

Multiple Sclerosis: New Perspectives on the Patient Journey—2019 Update

Summary of an Actuarial Analysis and Report

Supplement to

Pharmacy and Therapeutics



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This is a summary of the *Multiple Sclerosis: New Perspectives on the Patient Journey—2019 Update* report that was commissioned by Biogen. The report findings reflect the research of the authors; Milliman did not intend to endorse any product or organization. The report's analysis of MS patient characteristics, impairment indicators, and utilization of healthcare services and costs is based on historical practice patterns and therapies, which can be expected to change over time. Future experience will vary from the estimates presented in this summary for many reasons, including random fluctuation. As with any economic or actuarial analysis, it is not possible to capture all factors that may be significant. Further, no algorithm for identifying MS patients and relapses will be perfect. Different identification algorithms could produce different results. Because the report presents national average data, the findings and this summary of those findings should be interpreted carefully before they are applied to any particular situation since there could be considerable variation among subsets of the population. One of the report's authors, Bruce Pyenson, is a member of the American Academy of Actuaries and meets its qualification standards for this work.

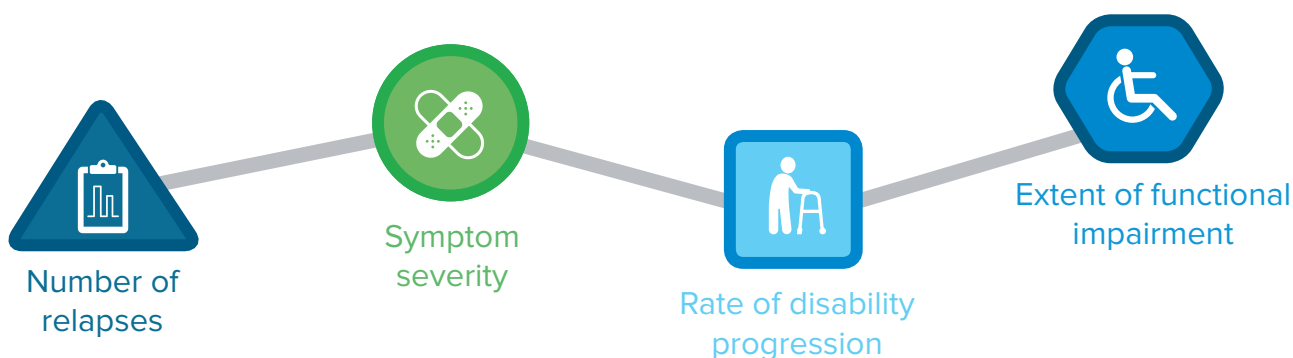
Multiple Sclerosis: New Perspectives on the Patient Journey–2019 Update

Summary of an Actuarial Analysis and Report

Background on MS

Multiple sclerosis (MS) is a progressive, neurodegenerative, immune-mediated neurological disease that is associated with irreversible physical disability and functional impairment.¹ The estimated cumulative prevalence of MS in the United States as of 2017 ranges from 851,749 to 913,925 people based on health claims data.^{2,3} This estimated range should be viewed with caution, as it assumes there have been no changes in the different variables of the algorithm since the year 2000.

Most individuals are diagnosed between the ages of 28 and 31 years,⁴ meaning they will live with MS during their peak working years. The disease course in MS differs from individual to individual.⁵ In addition, the presentation and severity of MS can also vary.⁶ There is substantial clinical heterogeneity in relapsing-remitting multiple sclerosis (RRMS),⁷ with the following characteristics varying considerably within the patient population.^{1,7,8}



According to the MS Coalition,⁹ early and ongoing treatment with a disease-modifying therapy (DMT) is recommended as soon as possible after an MS diagnosis. Due to the heterogeneity of the patient population, access to a broad range of DMT options and highly individualized treatment is important for patients living with MS and their clinicians.⁵

⁹ The Multiple Sclerosis Coalition was founded in 2005 to increase opportunities for cooperation and provide greater opportunity to leverage the effective use of resources for the benefit of the MS community. Member organizations include Accelerated Cure, Can Do Multiple Sclerosis, Consortium of Multiple Sclerosis Centers, International Organization of Multiple Sclerosis Nurses, Multiple Sclerosis Association of America, Multiple Sclerosis Foundation, National Multiple Sclerosis Society, and United Spinal Association. MS Views and News serves as an affiliate member (since 2015).⁵

Background on the MS Patient Journey

The Milliman actuarial analysis and report titled *Multiple Sclerosis: New Perspectives on the Patient Journey—2019 Update* was commissioned by Biogen to help understand the patient journey in MS through the utilization of data, including the heterogeneity of MS, the role of disability progression, the potential impact on the payer

system, and the potential value of early treatment.

