

Clinical Trial of ENTR-601-44, an Endosomal Escape Vehicle (EEV™)-Oligonucleotide Conjugate for the Treatment of Duchenne Muscular Dystrophy

Mahasweta Girgenrath, PhD

Vice President, Neuromuscular Therapeutics

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OUR MISSION:

To Treat Devastating Diseases With Intracellular Therapeutics

*We're proud to share the stories of JJ,
Andrew, Max and Franklin – all living with
Duchenne muscular dystrophy*



EEV™ PLATFORM



Unique chemistry

Improved uptake and endosomal escape

Cyclic structure

Extended half-life and increased stability

Phospholipid binding

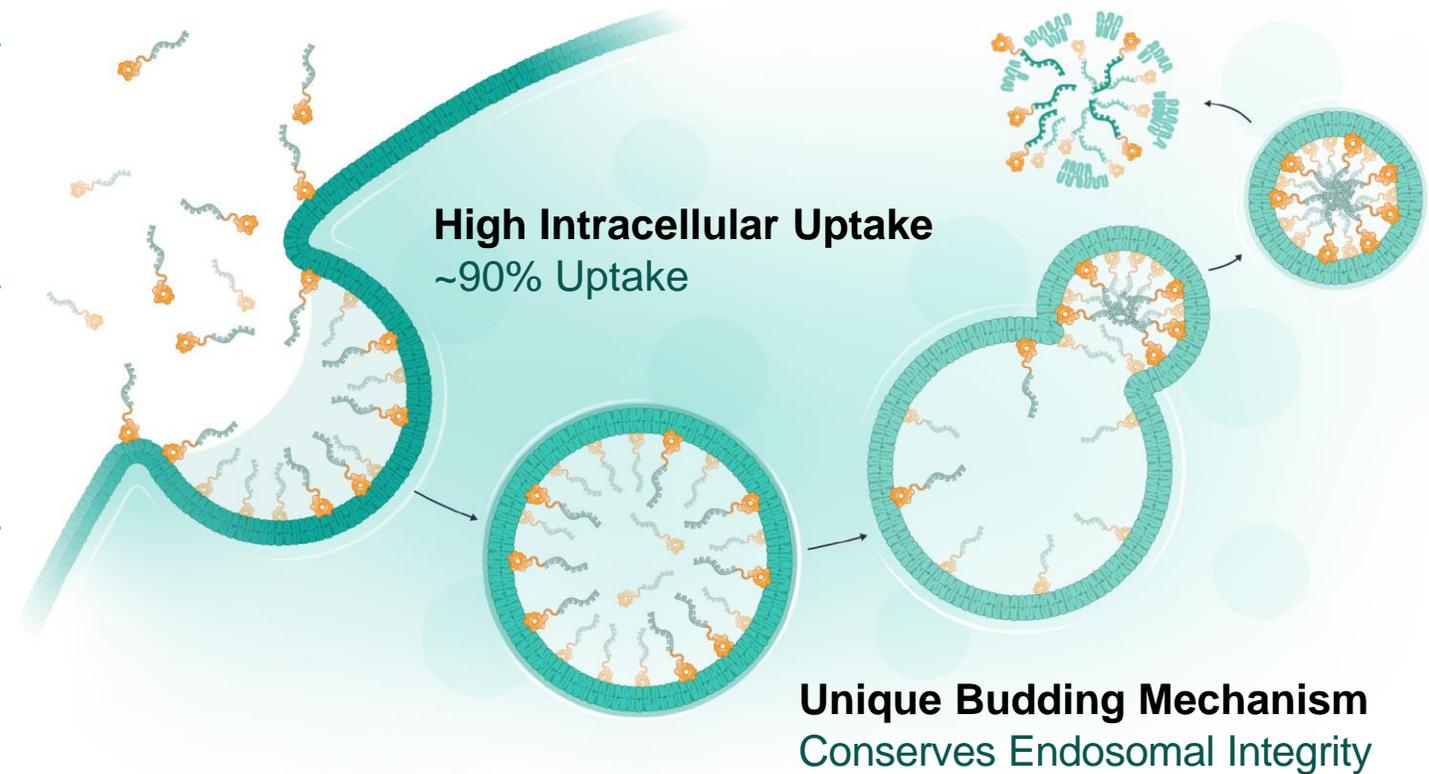
Broad biodistribution to all cells

Consistent and predictable pharmacokinetics

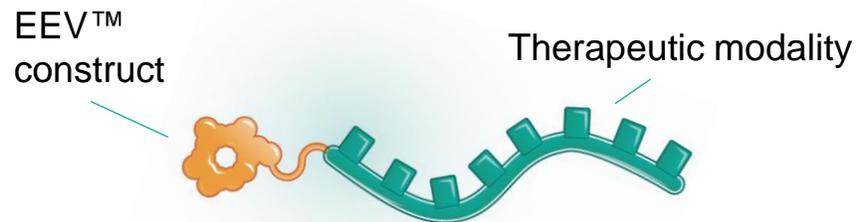
Same EEV used across initial programs

Efficient Endosomal Escape

~50% Escape vs. ~2% Standard

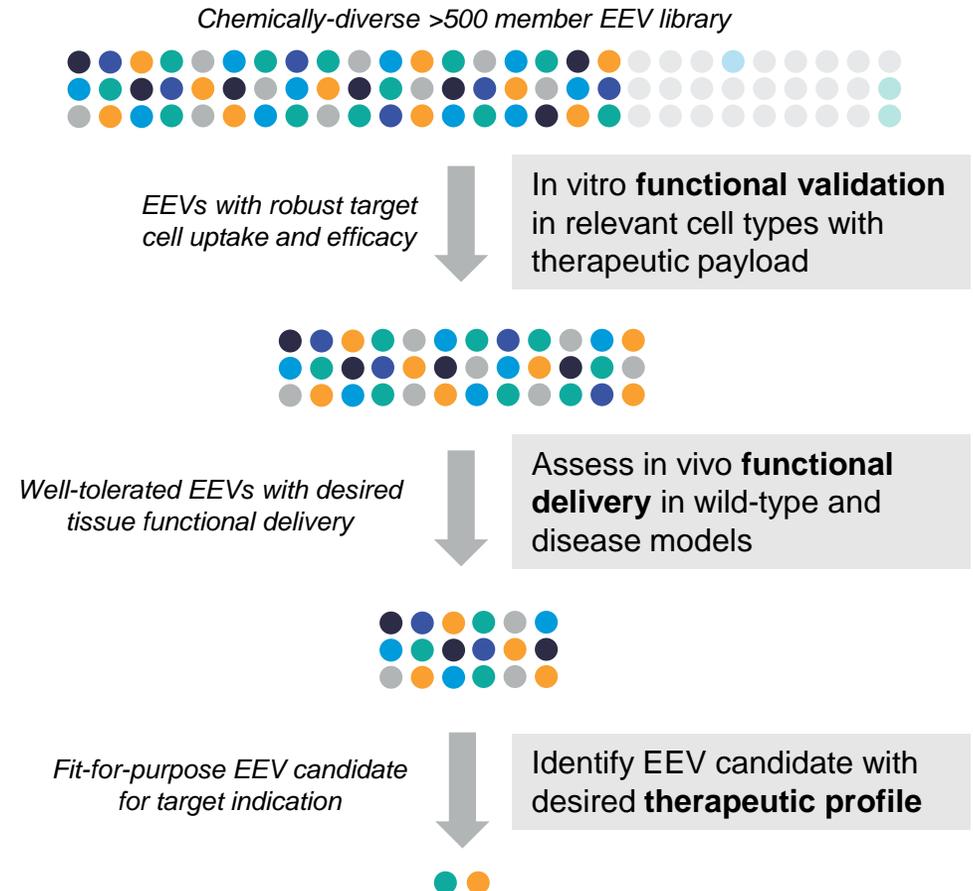


Discovery Engine for Intracellular Therapeutics



- Cyclic peptide library design and combinatorial synthesis to generate **EEV library**
- Delivery and counter-screening assays enabled for in vitro **high throughput screening**
- Functional screening of lead EEVs in vivo to select for **pharmacodynamic activity** in target tissues
- Optimize **conjugation chemistry** for desired therapeutic modality

Screening Cascade for EEV Candidates

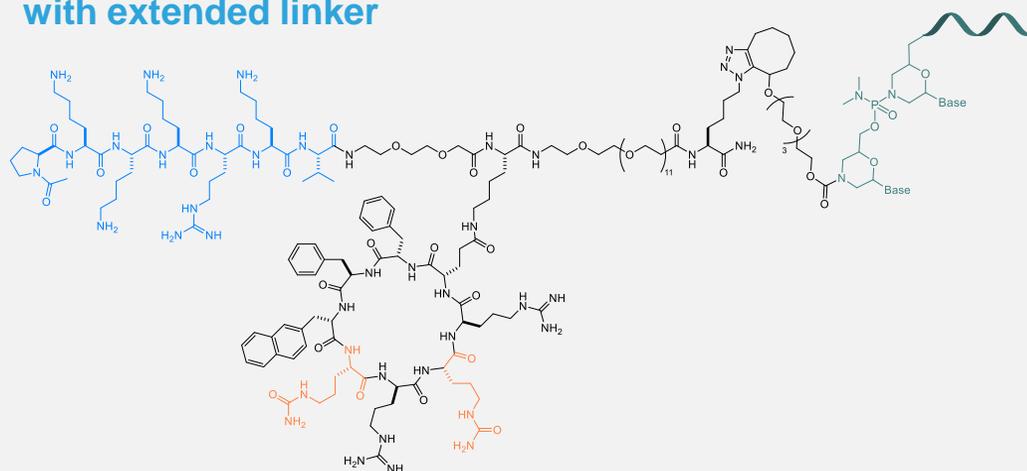


Rational substitution of cationic residues with a surrogate results in robust functional delivery to skeletal and cardiac muscle

