Kidney disease GI symptoms Peripheral neuropathy Bilateral deafness Tinnitus Peripheral edema Decreased cold sensation 		
Leukocyte AGA enzyme activity at baseline (nmol/h/mg)	0.10*	2.38**	0.58**		
Plasma lyso-Gb3 at baseline (nM)***	202	8	147		
Comment	IgA deposits in kidney biopsy	Cardiac variant, not a classic Fabry male			



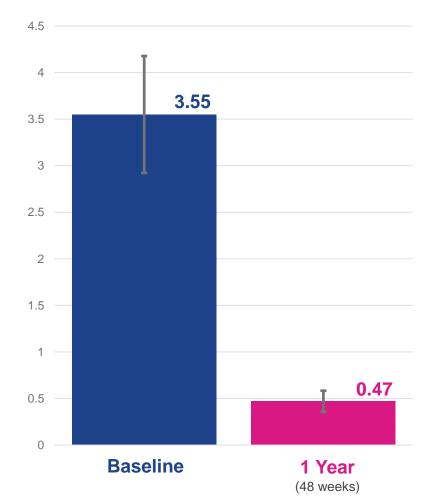
^{*} Mayo Lab, ref range ≥23.1 nmol/h/mg

^{**} Rupar Lab, ref range 24-56 nmol/h/mg *** Reference value ≤ 2.4 nM

FAB-201 Patient 1: 87% substrate reduction in kidney biopsy



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



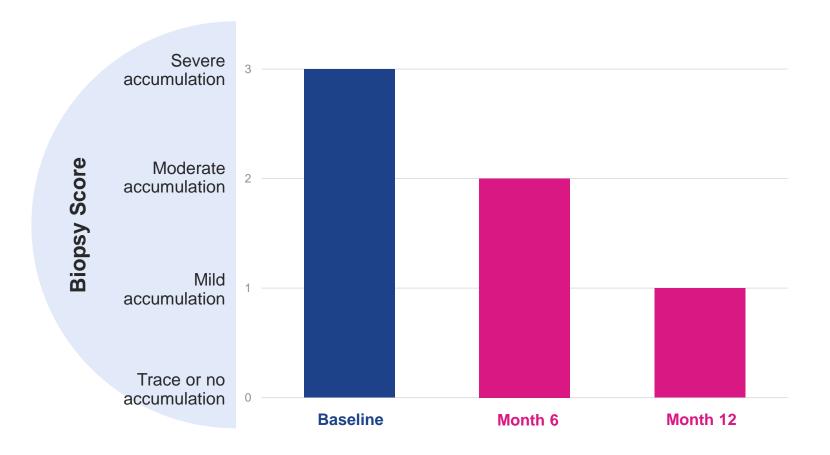
- Unpaired t test for difference between n=55 PTCs at baseline vs. n=101 PTCs at 1 year; p < 0.0001
- Error bar represents the standard deviation

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







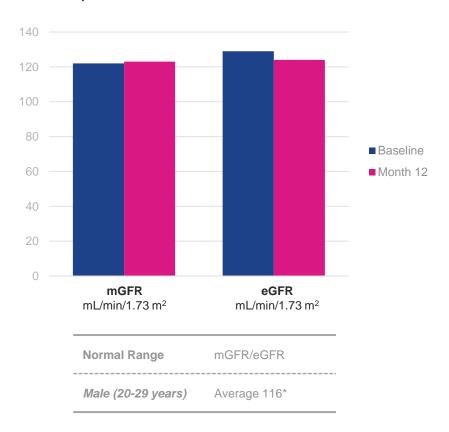




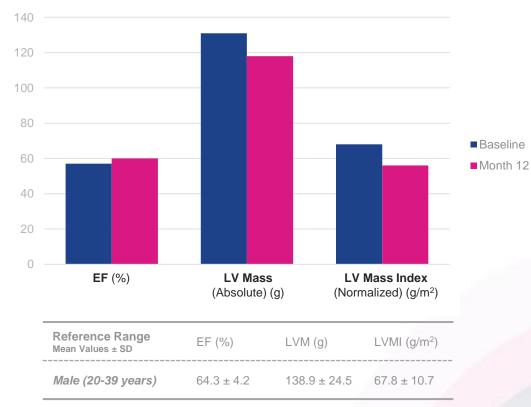
FAB-201 Patient 1: Kidney and cardiac function stable at one year