Two analyses were conducted using data from 2006 to 2017 from the Truven Health Analytics MarketScan® Commercial Databases, which include approximately 30 million insured lives from self-funded large employers and health plans across the United States.^{9,b}



Snapshot analysis for 2015

The snapshot analysis for 2015 focused on descriptive statistics on prevalence and incidence of MS, as well as DMT treatment rates and healthcare costs, in a calendar year time frame.⁹



Prevalence



Incidence



DMT treatment rate



Healthcare costs



Longitudinal analysis for the years 2006 to 2017

2006

2017

12-year period

The longitudinal analysis for the years 2006 to 2017 focused on the potential patient journey during the course of MS, including disease progression, treatment patterns with DMT, and related healthcare costs in newly diagnosed patients with MS over the course of 10 years, with a 2-year look-back period. In addition, this analysis captured information about the disease activity, functional impairment, and estimated healthcare costs during the time period leading up to the MS diagnosis.⁹



Disease progression after diagnosis



DMT treatment initiation



DMT treatment patterns



Healthcare costs

^b MarketScan® databases contain all paid claims generated for millions of commercially insured lives. The 2016 MarketScan® database currently contains about 30 million lives. The MarketScan® database represents the inpatient and outpatient healthcare service use of individuals nationwide who are covered by the benefit plans of large employers, health plans, government, and public organizations.⁹

MS Population Insights

MS prevalence data for 2015 showed the following⁹:



Prevalence in sample:

207 per 100,000

47.9 years

76%

MS affect

Average age

Proportion of females



Incidence in sample:

20 per 100,000

45.2 years

75%

DMT Treatment in MS Insights

DMT Use

- About 1 in 4 patients with MS did not receive DMT treatment in 2015⁹
- Nearly 30% of newly diagnosed patients from 2008 to 2017 did not receive a DMT in the 2 years following diagnosis,⁹ despite the MS Coalition recommendation of early and ongoing DMT treatment as soon as possible after diagnosis⁵

Time to Treatment⁹

- The average time to treatment with an MS-specific DMT was 3.1 months after diagnosis for men and 3.3 months after diagnosis for women

DMT Switching⁹

- 28.5% of patients newly diagnosed with MS switched DMTs, while 20% of patients with established MS on DMT therapy switched to a different DMT, according to an analysis of DMT switching patterns for the 2015-2017 cohorts of patients who were newly diagnosed in 2015 and those who were existing patients
- Of those who switched during 2015 to 2017, the vast majority made their first switch within 2 years of diagnosis (85.3% of all switchers)
- The majority (85%) of patients with MS remained with the same DMT delivery type—oral, injectable, or infusion

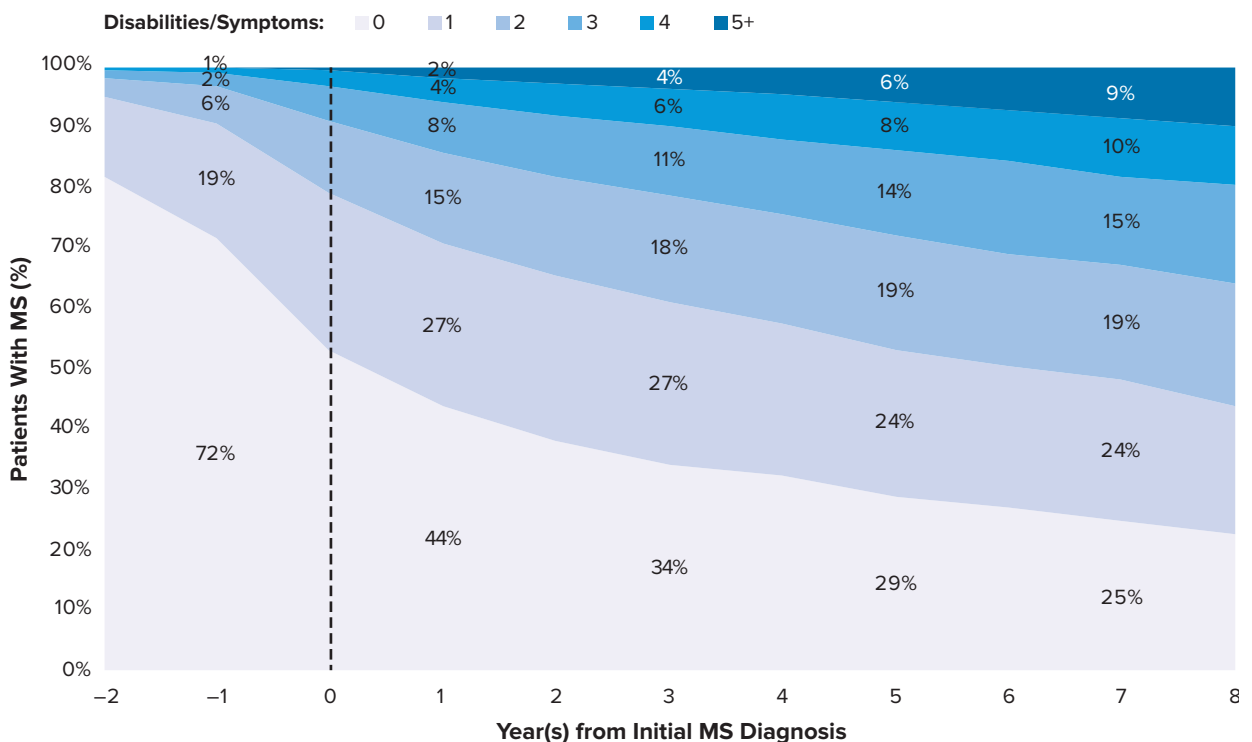
Disability and Neurologic Impairment Indicators in MS Appear Prior to Diagnosis⁹