EEV3-PMO654 Structure and Medicinal Chemistry

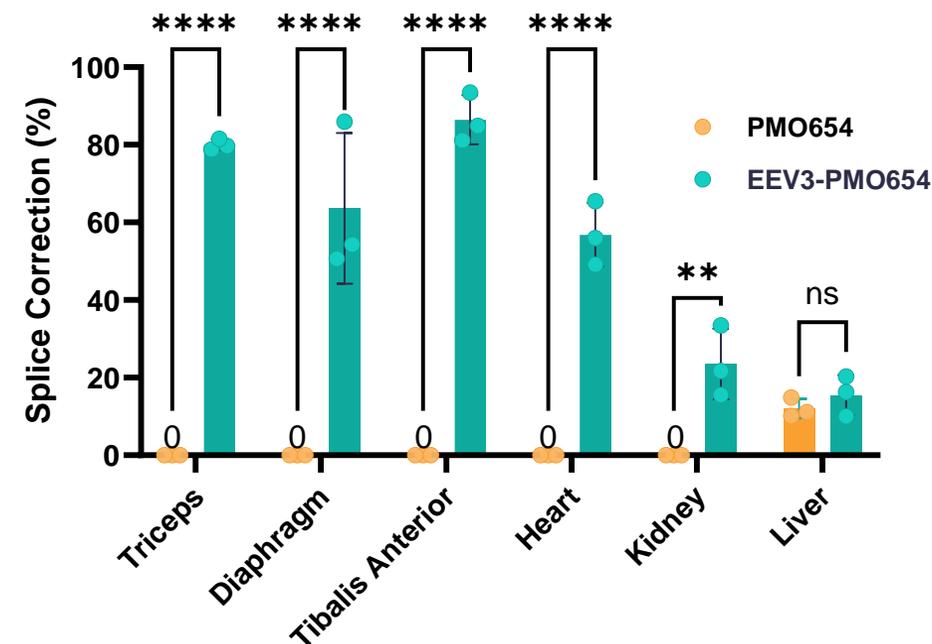
Exocyclic peptide sequence with extended linker

Conjugation with PMO



Substitution of positively charged arginine residues with neutral charged citrullines

Enhanced Functional Delivery to Muscle



- *EGFP654* mice were evaluated for splice correction 7 days following three weekly 10 mg/kg IV injections of PMO654 or EEV3-PMO654

DUCHENNE MUSCULAR DYSTROPHY



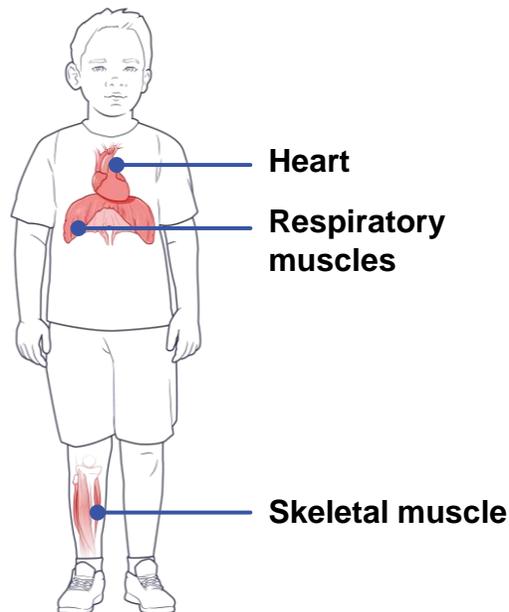
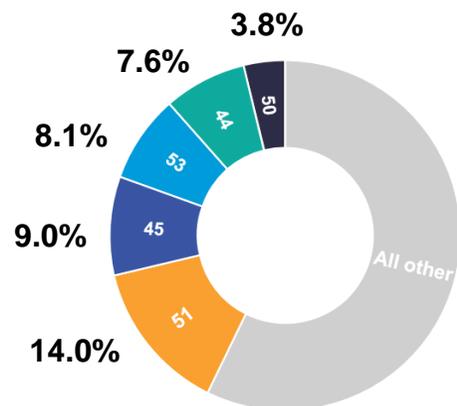
SIGNIFICANT THERAPEUTIC NEED EXISTS WITHIN A VALIDATED DUCHENNE MARKET

Duchenne is caused by **mutations in the *DMD* gene, which lead to a lack of functional dystrophin**, causing progressive loss of muscle function throughout the body

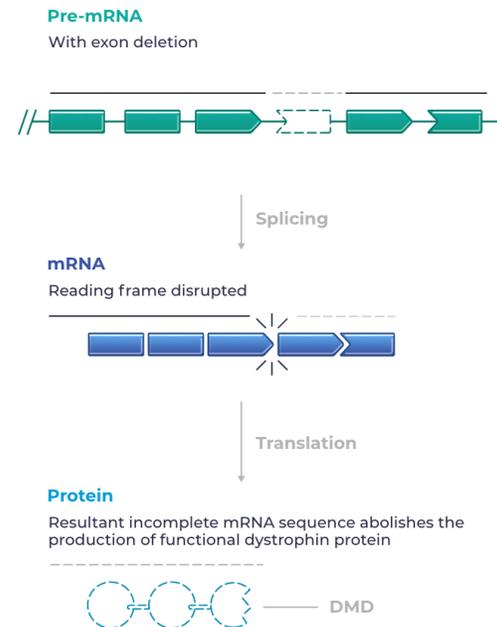
Exon skipping therapeutics have been approved based on **modest improvement in dystrophin levels ranging from ~1% to 6%**⁴⁻⁷

Approximately **41,000** people in the **U.S.¹ and Europe²** have Duchenne

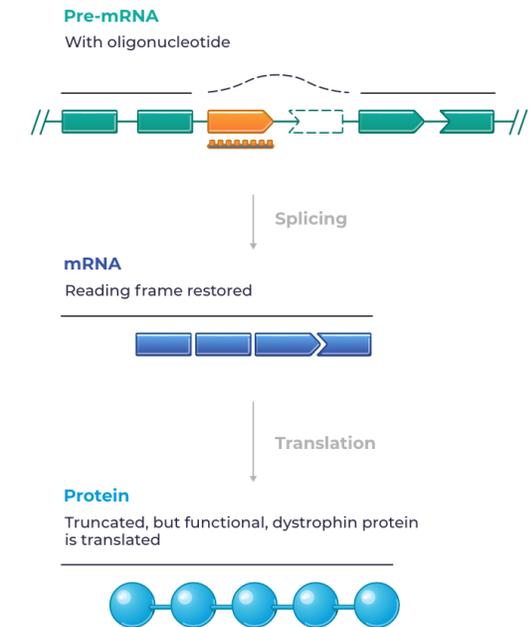
>40% of patients with Duchenne³ have mutations amenable to exon skipping of exons 44, 45, 50, 51 and 53