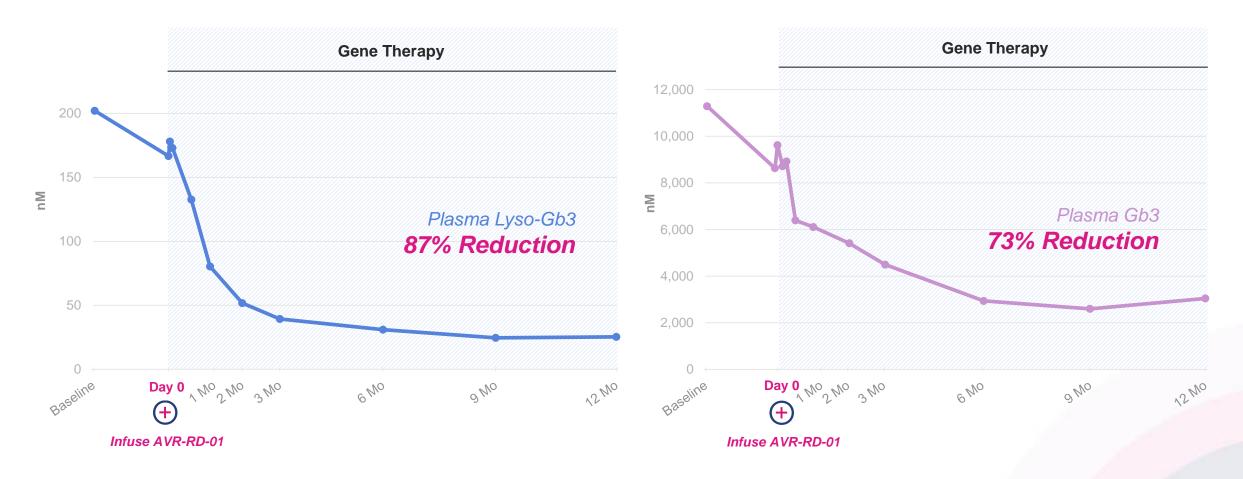






FAB-201 Patient 1: Substantial reduction in plasma substrate / metabolite levels, sustained at 1 year







FAB-201 Patient 1: Sustained leukocyte and plasma enzyme activity at 1 year; VCN stable