Disability indicators were identified by the Expanded Disability Status Scale (EDSS)^a and included spasticity; bladder dysfunction; visual impairment; mobility impairment requiring a cane, walker, wheelchair, or special bed; and cognitive/behavioral dysfunction.^b Related neurologic impairment indicators identified through drug treatment included pain, fatigue, depression, and cognitive impairment.^{9,c}

Indicators for disability and related neurologic impairment were evident in claims for many patients before their MS diagnosis was established and increased during the course of the disease.⁹

Nearly one-third (27%) of patients had 1 or more indicators of disability or neurologic impairment at 1 year prior to an MS diagnosis.⁹

Cumulative Distribution of Patients With MS by the Combined Number of Indicators for EDSS-Derived Disability and Related Neurologic Impairment During the Course of the Disease⁹



Based on Milliman's analysis of MarketScan[®] commercial databases, 2006-2017.

^a The EDSS score assigns values from 0, which represents normal neurologic functioning, to 10, which represents death due to MS.¹⁰ The EDSS is largely affected by physical mobility, and it may underrepresent common functional impairments in MS, such as cognitive impairment, fatigue, pain, and depression.¹ The EDSS score is the basis of traditional disability insurance.

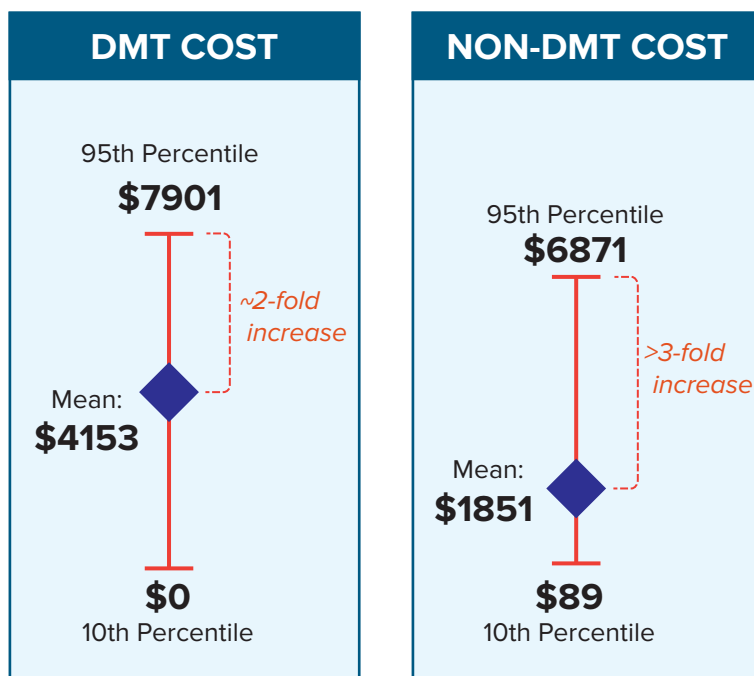
^b Identified through medical claims with relevant diagnosis codes (eg, *International Classification of Diseases, Ninth Revision* [ICD-9] codes for dementia, mild cognitive impairment, pseudobulbar affect, etc).⁹

^c Identified through pharmacy claims for relevant prescription drug therapies (eg, acetylcholinesterase inhibitors for the treatment of dementia).⁹

Patients With MS Use a Wide Range of Resources as Demonstrated by Per-Patient Per-Month Claim Costs

In the 2015 snapshot analysis, the average allowed per-patient per-month (PPPM) claim cost for all patients with MS (\$6004) was substantially greater than for the entire commercially insured population in the database (\$577).⁹

Percentile Distribution of Allowed PPPM Claim Costs for Patients With MS in 2015⁹



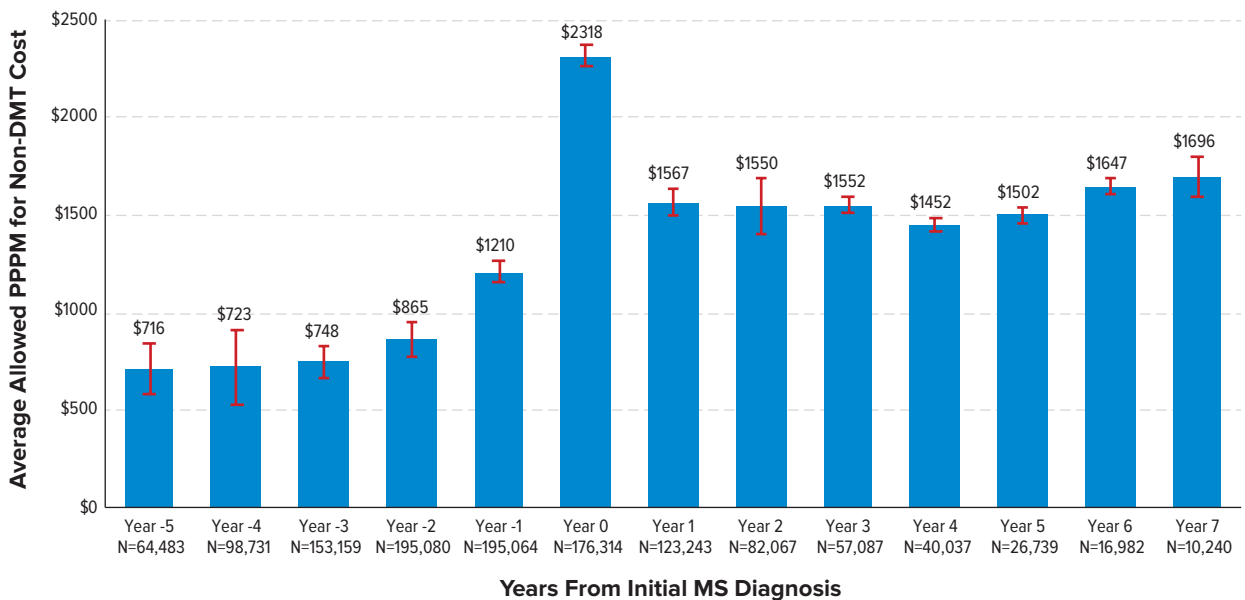
This analysis includes only MS-specific DMTs in the “DMT” category. DMT costs do not include costs to administer infused drugs, which are captured in non-DMT costs. Based on Milliman’s analysis of MarketScan® commercial databases, 2006-2017. All costs trended to 2017.

For non-DMT services, the 95th percentile PPPM claim cost (\$6871) was almost 4 times the mean (\$1851). This finding demonstrates the wide range of resource use by people in the MS population.⁹

Nonmedical (Non-DMT) Costs Increase 2 Years Prior to MS Diagnosis

In the 1-year period before MS diagnosis, non-DMT spending appeared to increase from the prior year's level. Costs appeared to spike in the year following MS diagnosis (year 0), after which costs returned to a relatively steady amount that was consistently higher than prior to diagnosis.⁹

Allowed PPM Costs Associated With Non-DMT Services During the Course of Disease (including 95% confidence interval)⁹

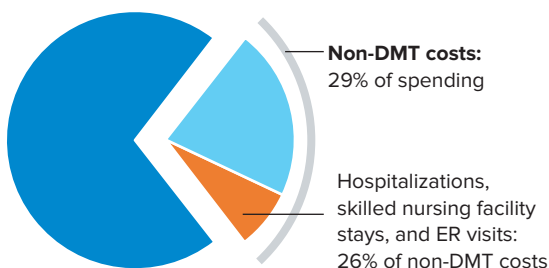


N=Member Months.

Based on Milliman's analysis of MarketScan[®] commercial databases, 2006-2017. All costs trended to 2017.

Non-DMT Costs Vary by Resource, Use of DMTs, and Gender⁹

- 29% of healthcare spending for patients with MS was attributed to non-DMT costs (inpatient and outpatient care, emergency room [ER] visits, durable medical equipment supplies, non-DMT prescription drugs, and other services). