The Societal Cost of Duchenne Muscular Dystrophy in Brazil: A Burden of Illness Study

Luis Fernanado Grossklauss[1], Júlio César Lins Barreto Sobrinho[2], Alexandre R. Fernandes[3], Patricia Krebs Ferreira[4], Rita Guedes[5], Edmar Zanoteli[6], Marcela Câmara Machado-Costa[7], Juliana Gurgel-Giannetti[8], Brian Ung[9], Joel Iff[9], Jonathan Evans[10]

[1]TDN/Afip Tratamento de Doenças Neuromusculares/Associação Fundo de Incentivo a Pesquisa, São Paulo, Brazil; [2]Associação Baiana de Distrofias Muscular (ABDM), Sao Paulo, Brazil; [3]Universidade Federal Fluminense, Fluminense, Brazil; [4]Faculdade Pequeno Príncipe, Curitiba, Brazil; [5]Programa VENTLAR da FHEMIG – Fundação Hospitalar do Estado de Minas Gerais, Gerais, Brazil; [6]Faculdade de Medicina da Universidade de São Paulo (FMUSP), São Paulo, Brazil; [7]Escola Bahiana de Medicina e Saúde Pública, Salvador, Brazil; [8]Hospital das Clínicas da UFMG, Belo Horizonte, Brazil; [9]Sarepta Therapeutics Inc., Cambridge, MA, USA; [10]Prime HCD, Knutsford, UK

Background

- Duchenne muscular dystrophy (DMD) is a rare, X-linked, progressive neuromuscular disease caused by mutations in the gene that encodes for dystrophin resulting in an absence of functional dystrophin, leading to progressive muscle weakness and life-threatening complications, including cardiomyopathy, respiratory insufficiency, and ultimately premature death[1,2]
- Current treatment options are limited to multidisciplinary supportive care and corticosteroids,[3,4] which are not suitable for all patients,[5] creating a high unmet need
- DMD is associated with substantial economic burden, including direct medical costs that are incurred by healthcare systems[6]

Objective

A burden-of-illness (BOI) study was conducted to quantify healthcare and nonhealthcare resource utilization, and to estimate the societal cost of DMD in Brazil, including direct medical, direct nonmedical, and indirect costs

Methods

Study design

- Data were collected from May 2023 to November 2023
- Physicians managing the treatment of DMD patients were recruited from specialist centers and they, in turn, recruited patients and their caregivers to participate
- The managing physicians comprised 5 neurologists, 4 pediatric neurologists, and 1 neuromuscular specialist

Study design (cont)

- Physicians reported clinical characteristics and healthcare resource utilization (HRU) from an electronic case record form (eCRF); patients and caregivers reported direct and indirect cost via a public patient involvement and engagement form (PPIE) over the last 12 months
- Direct medical cost included consultations, treatment, medications, medical devices, hospitalizations, and tests and procedures
- Direct nonmedical costs included alternative therapies, transportation, home/vehicle adaptation, professional care, informal caregiving (relative, friend, or other unpaid person), and transfer payments
- Indirect costs included work productivity (captured by the Work Productivity and Activity Impairment questionnaire [WPAI][7]) and retired/stopped working costs, for both patients and caregivers

Key inclusion criteria

- Male
- Diagnosed with DMD
- Pediatric (>4 years old) or adult
- Had 12 previous months of medical record follow-up available

Health states

The sample was stratified by 4 disease progression health states, collapsed from the university of Leicester 8 disease-stage model[8] (**Figure 1**)

Analysis

Unit costs were multiplied with HRU, cumulatively over the last 12 months, to calculate direct medical cost. Direct nonmedical and indirect costs were added to direct medical costs to estimate full societal cost (**Figure 2**)

Figure 1 *Health State Definitions*

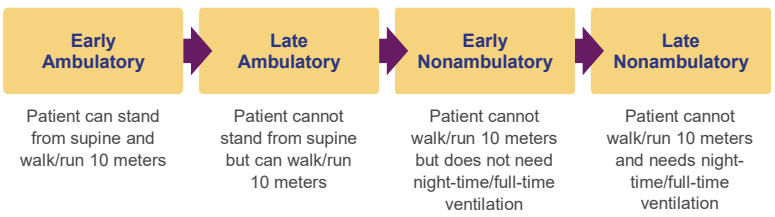
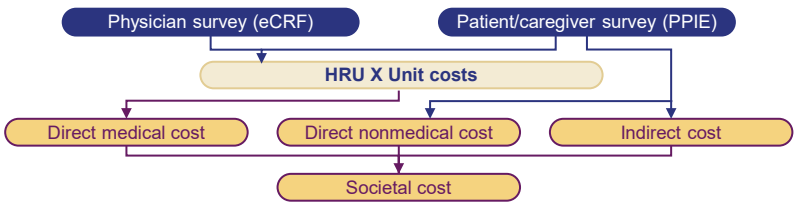


Figure 2 *Study Design*



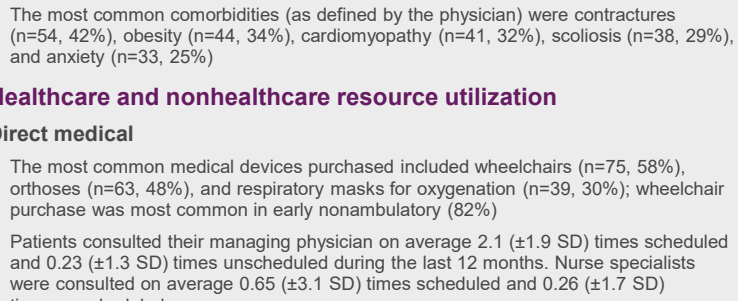
eCRF=electronic case report form; PPIE= public patient involvement and engagement; HRU=healthcare resource utilization.

Results

Patient characteristics

- The study comprised eCRFs completed by the managing physician matched with PPIEs from 130 patients and caregivers from 10 Brazilian urban DMD treatment centers
- Patients were distributed across all four health states, with most patients in early nonambulatory (n=74) (**Figure 3**)

Figure 3 *DMD Brazil BOI Sample by Health State*



See **Figure 1** for health state definitions
BOI=burden of illness; DMD=Duchenne muscular dystrophy.

- The mean age was 13.4 years (±4.6 SD), and the mean age of diagnosis was 6.2 years (±2.6 SD) (**Table 1**)

Table 1 *Patient Characteristics by Health State*

	Ambulatory		Nonambulatory		
Patient Characteristic	**Early (n=23)**	**Late (n=16)**	**Early (n=74)**	**Late (n=17)**	**Total (n=130)**
Mean age (SD)	8.5 (±2.3)	10.9 (±2.3)	14.4 (±3.9)	18.4 (±4.1)	13.4 (±4.6)
Mean age of diagnosis (SD)	5.0 (±2.5)	5.6 (±2.7)	6.7 (±2.2)	6.2 (±3.6)	6.2 (±2.6)
Mutation type					
Exon deletion, n (%)	12 (52)	8 (50)	49 (66)	13 (77)	82 (63)
Duplications, n (%)	4 (17)	1 (6)	9 (12)	0 (0)	14 (11)
Point mutations, n (%)	2 (9)	4 (25)	8 (11)	1 (6)	15 (12)
Other mutations, n (%)	4 (17)	2 (13)	4 (5)	1 (6)	11 (9)
Do not know/missing, n (%)	1 (4)	1 (6)	4 (5)	2 (12)	8 (6)
Receiving corticosteroids					
Yes, n (%)	20 (87)	16 (100)	69 (93)	10 (59)	115 (89)
No, n (%)	3 (13)	0 (0)	5 (7)	7 (41)	15 (12)

Mutation percentages may not add to 100% due to rounding.

