Comparing Home-Based Respiratory Function Monitoring to Hospital-Based Spirometry in Duchenne Muscular Dystrophy (DMD)

Christian Rummey[1], Shabir Hasham[2], Thomas Meier[2], Mika Leinonen[2], Oscar H Mayer[3], Thomas Voit[4] and Gunnar Buyse[5] for the DELOS study group
[1]Clinical Data Science GmbH, Basel, Switzerland; [2]Santhera Pharmaceuticals, Pratteln, Switzerland; [3]Children's Hospital of Philadelphia (CHOP), Philadelphia, USA;
[4]UCL Great Ormond Street Institute of Child Health, London, UK; [5]University Hospitals Leuven, Leuven, Belgium

Poster presented at WMS 2nd – 6th October. Poster session: DMD therapies II. Poster: P.134

Background

- Respiratory function decline in DMD is caused by progressive weakening of respiratory muscles and leads to high respiratory morbidity and early mortality[1,2]
- Loss of respiratory function starts early – usually preceding loss of ambulation – and decreases below the lower limit of normal (80% predicted) around 10 years of age[1]
- Recent publications have demonstrated that peak expiratory flow, as percent of predicted (PEF%p), starts to decline earlier than forced vital capacity (FVC%p) and therefore may be a more sensitive measure of global respiratory function[4,5]
- Recent standard of care guidelines recommend increased frequency in monitoring respiratory function following the loss of ambulation, allowing for timely implementation of supportive strategies that could improve clinical outcomes[3]
- The ability to self-monitor respiratory function accurately and regularly at home could greatly aid in this proactive approach[3]

The Phase III DELOS study

- The Phase III, placebo-controlled DELOS trial has previously reported a statistically significant and clinically relevant reduction in the rate of respiratory function decline of 6.27%, measured as PEF%p in patients not taking glucocorticoids[6]
- The utility of home-based monitoring of respiratory function with a hand-held device (HHD) was also assessed for the first time in DELOS patients[6]

Objectives

- To compare the respiratory function measurements of PEF%p and forced expiratory volume in 1 second (FEV1%p) obtained using a HHD with those obtained by hospital-based spirometry measures in patients with DMD taking part in the DELOS trial

Methods

- Respiratory function data were prospectively collected from 64 DMD patients enrolled in DELOS
- Patients were aged 10 – 18 years old, and not taking concomitant glucocorticoids. All patients were required to have lung function already below the lower limit of normal (PEF ≤ 80%p) at baseline (BL)
- Patients were treated with idebenone (900 mg/day) or placebo
- Spirometry was conducted during hospital visits at BL and at 3 month intervals thereafter over the 52-week study period[6]
- Patients also measured PEF%p and FEV1%p weekly at home using the HHD (type ASMA-1, Vitalograph)

Results

DELOS patients were non-ambulatory with limited upper limb mobility and established respiratory function decline

- The mean age of DELOS participants was 14.3 years[6,7]
- At BL, most patients were already facing significant respiratory impairment, with a mean PEF%p of 53.8%[6,7]
- A majority (92%) were also already non-ambulatory and showed signs of upper limb weakness (59% had a Brooke's score of ≥ 5)[6,7]

Table 1. Baseline characteristics of the DELOS population by treatment group[6,7]

	Idebenone (*n* = 31)	Placebo (*n* = 33)
Mean age (years)	13.5	15.0
Previous glucocorticoid use (%)	55	58
Mean PEF%p	53.5	54.2
Non-ambulatory (%)	90	94
Brooke score ≥ 5	54.8	63.6

Results (continued)

Patients were generally comfortable carrying out home-based assessment of respiratory function

- During this study a total of 2689 weekly PEF-measures were collected
- Overall adherence to the weekly use of the HHD was very good at 75% overall
- Adherence was around 80% in the first quarter in both treatment groups, and remained relatively stable at approximately 75% in the idebenone group throughout the study period. In the placebo group, adherence dropped to 71% in Q3 and eventually to 67% in Q4 (**Figure 1**)

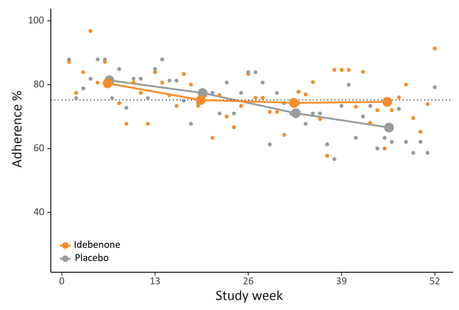


Figure 1. Weekly and quarterly adherence to the HHD respiratory function testing during the 52-week study period