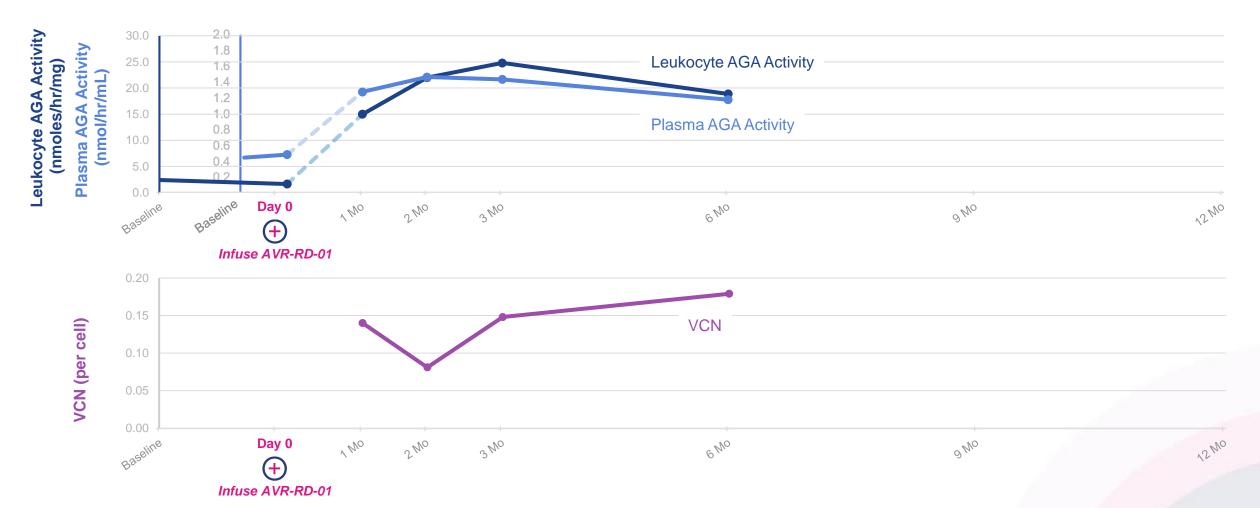




Note: 0.1 VCN is indicative of approx. 5-10% of all nucleated cells having an average of 1-2 copies of the transgene **Baseline:** The last available, non-missing observation prior to AVR-RD-01 infusion

FAB-201 Patient 2: Sustained leukocyte and plasma enzyme activity and VCN at 6 months





Note: Patient 3 had plasma AGA activity of 0.740, leukocyte AGA activity of 9.94 and VCN of 0.12 as of 1 month **Note:** 0.1 VCN is indicative of approx. 5-10% of all nucleated cells having an average of 1-2 copies of the transgene **Baseline:** The last available, non-missing observation prior to AVR-RD-01 infusion





FAB-201 3 patients dosed

No unexpected trends or safety events identified



No AEs or SAEs related to AVR-RD-01 drug product



AEs and SAEs reported

- AEs
 - Generally consistent with myeloablative conditioning, underlying disease or pre-existing conditions
- SAEs
 - Pre-treatment
 - Seizure (resolved)
 - Post-treatment
 - Dehydration, nausea, vomiting (resolved)
 - Febrile neutropenia (resolved)



Anti-AGA antibodies

Transient low titer in 1 subject (resolved)



Two AVR-RD-01 Fabry clinical trials



8 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

Patients

n = 8-12 (3 patients dosed to-date)
Treatment-naive
16 - 50 year-old males

Key Objectives

Safety and efficacy





Phase 1 Patient Characteristics

	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4	PATIENT 5
Age symptom onset / diagnosis	18 / 37	9 / 29	10/0	7 / 4	10 / 14
Years on ERT	11	6	4	11	2
Age dosed with AVR-RD-01	48	39	40	37	30
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	 Kidney disease Cardiac disease GI pain GI diarrhea Angiokeratoma Insomnia 	 Kidney disease Cardiomyopathy Hypohidrosis Corneal verticillata Peripheral neuropathy GI symptoms Angiokeratoma Lymphedema Acroparesthesia 	Cardiac DiseaseTinnitusHeadachesDizzinessAcroparesthesia	 Cardiac Disease Hypohidrosis Tinnitus Corneal verticillata Angiokeratoma GI symptoms 	 Kidney disease Hypertension Hypohidrosis Tinnitus Migraines Impaired hearing Angiokeratoma Sleep apnea Asthma Depression
Leukocyte AGA activity at baseline* (nmol/h/mg)	2.1	1.1	0.6	2.2	1.0
Plasma lyso-Gb3 at baseline (nM)**	25	26	59	29	16
Discontinued ERT	18 months after gene therapy dose		Did not resume ERT after gene therapy dose	7 months after gene therapy dose	