Patients with Duchenne



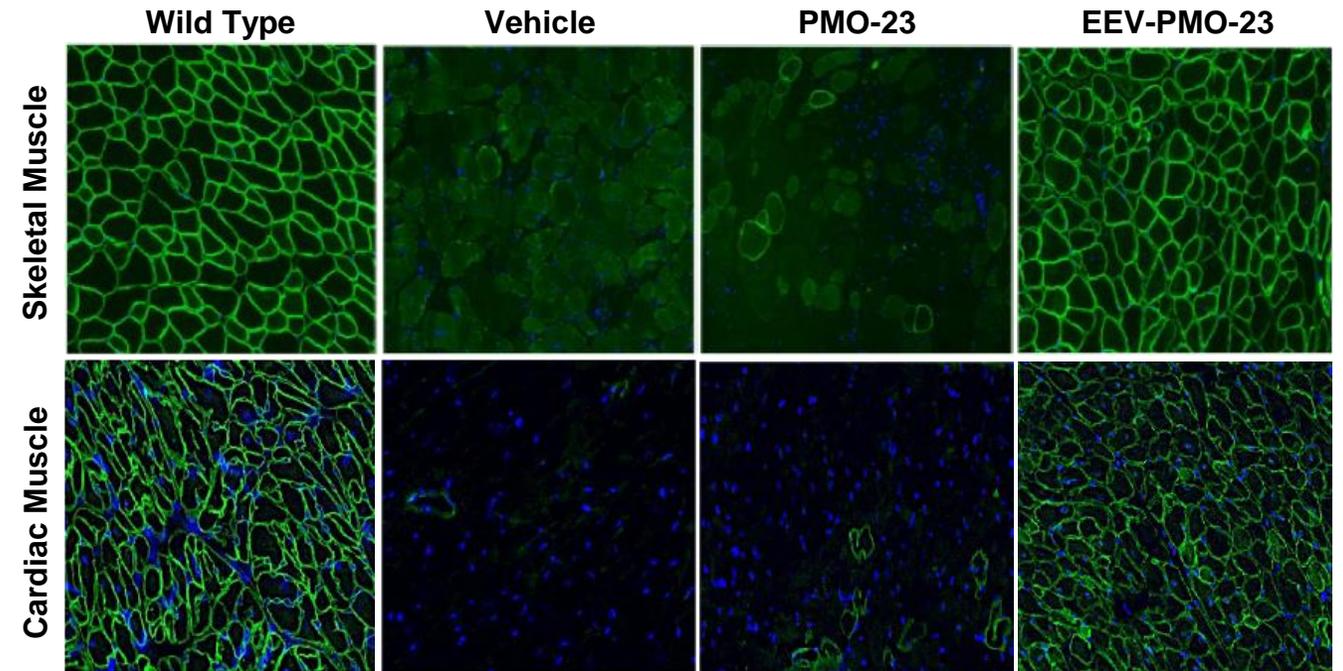
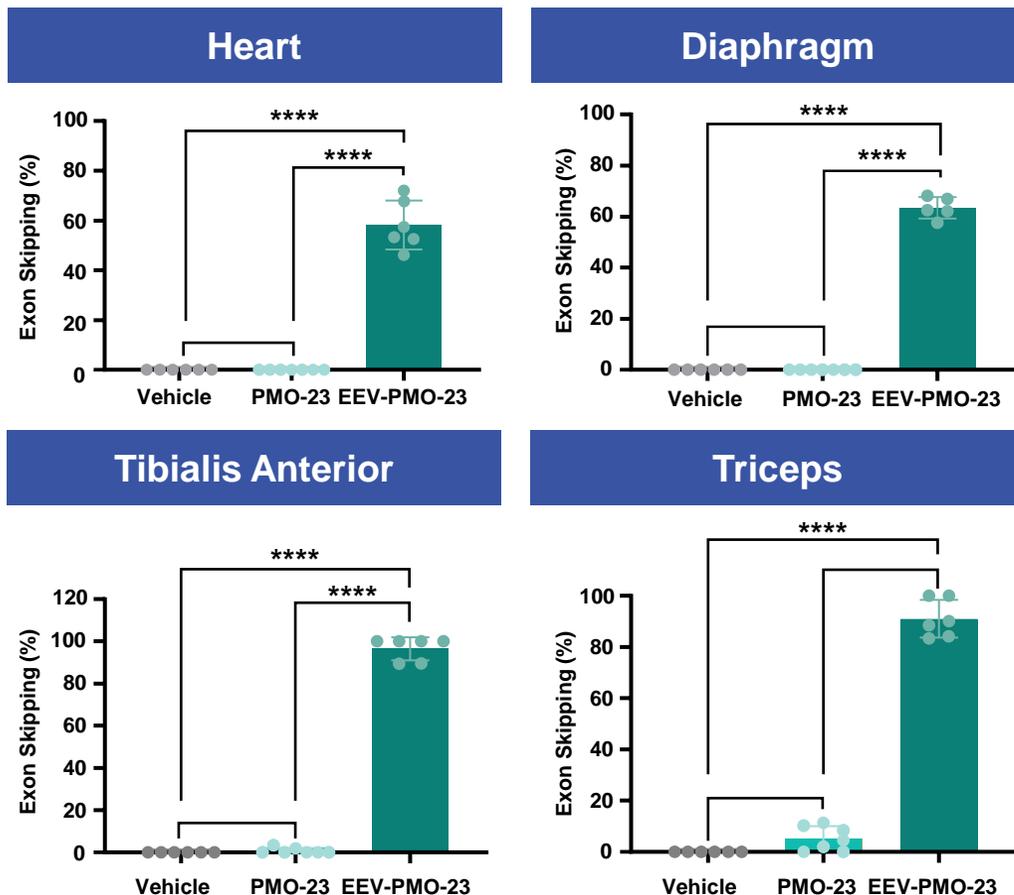
EEV-Oligonucleotide Approach



REPEAT EEV-PMO-23 TREATMENT IN D2-*mdx* MICE

Robust exon 23 skipping after 4 monthly IV doses of EEV-PMO-23 in D2-*mdx* mice

Broad dystrophin expression and restoration of muscle integrity after four monthly IV doses of EEV-PMO-23 in D2-*mdx* mice



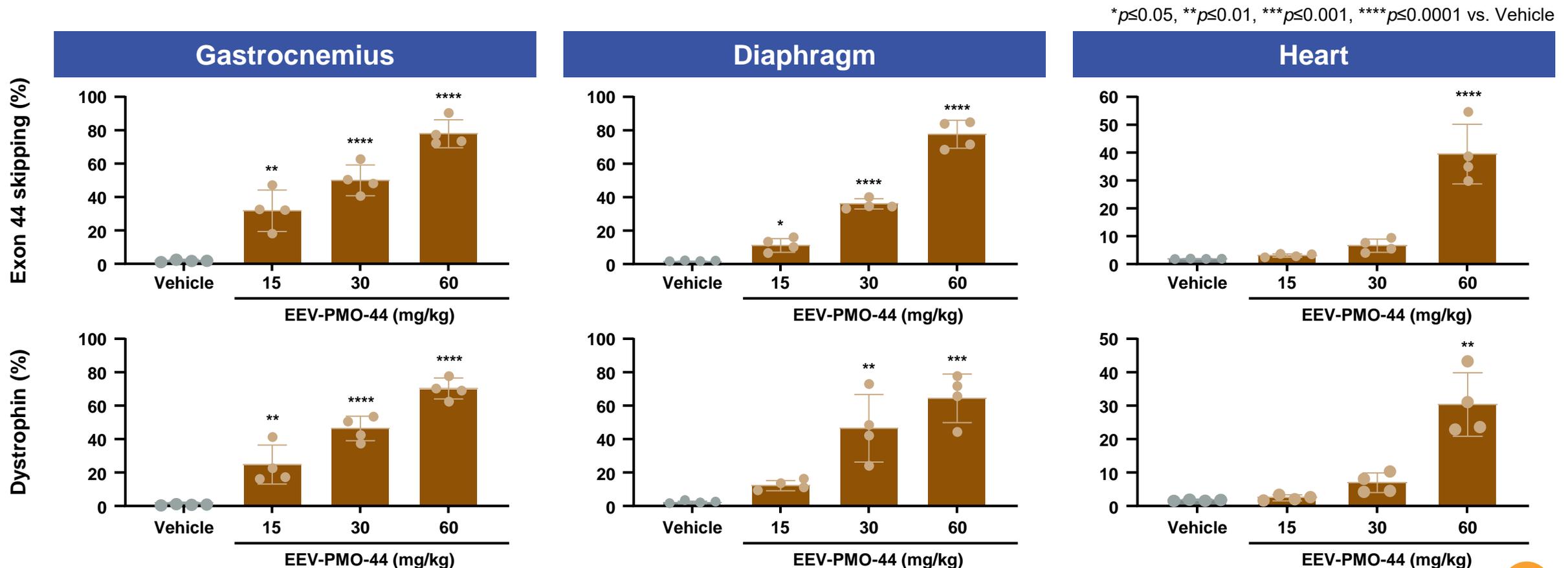
- D2-*mdx* mice (male, n=6-7) were treated with 4 monthly doses of either vehicle, 20 mg/kg unconjugated PMO-23 or 20 mg/kg PMO-23 equivalent of EEV-PMO-23, and the data were collected ~4 weeks after the last dose.

EEV-PMO PRECLINICAL STUDIES



EEV-PMO-44 EFFICACY IN *del45hDMD.mdx* MICE

A single dose of EEV-PMO-44 produced robust human *DMD* exon 44 skipping and dystrophin production 2 weeks post-dose in mice amenable to exon 44 skipping

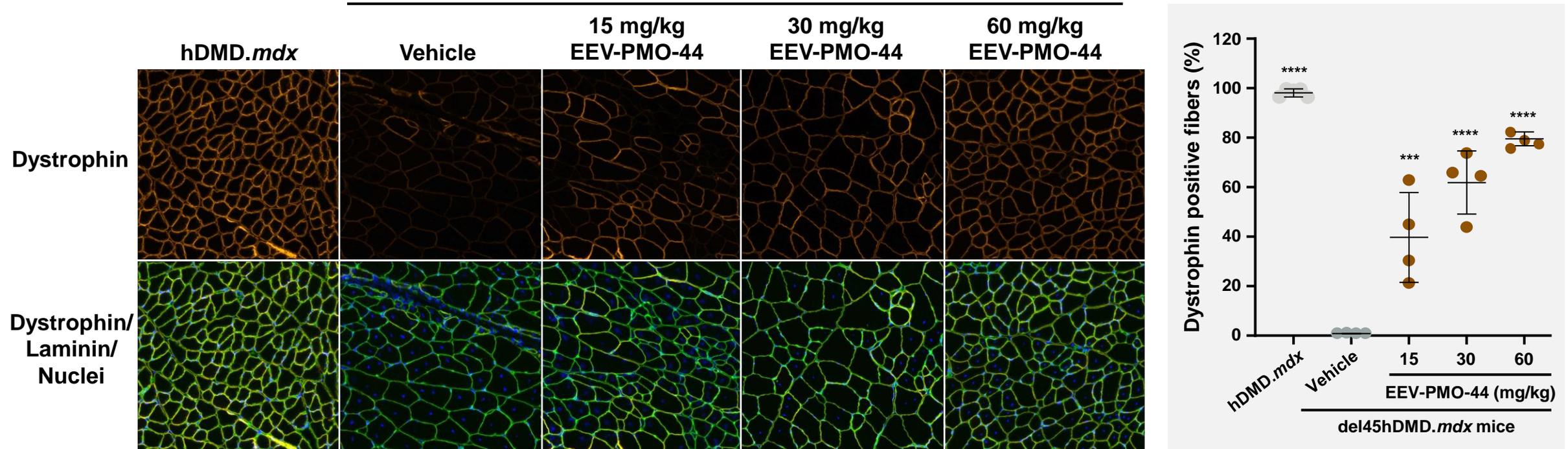


DYSTROPHIN LOCALIZATION WITH EEV-PMO-44 IN *del45hDMD.mdx* Mice

EEV-PMO-44 produced dose-dependent increases in dystrophin-positive muscle fibers localized to the sarcolemma of *del45hDMD.mdx* mice 2 weeks post-dose

del45hDMD.mdx Skeletal Muscle

*** $p \leq 0.001$, **** $p \leq 0.0001$ vs. Vehicle



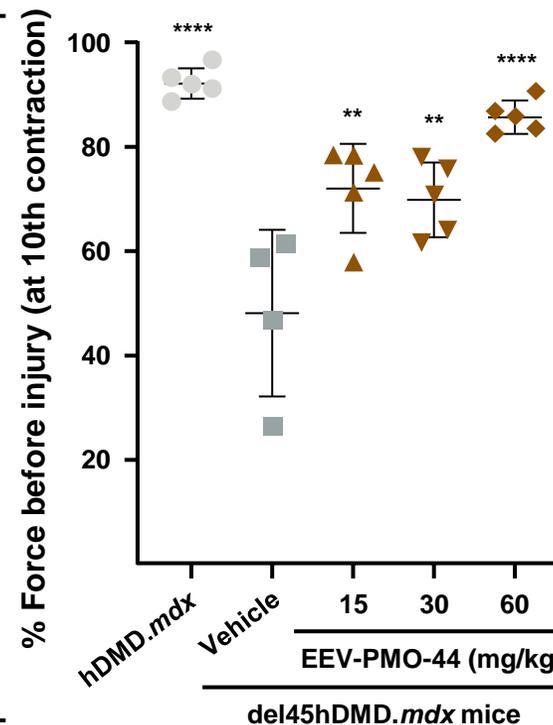
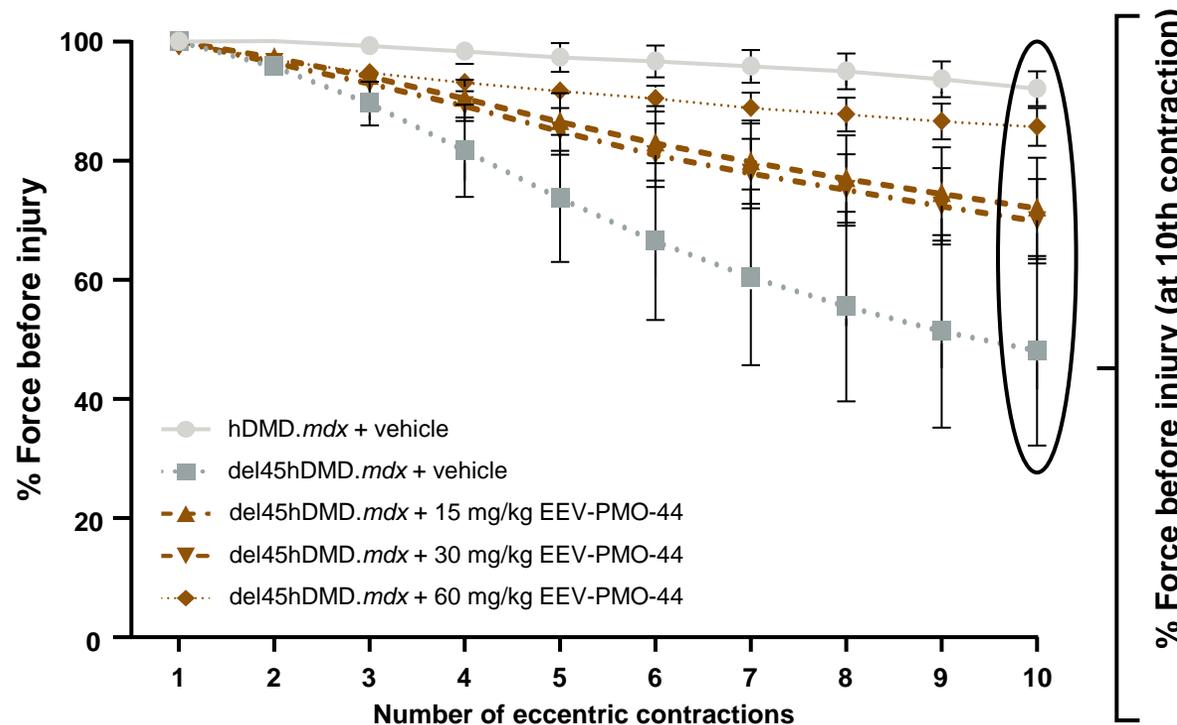
- *del45hDMD.mdx* mice were treated with a single IV dose of EEV-PMO-44 or vehicle. Dystrophin protein distribution and cellular localization were analyzed by immunofluorescence in the gastrocnemius 2 weeks post-dose.

EEV-PMO-44 IMPROVES MUSCLE FUNCTION IN *del45hDMD.mdx* Mice

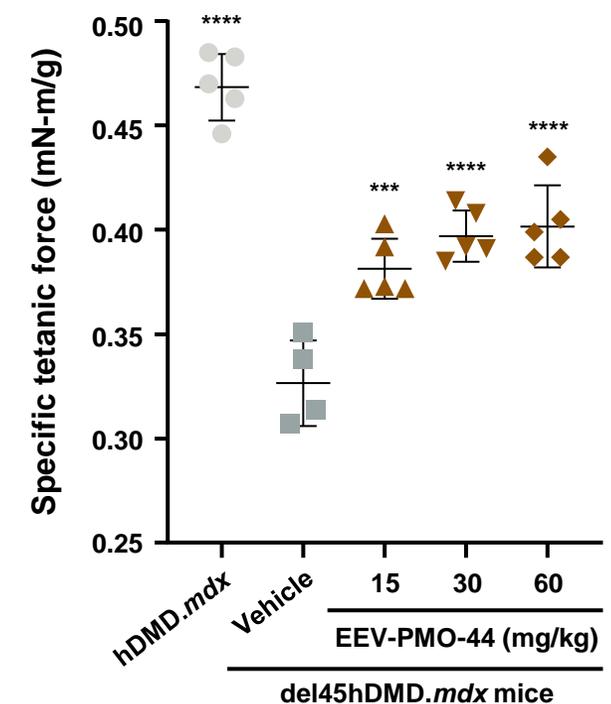
A dose-dependent increase in resistance to membrane damage was observed following the tenth contraction, as well as an increase in tetanic force 2 weeks post-dose of EEV-PMO-44

** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$ vs. Vehicle

Skeletal Muscle Membrane Stability

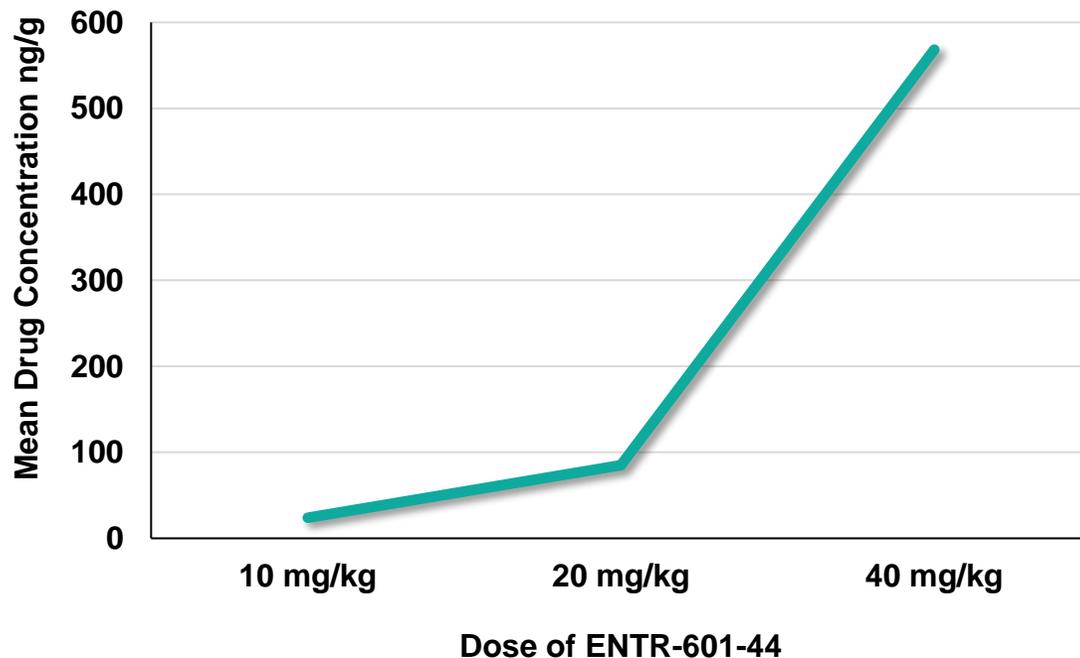


Specific Tetanic Force

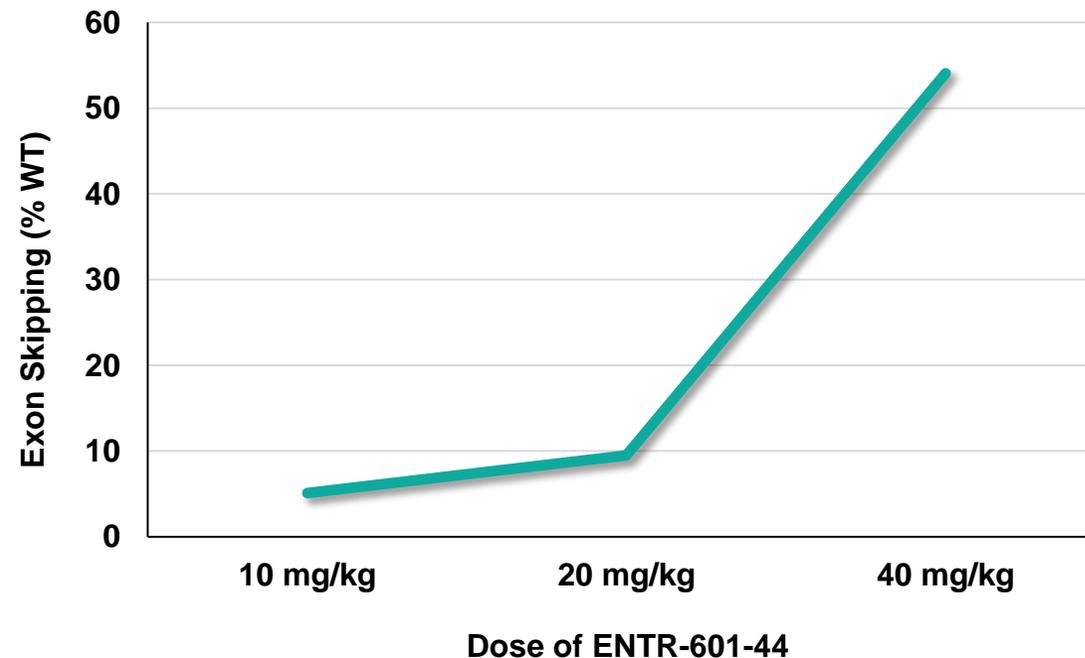


NHP data demonstrated exponential increases in exon skipping at higher doses; A close correlation between drug concentration and exon skipping was observed

NHP Mean Drug Concentration



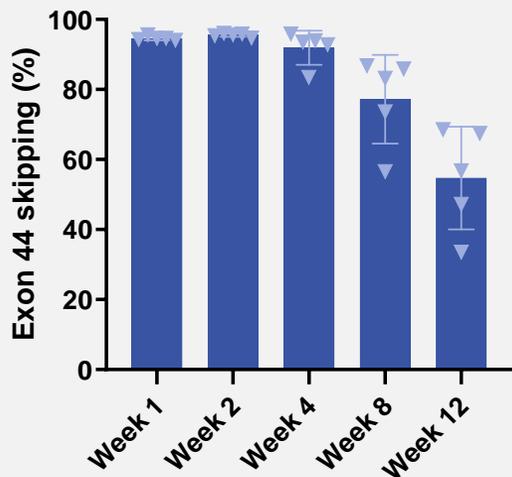
NHP Exon Skipping



CONSISTENT AND DURABLE EFFICACY OF EEV-PMO WAS DEMONSTRATED ACROSS SPECIES

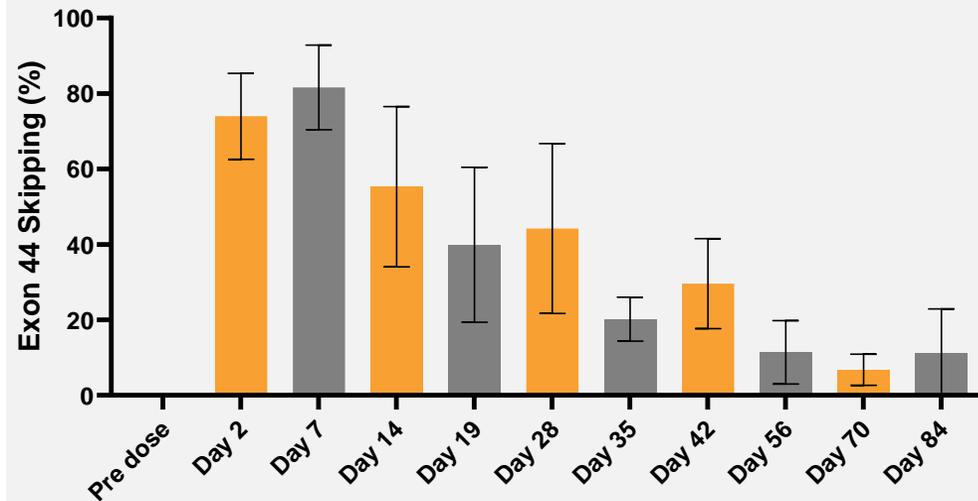
Significant patient benefit is implied by data in the mouse and the monkey at clinically relevant levels; *in vitro* data suggests much higher target engagement in patient cells

Exon 44 Skipping in hDMD Mouse



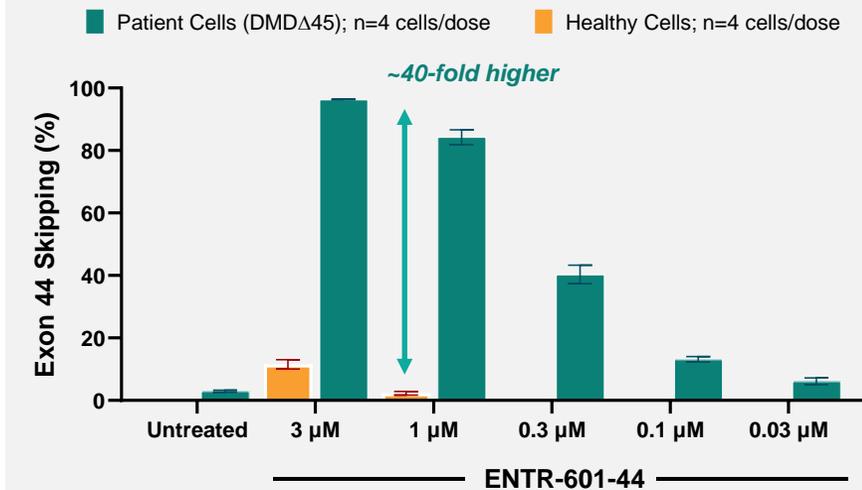
- Single IV 80 mg/kg dose of ENTR-601-44
- Tibialis Anterior

Exon 44 Skipping in Monkey



- Post IV infusion of single 45 mg/kg dose of ENTR-601-44, robust exon 44 skipping observed in biceps of treated monkeys (n=3 per cohort) for at least 12 weeks

Exon 44 Skipping in Healthy and Patient-Derived Muscle Cells

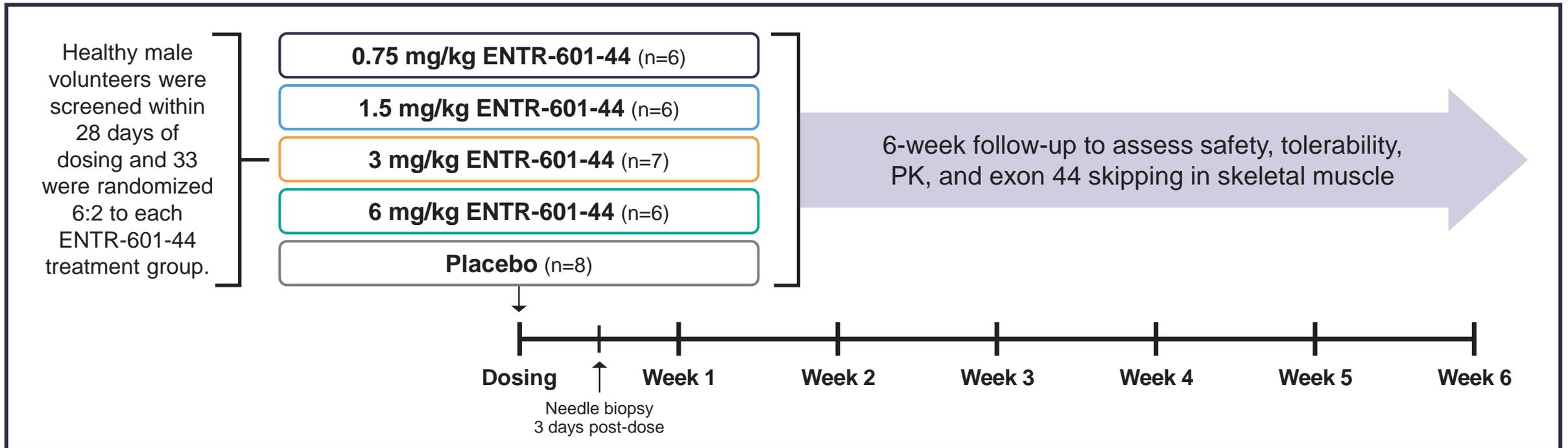


- Robust dose-dependent exon 44 skipping was observed in DMD patient-derived muscle cells harboring an exon 44 skip-amenable mutation

ENTR-601-44-101 PHASE 1 STUDY



ENTR-601-44-101: STUDY DESIGN



Key Inclusion Criteria

- Healthy males aged 18–55 years, inclusive.
- Body mass index (BMI) of 18.0 to 32.0 kg/m², inclusive, and a minimum weight of 50 kg at screening.

Key Exclusion Criteria

- No current or prior history of clinically significant illness, organ transplant, cardiac disease, hypertension, long QT syndrome, hepatitis B, or diabetes.

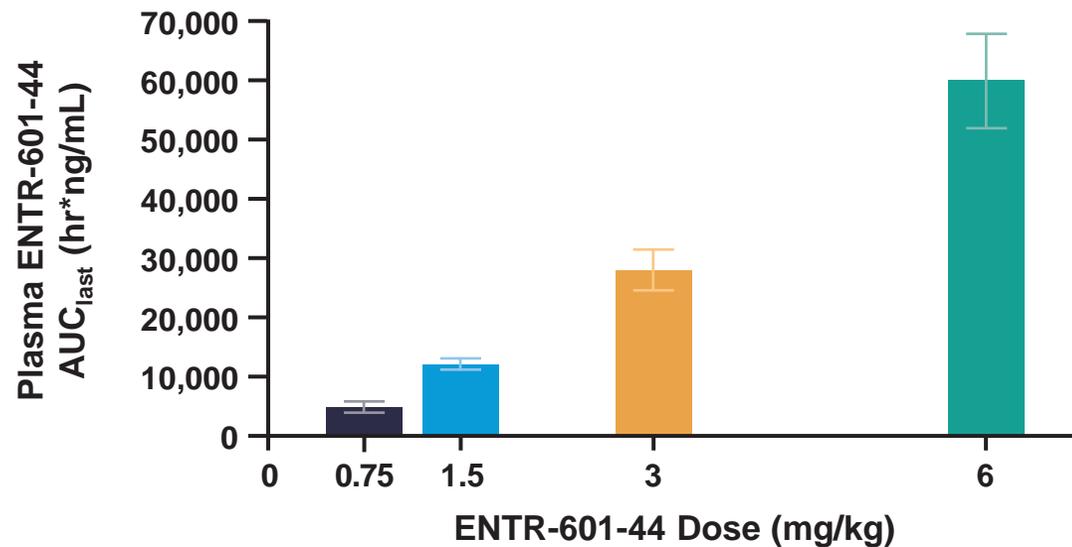
A single IV dose of ENTR-601-44 was well-tolerated in healthy human volunteers up to a dose of 6 mg/kg. No treatment-related adverse events were reported in the study.

- No AEs related to study drug
- Most common AE was headache (n=7; 5 mild and 2 moderate)
- No clinically significant findings with lab values, ECG or vital signs
- No adverse findings or clinically relevant changes to biomarkers of renal toxicity at highest dose of 6 mg/kg

n (%)	Pooled placebo (N=8)	ENTR-601-44				
		0.75 mg/kg (n=6)	1.5 mg/kg (n=6)	3.0 mg/kg (n=7)	6.0 mg/kg (n=6)	Total (N=25)
Randomized	8 (100)	6 (100)	6 (100)	7 (100)	6 (100)	25 (100)
Dosed	8 (100)	6 (100)	6 (100)	6 (85.7)	6 (100)	24 (96)
Completed study	8 (100)	6 (100)	6 (100)	6 (85.7)	6 (100)	24 (96)
Any TEAE	1 (12.5)	5 (83.3)	2 (33.3)	3 (50)	3 (50)	13 (54)
Treatment-related TEAE	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Severe AEs	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SAEs	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

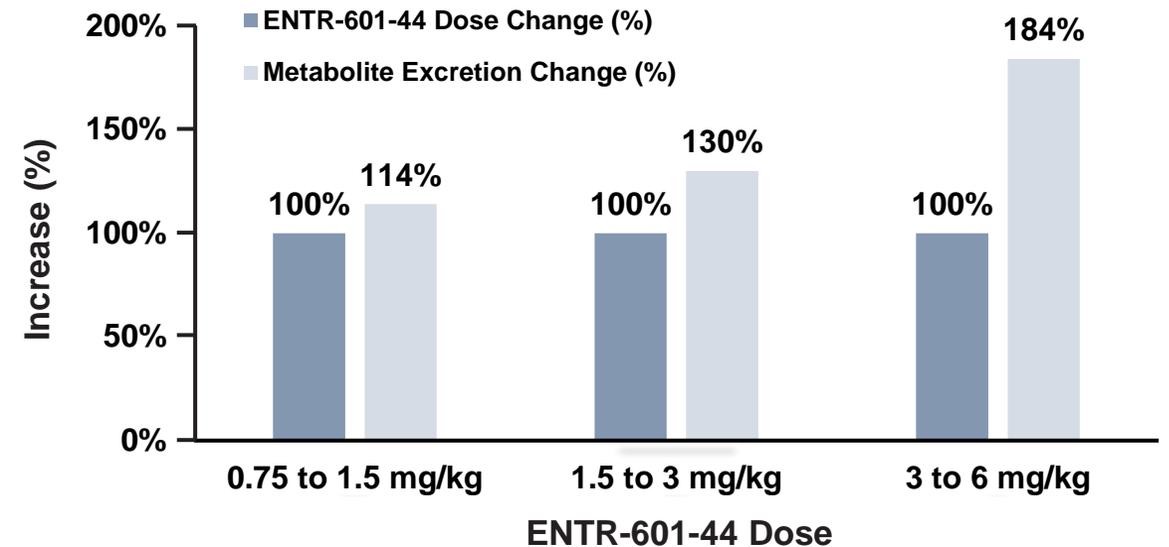
Pharmacokinetic analysis of ENTR-601-44 demonstrates dose-dependent increases in plasma concentration and urinary excretion.

Plasma Concentration



- Dose-dependent increase in mean C_{max} (range) of 3530 (2970–4530), 7380 (6750–8000), 15,400 (12,400–18,500), and 30,900 (26,300–34,200) ng/mL in the 0.75, 1.5, 3.0, and 6.0 mg/kg dose groups, respectively

Urinary Excretion of Final PMO-44 Metabolite

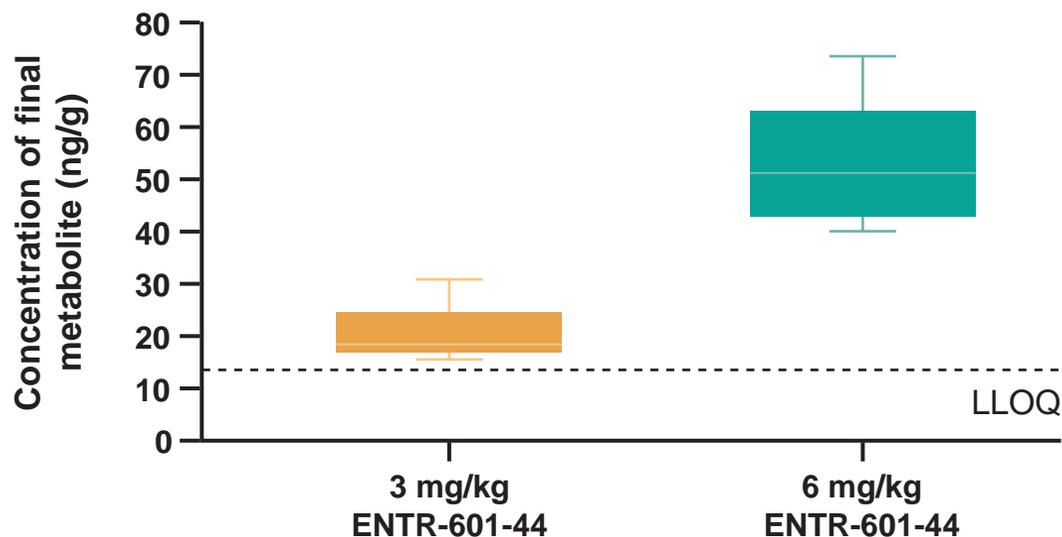


- Urinary excretion of the final metabolite is consistent with preclinical data, which demonstrate urinary excretion as the primary route of elimination.

ENTR-601-44-101: MUSCLE CONCENTRATION AND EXON SKIPPING

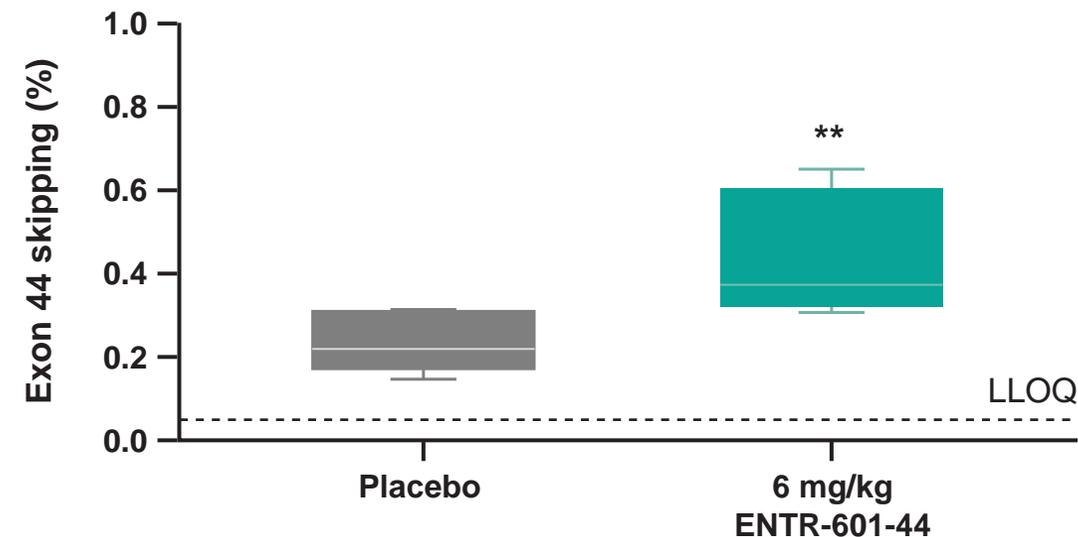
Dose-dependent increases in muscle concentration and *DMD* exon 44 skipping were observed 72 hours following a single IV dose of ENTR-601-44

Skeletal Muscle Concentration



- All six volunteers in the 6 mg/kg dose group had detectable levels of PMO-44 metabolite in skeletal muscle (mean 52.4 ng/g, range 40.0–73.5 ng/g)
- Concentrations of PMO-44 metabolite were below LLOQ in 3 of 6 volunteers in the 3 mg/kg dose group and all volunteers in the 0.75 and 1.5 mg/kg dose groups

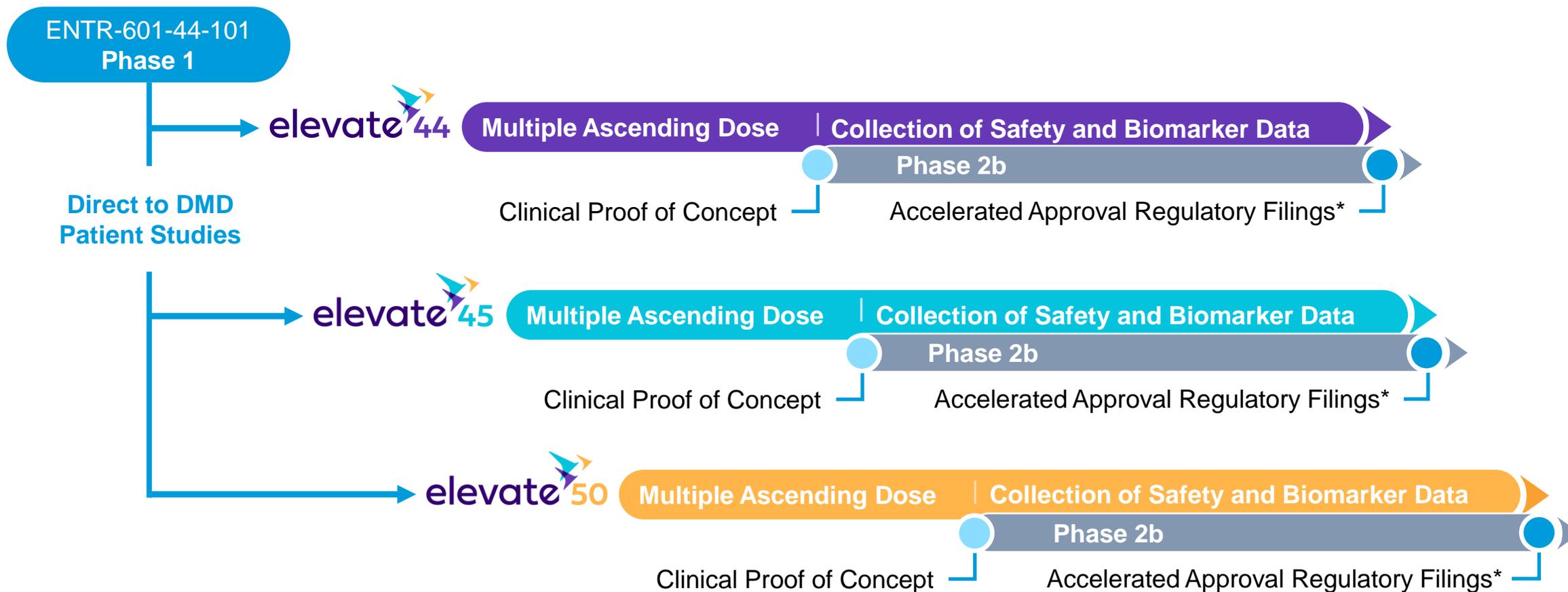
DMD Exon 44 Skipping



- Statistically significant *DMD* exon 44 skipping was observed with 6 mg/kg ENTR-601-44 (mean 0.44%, range 0.30%–0.65%) in comparison with placebo (mean 0.22%, range 0.14%–0.31%)
- No other ENTR-601-44 dose group was statistically significant in comparison with placebo.

CLINICAL STRATEGY IS DESIGNED FOR EFFICIENT REGULATORY PATH

All ENTR-601-series programs will follow a similar clinical and regulatory approach



Protocols pending regulatory feedback; *Potential for Accelerated Approval in the US, followed by confirmatory Phase 3 studies to obtain Full Approval in the US and ex-US countries.

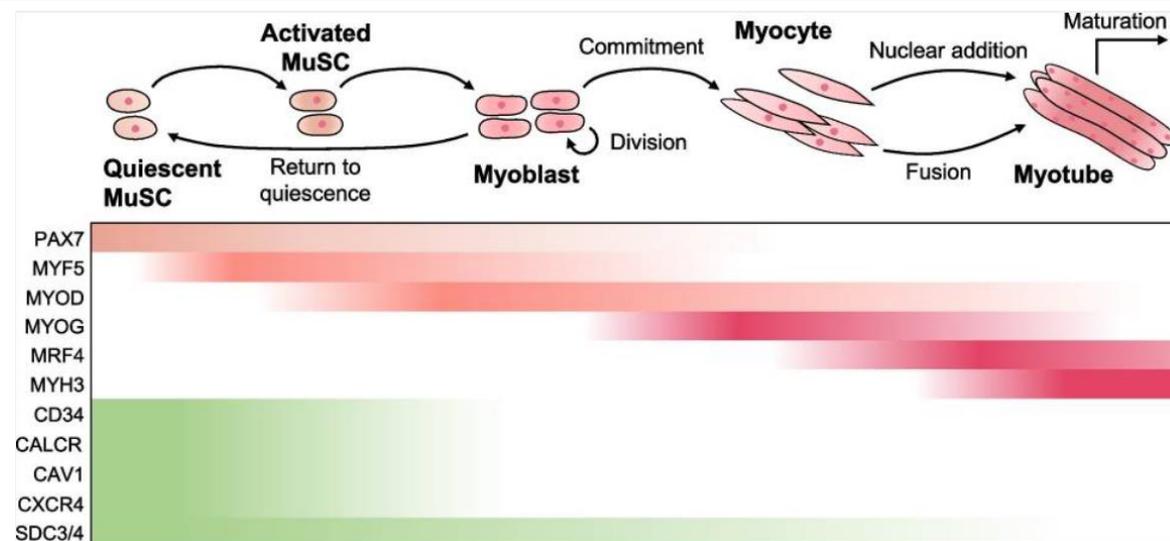
DELIVERY OF PMO TO SATELLITE CELLS



Muscle satellite cells as a new therapeutic target with potential in several neuromuscular disorders

- **Satellite cells are muscle stem cells responsible for generating myoblasts for early muscle growth**
 - Mitotically quiescent in mature muscle, satellite cells maintain their own population by self renewal
 - In post-mitotic muscles, they can be activated to generate myoblast for homeostasis, repair, and hypertrophy
- **Quiescent satellite cells are historically challenging to access by therapeutic modalities**
- **EEV-mediated delivery to access quiescent satellite cells could enable early disease intervention**
 - Ability to deliver to myonuclei of muscle fibers and to quiescent satellite cells holds potential in several neuromuscular disorders
- **Currently evaluating satellite cell-opathies (primary and secondary) to identify attractive target-indication pairs, e.g., FSHD**

Developmental Stages of Muscle Satellite Cells



- **The developmental stages of muscle satellite cells can be delineated by various myogenic factors**
 - Pax7, a canonical myogenic marker essential for orchestrating proper muscle regeneration, is mainly expressed in **quiescent** state, and at a lower level in activated state
 - Stage-specific expression of myogenic factors provides tools for studying EEV-PMO uptake at different developmental stages of satellite cells

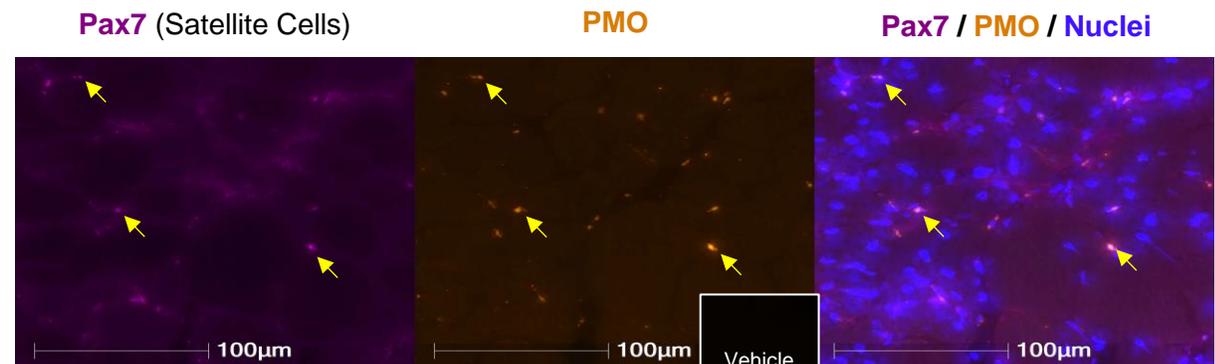
EEV-PMO shows 100% co-localization with quiescent satellite cells (Pax7 positive) at 48 hours;
Qualitative data demonstrates that co-localization lasts at least 1-week post-dose

- **Two independent molecular techniques were utilized to determine EEV-PMO distribution within specific cell lineages across muscle tissue**
 - RNA-ISH: Highly selective and sensitive technique to assess specific cell lineages across muscle tissue
 - Immunohistochemistry Assessment
- **Quantification analysis of RNA-ISH data confirms that EEV-PMO is co-localized in 100% of satellite cells at 48 hours**
 - Quantitative assessment confirms qualitative data (data not shown)
- **Qualitative assessment of IHC data demonstrates co-localization of satellite cells in hDMD mice with EEV-PMO at 7 days**

PMO Distribution (48 hours, RNA-ISH Quantitation)

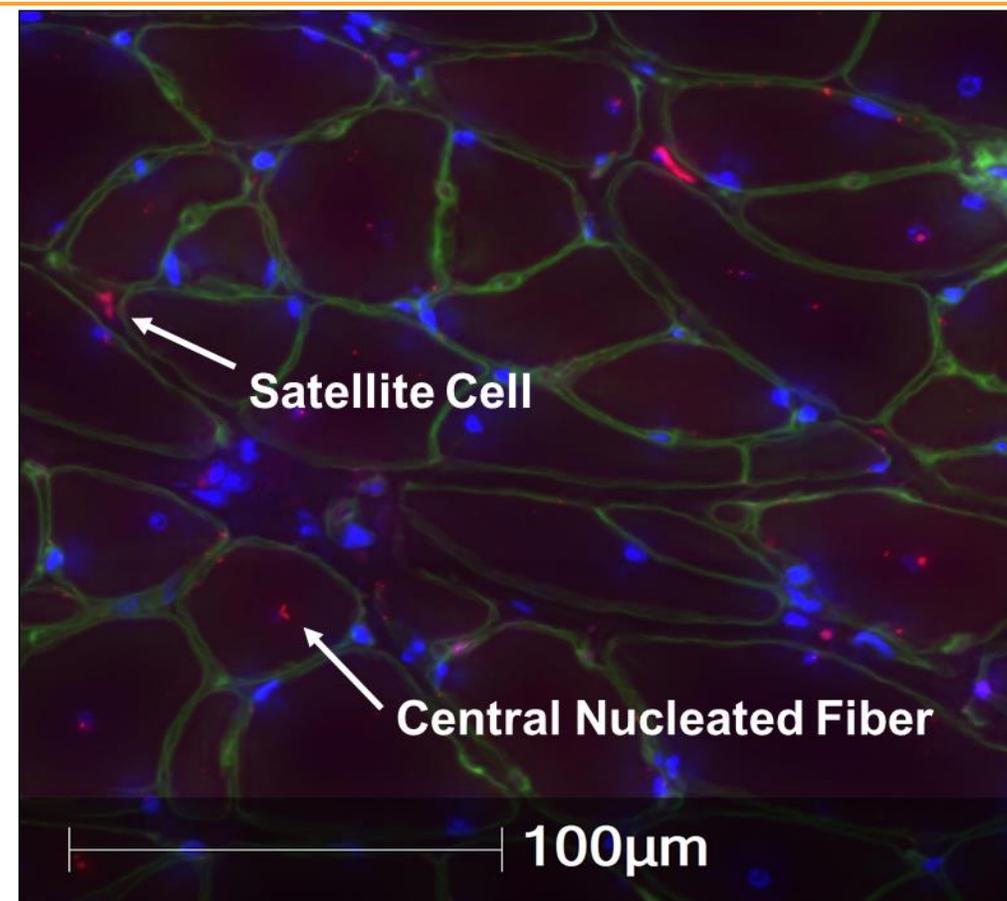
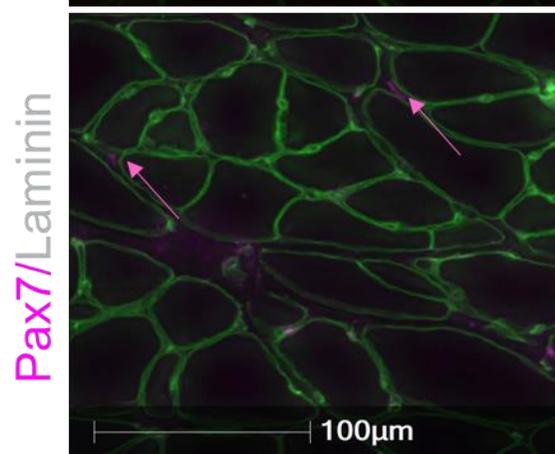
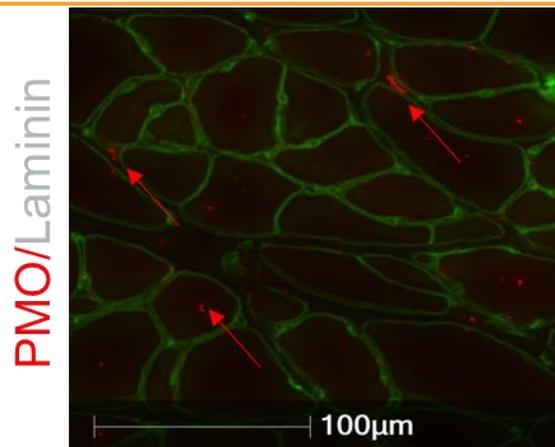
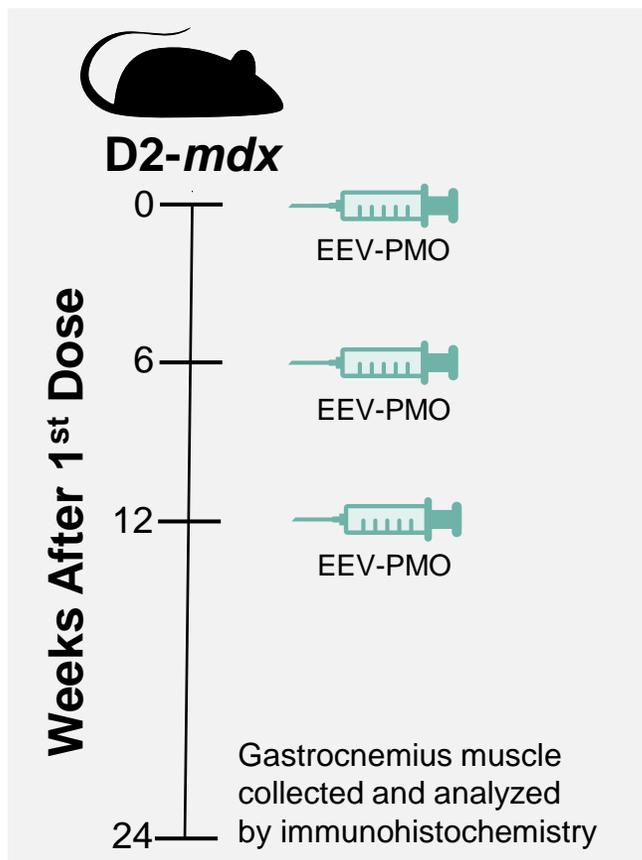
Treatment Group (D2- <i>mdx</i> mice)	% Pax7 Positive Cells	% Pax7 + PMO Positive Cells
Saline	1-10%	0%
EEV-PMO Treated	1-10%	1-10%

PMO Distribution in hDMD Mice (Day 7, IHC)



EEV-PMO PERSISTS IN SATELLITE CELLS 12 WEEKS AFTER FINAL DOSE

PMO co-localizes with satellite cells and newly regenerated centrally nucleated fibers 12 weeks post washout after 3 Q6W doses



Visit poster #1650 on Thursday, May 15th:

Exon 45 Skipping, Dystrophin Production, and
Functional Improvement With ENTR-601-45 in
Preclinical Models of Duchenne Muscular Dystrophy



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*Meet Franklin and his family, living with
Duchenne muscular dystrophy*