Home-based respiratory function data is consistent with hospital-based spirometry data

- The 52-week changes in PEF%p assessed by the HHD and traditional hospital-based spirometry matched very well
- There were only 8 patients for whom the change in PEF%p over the study period deviated by > 20% between the home and hospital-based data (**Figure 2**)

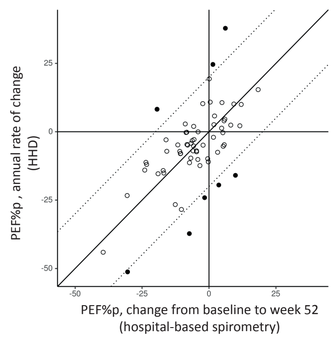


Figure 2. Scatterplot for individual patients (n = 64) for change in PEF%p from baseline to week 52 by assessment method

Both home- and hospital-based spirometry results confirmed a treatment benefit in favor of idebenone

- Weekly changes in PEF%p measured at home compared well with those from hospital-based measurements, showing a 5.60% (p = 0.002) overall treatment difference in favor of idebenone across all weekly visits, compared to a 6.27% difference at last visit using standard hospital-based spirometry (p = 0.031) (**Table 2**)
- Weekly changes in FEV1%p measured at home also compared well with those from hospital-based measurements, showing a 5.46% (p = 0.0046) overall treatment difference in favor of idebenone across all weekly visits, compared to a 6.42% difference at last visit using standard hospital-based spirometry (p = 0.023) (**Table 2**)

Table 2. Comparison of weekly PEF%p and FEV1%p data measured by the ASMA-1 HHD as compared to those measured by hospital-based spirometry

	Assessment method	Group (*n*)	PEF%p at BL	Change from BL to week 52 (95% CI)	Treatment difference week 52 (95% CI)	Treatment difference overall (95% CI)
PEF%p	Hospital-based spirometry	Idebenone (*n* = 31)	53.5 (10.3)	-2.57 (-6.68, 1.54)	6.27 (0.61, 11.93) p = 0.0306	6.52 (1.98, 11.06) p = 0.0056
		Placebo (*n* = 33)	54.2 (13.2)	-8.84 (-12.73, -4.95)		
	Home-based spirometry (all individual weekly measurements)	Idebenone (*n* = 27)	55.6 (12.6)	NA*	NA*	5.60 (2.16, 9.04) p = 0.0018
		Placebo (*n* = 31)	52.8 (14.7)	NA*		
FEV1%p	Hospital-based spirometry	Idebenone (*n* = 31)	53.6 (16.1)	-4.23 (-8.21, -0.25)	6.42 (0.92, 11.92) p = 0.023	6.96 (2.90, 11.01) p = 0.0011
		Placebo (*n* = 33)	49.5 (20.6)	-10.65 (-14.43, -6.87)		
	Home-based spirometry (all individual weekly measurements)	Idebenone (*n* = 28)	56.1 (15.2)	NA*	NA*	5.46 (1.75, 9.18) p = 0.0046
		Placebo (*n* = 31)	49.5 (19.0)	NA*		

**The treatment difference in home-based data was assessed across the entire 52-week study period (not separately at each week), as opposed to hospital-based spirometry, which was assessed at each individual hospital visit (including week 52, the DELOS primary endpoint). CI: Confidence interval*

Discussion

- Regular assessment of respiratory function is recommended for patients with DMD, but compliance is generally poor[3,8]
- Several recent publications have indicated that PEF%p may be a more sensitive and earlier marker of respiratory function decline compared to FVC%p[4,5]
- Our results demonstrate, for the first time, that PEF%p can be easily and reliably assessed with a home-based device, and results were comparable to the hospital-based spirometry from the DELOS Phase III study
- Data collected at home confirmed the previously observed treatment benefit seen in DELOS;[6] a relative preservation of PEF%p over the study in patients taking idebenone

Conclusion

- More frequent home-based monitoring may provide a useful tool for assessing the long-term rate of respiratory function decline. Its role in detecting acute respiratory exacerbations was not investigated in the DELOS study and should be studied further

References

1. Mayer OH, et al. US *Neurology*, 2017;13:35-41.
2. Van Ruiten HJ, et al. *Eur J Paediatr Neurol*, 2016;20:904-9.
3. Birnkrant DJ, et al. *Lancet Neurol,* 2018;17:347-61.
4. LoMauro A, et al. *Eur Respir J*, 2018;51:1701418.
5. Domingos J, et al. *Neuromusc Disord* 2017;27:s232-3.
6. Buyse GM, et al. *Lancet*, 2015;385:1748-57.
7. Meier T, et al. *Neuromuscul Disord*, 2017;27:307-14.
8. Landfeldt E, et al. *J Neuromuscul Dis*, 2015;2:63-72.