^{*} Rupar Lab, ref range 24-56 nmol/h/mg

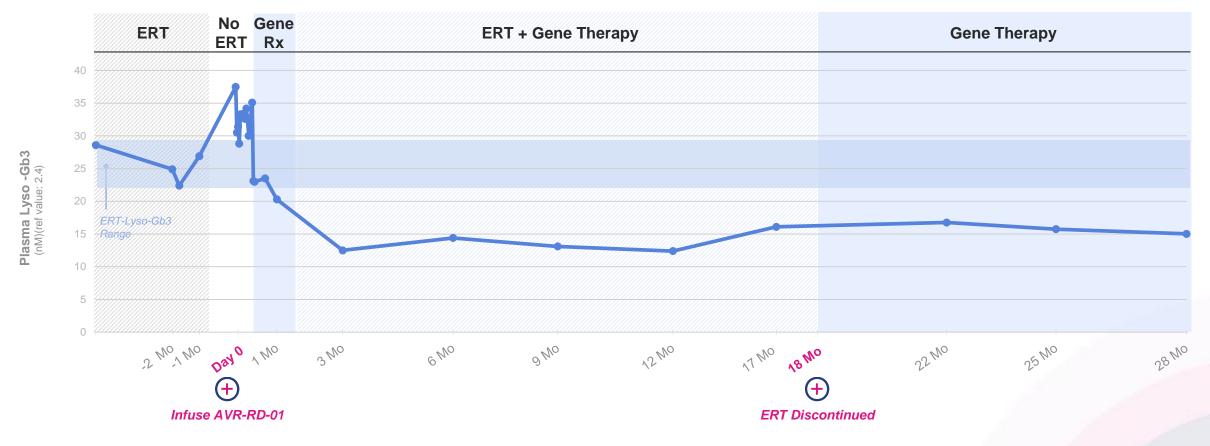
^{**} Reference value ≤ 2.4 nM

Phase 1: Plasma lyso-Gb3 reduction sustained >2 yrs



Reduced 41% from ERT baseline*

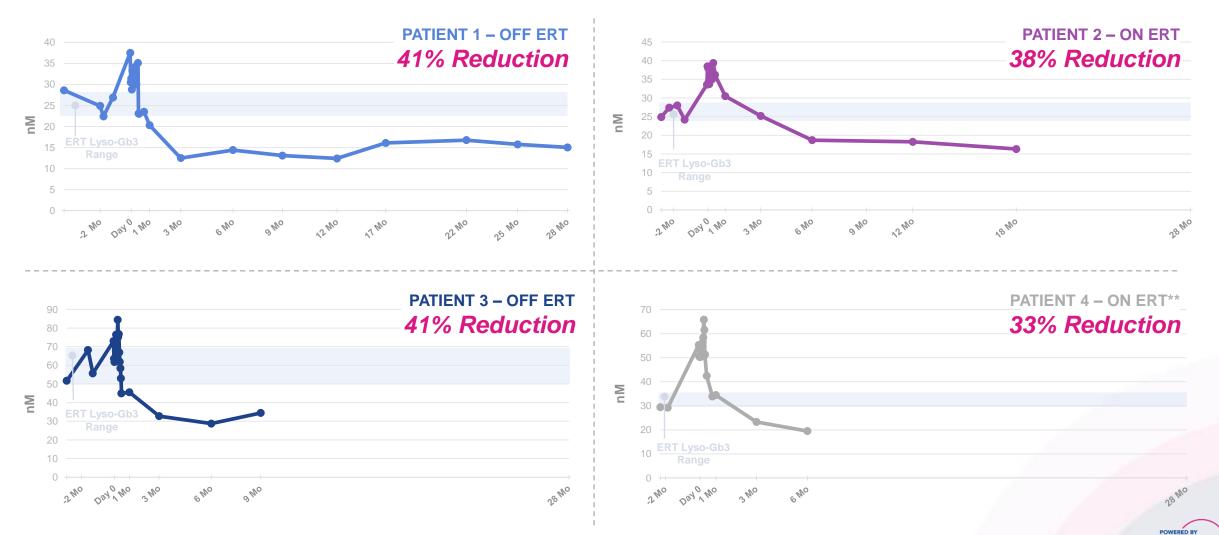






Phase 1: Plasma lyso-Gb3 consistently reduced by 33-41% vs. baseline* ERT at 6+ months post AVR-RD-01 treatment





*Baseline: The mean of the values reported prior to initiating mobilization **Percent reduction:** As measured from baseline to last assessment **Patient 4 discontinued ERT 7 months after gene therapy dose