- Among patients receiving corticosteroid treatment (n=115, 88%), the most used corticosteroid was deflazacort (n=73, 63%), followed by prednisolone (n=21, 18%) and prednisone (n=19, 15%)
- The most common comorbidities (as defined by the physician) were contractures (n=54, 42%), obesity (n=44, 34%), cardiomyopathy (n=41, 32%), scoliosis (n=38, 29%), and anxiety (n=33, 25%)

Healthcare and nonhealthcare resource utilization

Direct medical

- The most common medical devices purchased included wheelchairs (n=75, 58%), orthoses (n=63, 48%), and respiratory masks for oxygenation (n=39, 30%); wheelchair purchase was most common in early nonambulatory (82%)
- Patients consulted their managing physician on average 2.1 (±1.9 SD) times scheduled and 0.23 (±1.3 SD) times unscheduled during the last 12 months. Nurse specialists were consulted on average 0.65 (±3.1 SD) times scheduled and 0.26 (±1.7 SD) times unscheduled
- Consultations outside of the managing physician occurred in 101 (78%) of patients. The other specialists consulted most often were cardiologists (n=73, 56%), physiotherapists (n=67, 52%), and other neurologists (n=24, 18%)

Healthcare and nonhealthcare resource utilization (cont)

- Echocardiogram was the most common test/procedure reported in 97 (75%) of patients, followed by forced vital capacity in 69% of patients

Direct nonmedical

- Mean informal caregiving time was 52.5 hours (±61.8 SD) per week per patient, and was lowest in early ambulatory (15.7 hours, ± 35.5 SD) and increased with disease progression to 83.5 hours (±74.5 SD) in late nonambulatory

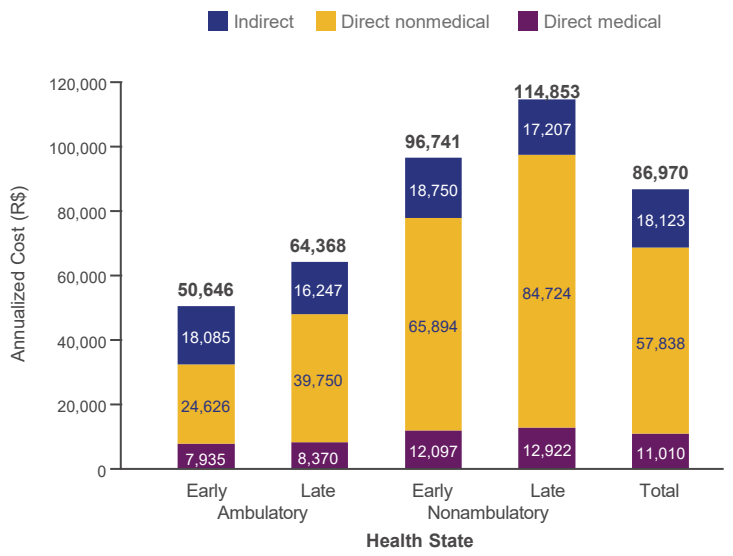
Indirect

- A large proportion of caregivers retired, stopped working, or were never able to work due to caregiving (n=56, 52%). Stopping working or retiring was highest in early ambulatory (71% of caregivers) and late nonambulatory (60% of caregivers)

Societal cost

- Mean **direct medical costs** were R$ 11,010 (±5,770 SD), and these costs were highest in late nonambulatory. Across health states, 83% of direct medical costs were attributed to medical device use at a mean of R$ 9,100 (±4,508 SD)
- Mean **direct nonmedical** costs were R$ 57,838 (±52,673 SD), and these costs were highest in late nonambulatory (R$ 84,724, ±57,326 SD). Direct nonmedical costs for all health states were driven by informal caregiving at a mean of R$ 35,128 (±41,332 SD), followed by alternative and complementary therapies at a mean of R$ 11,148 (±14,359 SD)
- Mean **indirect costs** were R$ 18,123 (±14,636 SD) and were similar across all health states. Costs were most influenced by caregivers retiring/stopping working at a mean of R$ 12,541 (±14,282 SD) and caregiver work productivity loss at a mean of R$ 4,686 (±10,435 SD)
- Mean societal cost per patient was R$ 86,970 (±58,263 SD). Direct nonmedical costs contributed the largest amount (67%), followed by indirect costs (21%), and finally direct medical costs (13%) (**Figure 4, Table 2**)

Figure 4 *Mean Societal Cost and Cost Type of DMD by Health State (12 Months)*



Costs are presented in Brazilin reals reflecting 2023 values. DMD=Duchenne muscular dystrophy.

Table 2 *Proportion of Societal Cost by Cost Type and DMD Health State*

	Ambulatory		Nonambulatory		
Percentage of Societal Cost	**Early**	**Late**	**Early**	**Late**	**Total**
Direct medical	16%	13%	13%	11%	13%
Direct nonmedical	49%	62%	68%	74%	67%
Indirect	36%	25%	19%	15%	21%

Percentages may not add to 100% due to rounding.

Key Finding

The societal cost per patient increased as DMD progressed, from R$ 50,646 in early ambulatory patients to R$ 114,853 in late nonambulatory patients

Conclusions

This study demonstrates the socioeconomic burden of DMD in Brazil. Direct nonmedical costs were the largest overall cost driver (67%), the majority of which (61%) was associated with informal caregiving

Direct medical costs contributed the least (13%) to the societal cost of DMD per patient

This extensive and varied dataset offers the potential to explore the burden experienced by Brazilian DMD patients and identifies the key factors driving this burden across different health states

Societal costs (R$ 86,970) were approximately four times greater than those previously reported by Schneider et al[9] (R$ 21,898). This difference may be attributed to variations in study methodology and scope of captured costs; however, both studies suggest that societal costs are driven by caregiving and lost productivity

Larger datasets with longer recall periods (>12 months) could provide a more complete perspective of all costs associated with DMD in Brazil

Acknowledgments & Disclosures

Acknowledgments: This study was funded by Sarepta Therapeutics, Inc. Editorial support was provided by Hailey Batman, PharmD, of Eloquent Scientific Solutions, and was funded by Sarepta Therapeutics, Inc. Site management and data collection was conducted by the Oracle Life Sciences team in Brazil. The authors thank Karen Phillips for critical review of the content presented in this poster

Disclosures: LFG: Participated on advisory boards/received speaker honoraria from PTC Bio, Sarepta Therapeutics, Inc., Biogen, Novartis, Roche, Axio Biosolutions. **JCLBS, ARF, PKF, JGG:** Report no conflicts of interest. **RG:** Consulted on advisory boards/received speaker honoraria from Biogen, Sarepta Therapeutics, Inc., Roche, and PTC Bio. **EZ:** Speaker and consultant for PTC Bio, Roche, and Sarepta Therapeutics, Inc. **MCMC:** Reports participating in the study with Sarepta Therapeutics, Inc. **BU, JI:** Employees of Sarepta Therapeutics, Inc., and may own stock/options in the company. **JE:** Employee of HCD Economics.

References

1. Bushby K, et al. *Lancet Neurol*. 2010;9(1):77-93.
2. Mendell JR, et al. *Ann Neurol*. 2013;74(5):637-47.
3. Duan D, et al. *Nat Rev Dis Primers*. 2021;7(1):13.
4. Osorio AN, et al. *Neurologia*. 2019;34(7):469-81.
5. Quinlivan R, et al. *J Neuromuscul Dis*. 2021;8(6):899-926.
6. Landfeldt E, et al. *Neurology*. 2014;83(6):529-36.
7. Reilly MC, et al. *Pharmacoeconomics*. 1993;4(5):353-65.
8. Broomfield J, et al. *Pharmacoeconmics* 2023; 8, 79–89 (2024).
9. Schneider NB, et al. *Orphanet J Rare Dis*. 2023;18(1):159.

SCAN THE QR CODE

The QR code is intended to provide scientific information for individual reference, and the information should not be altered or reproduced in any way.

Presented at ISPOR Europe 17–20 November 2024 Barcelona, Spain