Acknowledgments

DELOS Study Group

Conflict of interest

C. Rummey is a consultant statistician for Santhera Pharmaceuticals. S. Hasham, T. Meier, and M. Leinonen are employees of Santhera Pharmaceuticals. O.H. Mayer, T. Voit and G. Buyse are paid consultants for Santhera Pharmaceuticals and are investigators in prior/current studies with idebenone in DMD. G. Buyse is co-inventor of relevant patent applications

santhera
THEIR FUTURE - OUR FOCUS

A Phase III Clinical Study Assessing the Efficacy and Safety of Idebenone in Patients with Duchenne Muscular Dystrophy (DMD) taking Concomitant Glucocorticoids (SIDEROS)

Shabir Hasham[1], Roxana Drake[1], Christian Rummey[2], Rosaline Quinlivan[3], Eugenio Mercuri[4], Oscar H Mayer[5] and Gunnar Buyse[6]

[1]Santhera Pharmaceuticals, Pratteln, Switzerland; [2]Clinical Data Science GmbH, Basel, Switzerland; [3]UCL, National Hospital for Neurology and Neurosurgery, London, UK; [4]UOC Neuropsichiatria Infantile, Rome, Italy; [5]Children's Hospital of Philadelphia (CHOP), Philadelphia, US, [6]University Hospitals Leuven, Leuven, Belgium, for the SIDEROS Study Group

Poster presented at WMS 2nd – 6th October. Poster session: DMD therapies I. Poster: P.122

Background

- Respiratory function decline in DMD is caused by progressive weakening of respiratory muscles, and leads to a high disease burden and early mortality[1,2]
- Secondary mitochondrial dysfunction is believed to be a major contributor to muscle decline, resulting in poor muscle regeneration,[3,4] energetic deficit,[3,4] oxidative damage, increased inflammation[3-5] and muscle cell necrosis[3,4]
- Idebenone, a synthetic short chain benzoquinone, restores mitochondrial function by reducing the neosynthesis of reactive oxygen species and recovering ATP synthesis, leading to an improved cellular energy balance[5]
- As part of an extensive clinical development program, Santhera Pharmaceuticals is developing idebenone as a potential treatment for respiratory function decline in patients with DMD (**Figure 1**)
- In the Phase III, 52-week, randomized, placebo-controlled DELOS trial, the effects of oral idebenone tablets (900 mg/day) on respiratory function were investigated in DMD patients aged 10 – 18 years who were not taking concomitant glucocorticoids (GCs)
- Results showed that idebenone significantly slowed the rate of respiratory function decline, as demonstrated by a statistically significant difference of 6.27% compared to placebo in peak expiratory flow, expressed as percent predicted (PEF%p) in addition to benefits seen on other respiratory outcome measures[6-8]

SIDEROS – Design and objectives

- SIDEROS is a Phase III, randomized, placebo-controlled study investigating the safety and efficacy of idebenone in 266 DMD patients taking GCs (**Figure 2**) in over 60 centers in the US (23), EU (37) and Israel (1) (**Figure 3**)
- Patients are randomized (1:1) to receive either idebenone (900 mg/day) or placebo taken 3 times daily, with meals. The treatment duration is 78 weeks. Patients who complete SIDEROS can participate in an open label extension study where all participants receive idebenone
- SIDEROS is one of only a few trials available for non-ambulatory patients with DMD

Key inclusion criteria are:

- Documented diagnosis of DMD (severe dystrophinopathy)
- Forced vital capacity, as percent of predicted (FVC%p), ≤ 80% and > 35%
- Minimum of 10 years old at screening
- Chronic use of systemic GCs (prednisone or deflazacort) for DMD related conditions continuously for at least 12 months prior to baseline (BL) and without any dose adjustments in last 6 months
- Ability to provide reliable and reproducible repeat FVC%p within 15% of the screening assessment at BL
- Immunized with pneumococcal polysaccharide vaccine, as well as yearly immunized with inactivated influenza vaccine
- Ambulatory and mutational status are not inclusion criteria for this study

Key endpoints include:

- Primary endpoint: change from BL to Week 78 in FVC%p, assessed by clinic-based spirometry measurements
- Other assessments include peak expiratory flow (PEF), forced expiratory volume in 1 second (FEV1), peak cough flow (PCF), inspiratory flow rate (IFR), blood oxygen saturation levels, end-tidal CO_2 readings, occurrence of bronchopulmonary adverse events, use of systemic antibiotics and hospitalizations due to respiratory causes