Phase 1: Leukocyte and plasma enzyme activity sustained >2 years; VCN stable



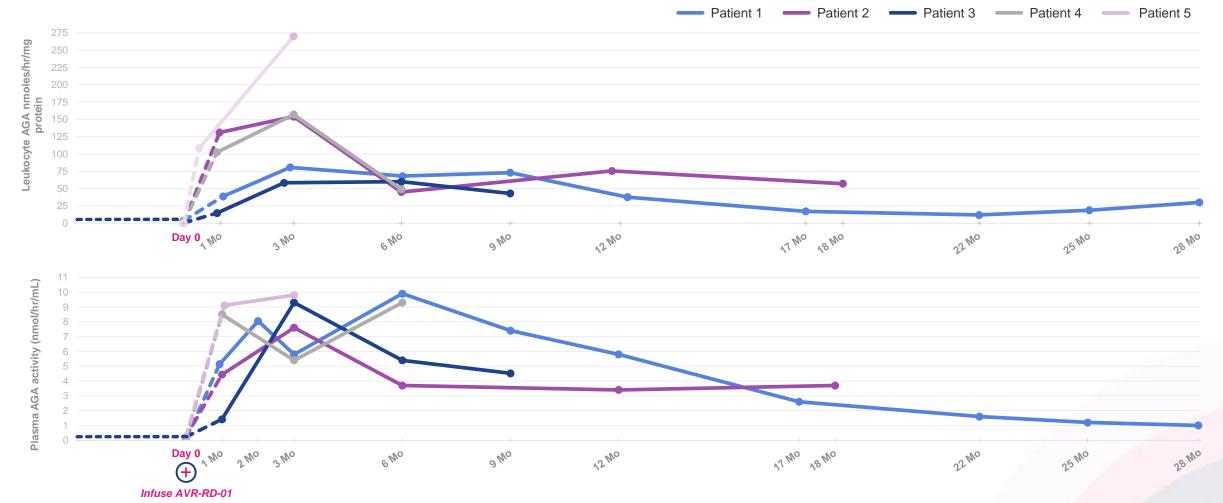
Patient #1





Phase 1: Leukocyte and plasma enzyme activity levels trend consistently across all patients

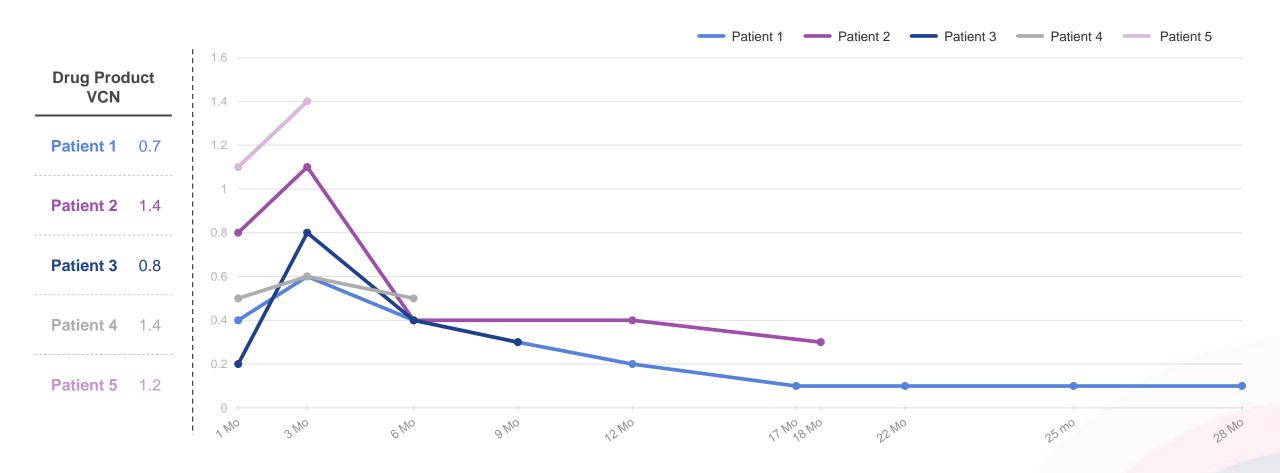






Phase 1: Consistent VCN trend across all patients









Phase 1 5 patients dosed

No unexpected trends or safety events identified



No SAEs related to AVR-RD-01 drug product



AEs and SAEs reported

- AEs
 - Generally consistent with myeloablative conditioning, underlying disease or pre-existing conditions
- SAEs
 - Febrile neutropenia (resolved)
 - Thrombophlebitis (resolved)*



Anti-AGA antibodies

Mild titer rise in 1 patient

Note: Safety database cut as of May 24, 2019

8 patients dosed across 2 trials

longest follow-up >2 years

Emerging data support potential first-line use in Fabry disease

- 87% decrease in Gb3 in first kidney biopsy at 1 year in first Phase 2 patient
- Plasma lyso-Gb3 reduced by 30-40% vs. baseline ERT in four Phase 1 patients
- Kidney and cardiac function stable at 1 year in first Phase 2 patient
- Durability sustained >2 years for enzyme activity and VCN in first Phase 1 patient
- No unexpected trends or safety events identified 8 patients across 2 trials



GAU-201: Phase 1/2 study in Gaucher Type 1 patients





An adaptive, open-label, multinational phase 1/2 study of the safety and efficacy of ex vivo, lentiviral vector mediated gene therapy AVR-RD-02 for patients with Type 1 Gaucher disease

OBJECTIVES	PATIENTS	ASSESS
 Safety Engraftment Efficacy (functional endpoints and biomarkers) 	 8-16 patients 16-35 year old males and females Two arms Treatment naïve Stable receiving ERT 	 Vector Copy Number (VCN) Chimerism GCase activity, including in CSF Efficacy Hematologic values End-organ volumes and BMD Biomarkers and QoL Safety

Investigator-sponsored* Phase 1/2 study in Cystinosis





A Phase 1/2 study to determine the safety and efficacy of transplantation with autologous human CD34+ Hematopoietic Stem Cells (HSC) from Mobilized Peripheral Blood Stem Cells (PBSC) of patients with Cystinosis modified by ex vivo transduction using the pCCL-CTNS lentiviral vector

OBJECTIVES	PATIENTS	ASSESS
SafetyEfficacy	 6 patients adults and potentially adolescents 14–17 years old Using oral and ophthalmic cysteamine 	 Cystine levels in granulocytes Vector Copy Number (VCN) Chimerism Renal, respiratory and endocrine function, ophthalmologic findings, muscle strength, growth, bone density, neurologic and psychometric measures Safety

^{*} Sponsored by UCSD

Pompe preclinical program advancing



Integrated 3-part approach

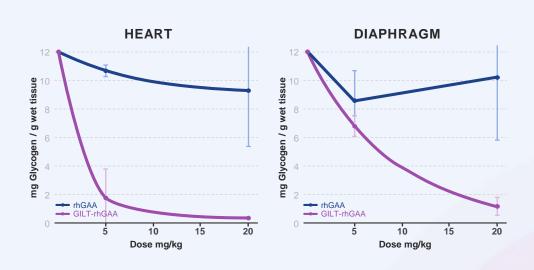
THE CHALLENGE

- 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

- 1. Potent transgene promoter
- GILT uptake tag
- 3. plato[™] for CNS impact









plato™

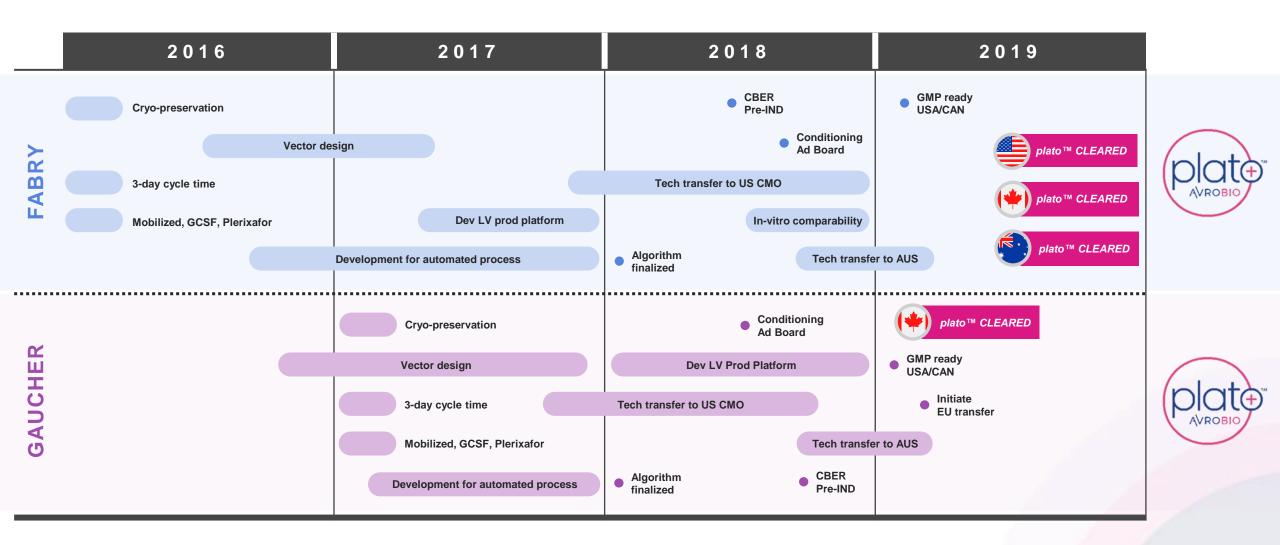
AVROBIO's foundation for worldwide commercialization

Beginning-to-end manufacturing platform

- Optimized for performance
- Redefines manufacturing best practices

Multiple plato[™] IND and CTA regulatory clearances achieved 1H 2019



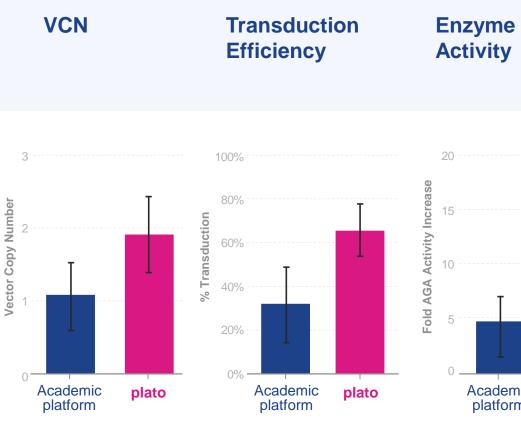


plato[™] optimized for performance

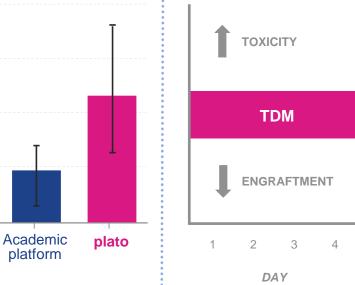


Proprietary Vector Toolbox

- OPTIMIZED VECTOR
- **PROMOTERS**
- OPTIMIZED
 TRANSCRIPTION
- OPTIMIZED TRANSLATION
- **TAGS**
- KOZAK
 SEQUENCE
- CODON OPTIMIZATION



ne Therapeutic Drug ty Monitored (TDM) Conditioning



Distribution











HEART



plato[™] platform designed to be scalable for commercial supply





~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









Multiple 2H 2019 milestones anticipated





FABRY

- Continued recruitment in FAB-201, with platoTM to be incorporated
- FAB-201 clinical sites to expand into USA and Canada



GAUCHER

 Dose first patient in GAU-201, incorporating plato[™] from the outset



CYSTINOSIS

 Dose first patient in investigator-sponsored trial



POMPE

 Pre-clinical IND-enabling study to be initiated







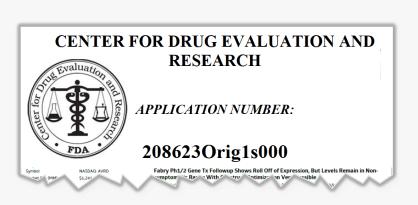
Appendix



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)

Treatment Group	n	Baseline Median (min, max)	Month 6 Median (min, max)	Change from Baseline Median (min, max)						
Average number of GL-3	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			2.0 (0.05, 4.3)	-0.04 (-0.5, 1.5)						

7/9 males ≥ 50% reduction (at 6 months from baseline)

28% average reduction (at 6 months from baseline)

Efficacy of the pharmacologic chaperone migalastat in a subset of male patients with the classic phenotype of Fabry disease and migalastat-amenable variants: data from the phase 3 randomized, multicenter, double-blind clinical trial and extension study Symbol MAGAGAMO PROPERTY CAPITY IN CONTROL OF THE PROPERTY CAPITY IN CAPITY CAP

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/M6b 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)

Source: Germain D et al. Genetics in Medicine. 2019

[•] 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

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