Idebenone is being studied as part of an extensive clinical development program

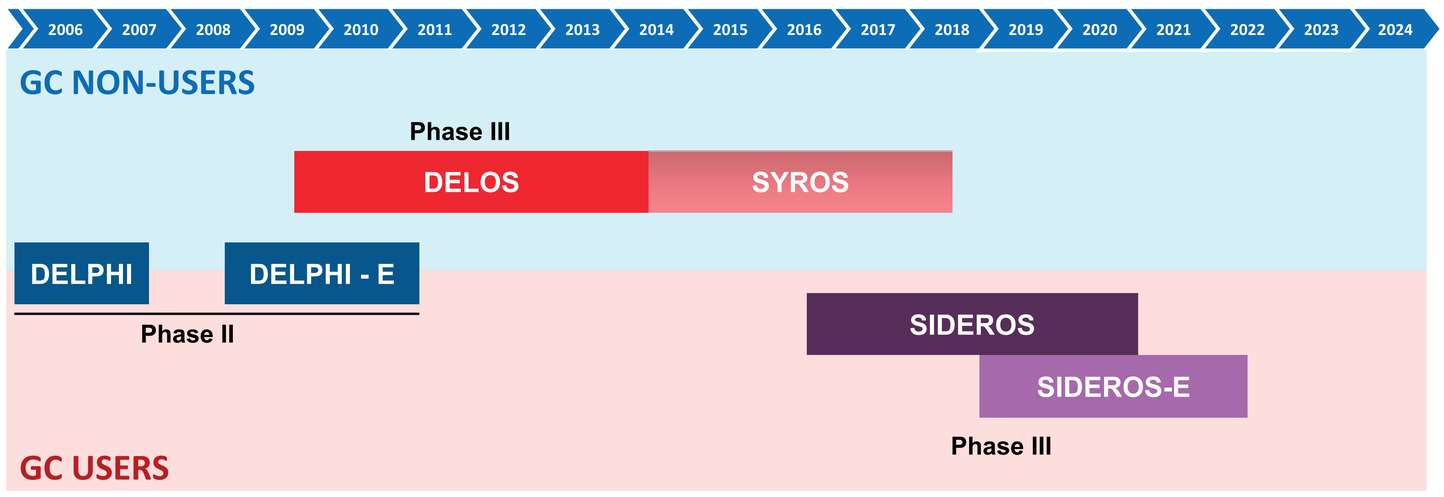
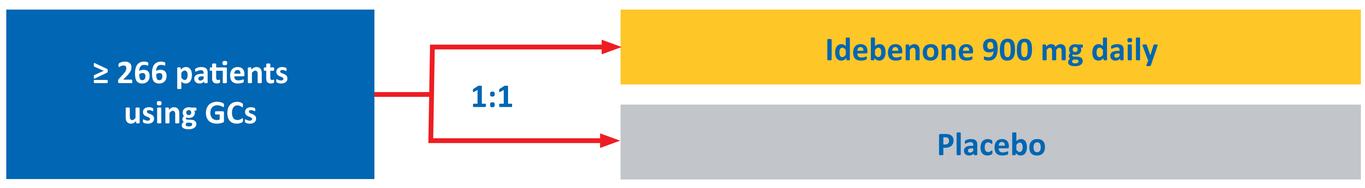


Figure 1. Overview of the clinical development program of idebenone. DELPHI-E: DELPHI Extension; SIDEROS- E: SIDEROS Extension

SIDEROS - A Phase III double-blind study with idebenone in patients with DMD taking GCs

(A)



(B)

Population	DMD patients ≥ 10 years in respiratory function decline (FVC%p ≤ 80% and > 35%)
Study design	Interventional, placebo-controlled, Phase III RCT
Treatments	Parallel group assignment to idebenone 300 mg orally 3 times daily or placebo
Treatment duration	78 weeks
Key endpoint	Change from BL in FVC%p at Week 78
Status	Recruiting

Figure 2. Design summary (A) and inclusion criteria (B) for the Phase III SIDEROS trial. RCT: randomized controlled trial

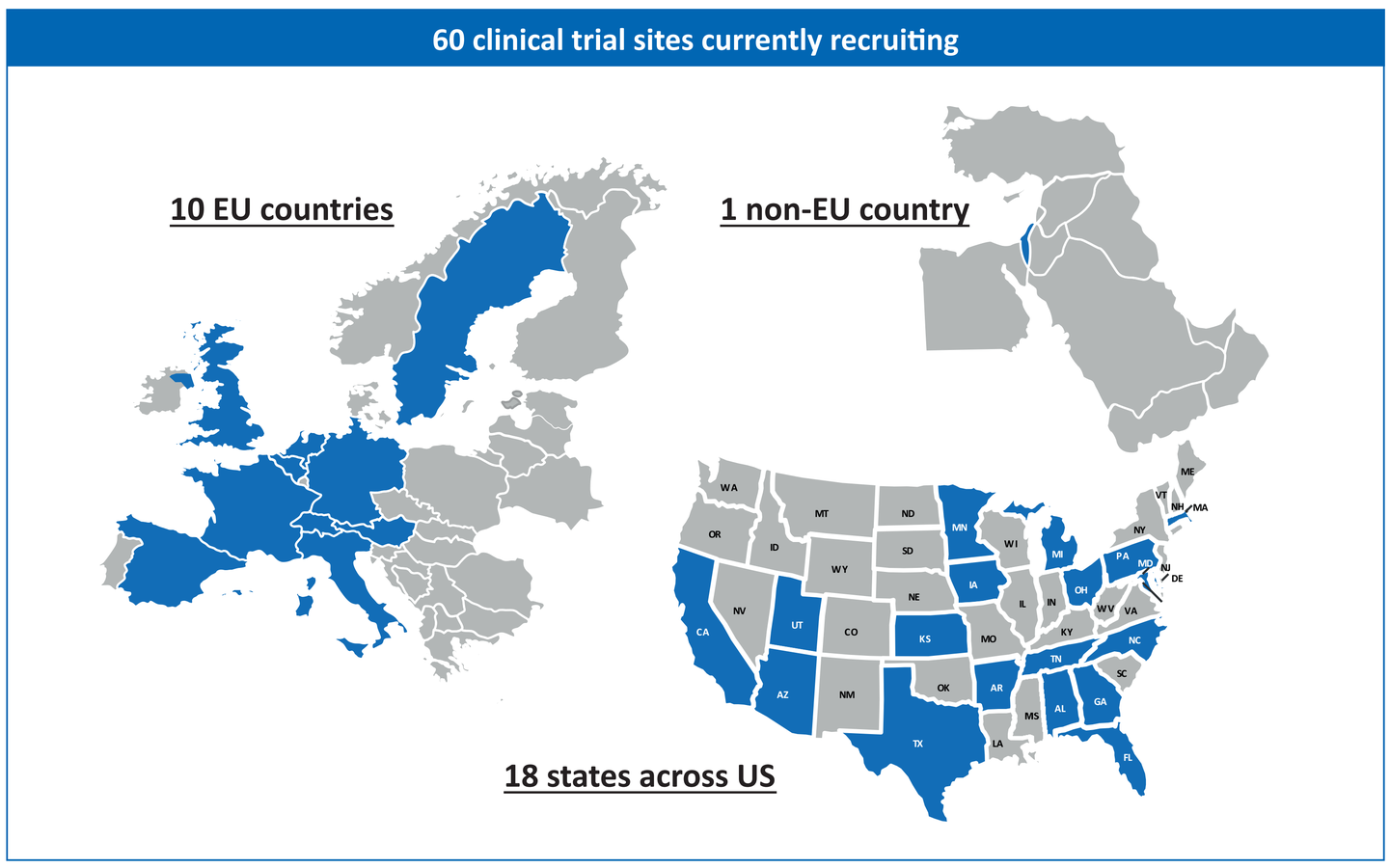


Figure 3. Maps of worldwide SIDEROS centers

Conflict of interest

S. Hasham and R. Drake are employees of Santhera Pharmaceuticals . C. Rummey is a consultant statistician for Santhera Pharmaceuticals.

R. Quinlivan, E. Mercuri, O.H. Mayer and G. Buyse are paid consultants for Santhera and are investigators in prior/ current studies with idebenone in DMD

G. Buyse is co-inventor of relevant patent applications

Acknowledgments

SIDEROS Study Group

For more information, please see www.siderosdmd.com or www.clinicaltrials.gov posting (NCT02814019).

Santhera Pharmaceuticals is the sponsor of the SIDEROS study

References

1. Van Ruiten HJ, et al. *Eur J Paediatr Neurol*, 2016;20:904-9.
2. Mayer OH, et al. *US Neurology*, 2017;13:35-41.
3. Kelly-Worden M and Thomas E. *Open J of Endorcrin and Metab Dis*, 2014;4:211-8.
4. Timpani CA, et al. *Medical Hypotheses*, 2015;85:1021-33.
5. Buyse GM, et al. *Eur Neurol Rev*, 2015:10189-94.
6. Buyse GM, et al. *Lancet*, 2015;385:1748-57.
7. Buyse GM et al. *Pediatr Pulmonol*, 2017; 52:508-515.
8. McDonald CM, et al. *Neuromuscul Disord*, 2016;26:473-80.

santhera
THEIR FUTURE - OUR FOCUS

Descriptive Characteristics of Males with Duchene Muscular Dystrophy (DMD) Using Insurance Claims Data

Authors: John Karafilidis[1], Oscar Henry Mayer[2], Brian Griffin[3], Kate Higgins[3]
[1]Santhera Pharmaceuticals; [2]Children's Hospital of Philadelphia (CHOP), USA; [3]IBM Watson Health
Poster presented at WMS 2nd – 6th October 2018. Poster session: DMD. Poster: P.27

Background

Duchenne muscular dystrophy (DMD) is characterized by muscle weakness, wasting, and degeneration starting in early childhood.[1,2] DMD is caused by a mutation in the dystrophin gene that leads to an absence of functional dystrophin protein.[3] In the United States, the estimated prevalence of DMD is approximately 1.02 per 10,000 male persons, though as it is a rare disease, it may be underreported.[4]

The associated muscle weakening leads to increased disability, with initial symptoms presenting as difficulty walking, climbing stairs, and frequently falling. [5] DMD is incurable, and treatment is limited to supportive measures. Children with DMD will typically utilize corticosteroids, as these have found to slow disease progression, and other support devices such as wheelchairs, ventilators, and cough assist devices. [5,6] The real-world healthcare utilization of this condition is not well represented in the literature, and inclusion criteria for DMD patients often differs, and sample sizes remain small. [2,6] Further, a previous cost of illness study obtained data via patient survey, [7] which is less accurate than administrative claims. [8]

Objectives

This study aims to describe the healthcare resource use (HCRU) of DMD patients in the commercial insurance and Medicaid populations, using a large administrative claims database.

Methods

Study Sample

- As a specific International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) for DMD is not available, the code 359.1 (hereditary progressive muscular dystrophy (HPMD)) was used.
- Patients were required to have at least two diagnoses for hereditary progressive muscular dystrophy (ICD-9-CM: 359.1) between 9/30/2011-9/30/2014, the diagnoses within 18 months of each other.

Study Design

- A retrospective, observational cohort design was used to describe male patients presumed to have DMD that were identified in an administrative claims database.
- Patients were stratified based on age at first captured diagnosis of DMD during the study period, into mutually exclusive categories of males aged 6-10, 11-14, 15-18, and 19-25 years of age.
- Clinical characteristics, treatment patterns, and healthcare utilization were assessed in the 12 months following the diagnosis date.
- A control cohort was established of healthy male patients of the same ages with commercial or Medicare insurance without a claim for DMD between 9/30/2011-9/30/2015, who have at least 12 months of continuous enrollment.

Data Sources:

- This study utilized two distinct U.S. insurance claims data from the *MarketScan® Commercial Claims and Encounters and Medicare Supplemental Database* and the *MarketScan® Multi-State Medicaid* databases (IBM Watson Health, Ann Arbor, MI).
- Claims are fully-adjudicated and represent the full continuum of care across all settings of care. Diagnosis, drug and procedure codes on claims are used to define patient characteristics.

Outcomes:

- Clinical characteristics were captured in the 12-month follow up, including fractures, pneumonia, and sleep disorders.
- Use of anti-infective agents, corticosteroids **(excludes use of deflazacort, since not FDA-approved during study period)**, cough assist devices, oxygen supply, ventilation support, or wheelchairs were also captured

Results

Table 1. Clinical Characteristics, Commercial Cohort

	Patients with DMD aged 6–10 N=300	Patients without DMD aged 6–10 N=566,599	Patients with DMD aged 11–14 N=248	Patients without DMD aged 11–14 N=483,704	Patients with DMD aged 15–18 N=277	Patients without DMD aged 15–18 N=509,517	Patients with DMD aged 19–25 N=320	Patients without DMD aged 19–25 N=1,005,395
Clinical characteristics								
Fracture, N (%)	30 (10.0)	19,742 (3.5)	36 (14.5)	32,327 (6.7)	42 (15.2)	23,036 (4.5)	4 (1.3)	23,344 (2.3)
Pneumonia, N (%)	16 (5.3)	12,450 (2.2)	19 (7.7)	6,117 (1.3)	38 (13.7)	4,090 (0.8)	45 (14.1)	4,868 (0.5)
Sleep issues, N (%)	31 (10.3)	2,998 (0.5)	66 (26.6)	1,722 (0.4)	20 (7.2)	2,109 (0.4)	66 (20.6)	6,405 (0.6)
Treatments								
Anti-infective agent, N (%)	33 (11.0)	53,718 (9.5)	31 (12.5)	31,194 (6.4)	42 (15.2)	33,454 (6.6)	87 (27.2)	77,445 (7.7)
Corticosteroid*, N (%)	130 (43.3)	71,623 (12.6)	42 (16.9)	40,498 (8.4)	38 (13.7)	50,363 (9.9)	57 (17.8)	89,351 (8.9)
Corticosteroid and a wheelchair claim, N (%)	36 (12.0)	196 (0.0)	17 (6.9)	204 (0.0)	20 (7.2)	182 (0.0)	18 (5.6)	158 (0.0)
Medical devices								
Cough assist devices, N (%)	15 (5.0)	25 (0.0)	30 (12.1)	16 (0.0)	34 (12.3)	14 (0.0)	42 (13.1)	15 (0.0)
Oxygen or oxygen supplies, N (%)	13 (4.3)	2,116 (0.4)	32 (12.9)	1,218 (0.3)	34 (12.3)	885 (0.2)	67 (20.9)	1,240 (0.1)
Ventilation support, N (%)	20 (6.7)	116 (0.0)	45 (18.1)	133 (0.0)	52 (18.8)	154 (0.0)	91 (28.4)	435 (0.0)
Wheelchair or accessories, N (%)	69 (23.0)	737 (0.1)	118 (47.6)	824 (0.2)	130 (46.9)	736 (0.1)	130 (40.6)	793 (0.1)
Utilization								
Emergency room visits, N (%)	78 (26.0)	75,522 (13.3)	65 (26.2)	67,744 (14.0)	74 (26.7)	78,451 (15.4)	110 (34.4)	143,319 (14.3)
Average visits per person, mean (SD)	8.5 (9.5)	6.8 (6.9)	12.1 (11.4)	7.7 (7.6)	12.6 (14.2)	9.0 (9.6)	14.4 (13.7)	10.5 (12.2)
Home nursing visits, N (%)	20 (6.7)	1,350 (0.2)	30 (12.1)	1,235 (0.3)	31 (11.2)	14 (0.0)	64 (20.0)	2,703 (0.3)
Inpatient admissions, N (%)	29 (9.7)	5,533 (1.0)	43 (17.3)	6,122 (1.3)	47 (17.0)	9,311 (1.8)	61 (19.1)	18,745 (1.9)
Average visits per person, mean (SD)	1.5 (10.6)	1.3 (1.0)	1.6 (1.1)	1.3 (1.1)	1.6 (1.2)	1.3 (1.0)	1.9 (1.6)	1.4 (1.1)
Physician office visits, N (%)	290 (96.7)	409,909 (72.3)	241 (97.2)	345,085 (71.3)	266 (96.0)	329,185 (64.6)	305 (95.3)	489,772 (48.7)

Table 2. Utilization and Expenditure, Commercial and Medicaid Cohorts

	Patients with DMD aged 6–10	Patients without DMD aged 6–10	Patients with DMD aged 11–14	Patients without DMD aged 11–14	Patients with DMD aged 15–18	Patients without DMD aged 15–18	Patients with DMD aged 19–25	Patients without DMD aged 19–25
Commercial cohort								
Patients with insurance coverage in the year 2014	213	203,902	161	173,065	180	177,630	220	324,295
Patients with an inpatient admission, N (%)	16 (7.5)	1,759 (0.9)	18 (11.2)	2,069 (1.2)	31 (17.2)	3,017 (1.7)	28 (12.7)	5,354 (1.7)
Average cost of impatient services*, mean (SD)	$49,197 ($64,466)	$25,510 ($51,081)	$97,426 ($130,031)	$30,306 ($69,149)	$55,960 ($89,671)	$27,941 ($73,607)	$54,755 ($8,2617)	$27,113 ($61,159)
Patients with a pharmacy claim, N (%)	186 (87.3)	118,346 (58.0)	140 (87.0)	97,006 (56.1)	155 (86.1)	99,460 (56.0)	184 (83.6)	151,594 (46.7)
Average cost of pharmacy services*, mean (SD)	$2,723 ($8,858)	$528 ($2,370)	$2,868 ($9,123)	$1,090 ($664)	$2,189 ($4,843)	$945 ($5,408)	$2,739 ($7,624)	$622 ($6,299)
Patients with any healthcare claim, N (%)	213 (100.0)	179,538 (88.1)	160 (99.4)	150,112 (86.7)	176 (97.8)	141,730 (79.8)	214 (97.3)	216,614 (66.8)
Average cost of all healthcare services, mean (SD)	$12,248 ($36,147)	$1,130 ($6,864)	$33,344 ($81,070)	$2,705 ($14,004)	$29,809 ($59,086)	$3,181 ($17,489)	$23,382 ($64,981)	$1,653 ($13,166)
Medicaid cohort								
Patients with insurance coverage in the year 2014	278	97,009	245	69,865	260	49,743	244	28,843
Patients with an inpatient admission, N (%)	29 (10.4)	1,078 (1.1)	41 (16.7)	1,012 (1.4)	28 (10.8)	1,115 (2.2)	41 (16.8)	1,129 (3.9)
Average cost of impatient services*, mean (SD)	$48,494 ($80,848)	$12,869 ($39,838)	$66,212 ($123,105)	$13,401 ($30,511)	$50,768 ($76,107)	$14,649 ($38,009)	$39,380 ($48,735)	$16,698 ($34,377)
Patients with a pharmacy claim, N (%)	249 (89.6)	59,420 (61.3)	223 (91.0)	39,521 (56.6)	184 (70.8)	27,033 (54.3)	211 (86.5)	11,926 (41.3)
Average cost of pharmacy services*, mean (SD)	$1,186 ($3,190)	$482 ($2,796)	$3,027 ($8,574)	$953 ($4,683)	$3,129 ($7,530)	$1,013 ($11,589)	$2,706 ($7,965)	$1,048 ($6,060)
Patients with any healthcare claim, N (%)	278 (100.0)	85,422 (88.1)	239 (97.6)	59,670 (85.4)	219 (84.2)	39,028 (78.5)	242 (99.2)	16,185 (56.1)
Average cost of all healthcare services, mean (SD)	$12,013 ($38,899)	$877 ($5,753)	$35,374 ($73,519)	$1,860 ($8,490)	$58,411 ($293,493)	$2,402 ($13,619)	$28,051 ($42,488)	$2,845 ($14,030)

**Payments were calculated as average payment per patient among those patients with a claim in the specified area in the calendar year 2014. Patient counts are reported as 'N (%)', averages are reported as 'mean (SD)'. DMD = Duchenne muscular dystrophy; N = number of patients; SD = standard deviation.*

- Clinical characteristics for those in the Medicaid cohort were similar to those in the commercial cohort depicted in **Table 1**
- Fractures, sleep issues and pneumonias were present in all age cohorts, where incidence tended to increase across the cohorts
- Medical devices were used across all age groups; utilization of cost assist devices and wheelchairs was lower than anticipated
- Average costs of all healthcare services was much higher in all DMD cohorts (aged 11-14 &15-18; approx. $33K-$58K/yr-**Table 2**)

Conclusion

- DMD results in significant burden to patients with DMD; based on this claims analysis, patients presumed to have DMD had higher annual HCRU costs when compared with non-DMD age-matched cohort

References

1. Muscular Dystrophy Association. Duchenne Muscular Dystrophy (DMD). https://www.mda.org/disease/duchenne-muscular-dystrophy (Accessed May 31st, 2018)
2. Thayer S, Bell C, McDonald C. J Manag Care Spec Pharm. 2017; 23(6):633-41
3. Relizani K, et al. Mol Ther Nucleic Acids. 2017; 8:144-57
4. Romitti P, et al. PEDIATRICS. 2015;135(3): 513–21.
5. Ryder S, et al. Orphanet J Rare Dis.2017;12:79
6. The Cleveland Clinic. Muscular Dystropy. Available at: https://my.clevelandclinic.org/health/articles/muscular-dystrophy (Accessed May 31st 2018)
7. Larkindale J, et al. Muscle Nerve. 2014 Mar;49(3):431-8
8. Short M, et al. J Occup Environ Med. 2009 July;51(7): 786–796

Conflict of interest

Oscar Henry Mayer is a paid consultant for Santhera Pharmaceuticals and is an investigator in prior/current studies with idebenone in DMD.

John Karafilidis was an employee of Santhera Pharmaceuticals.

Brian Griffin and Kate Higgins are employees of IBM Watson Health; this claims initiative performed by IBM Watson Health was funded by Santhera Pharmaceuticals

santhera
THEIR FUTURE - OUR FOCUS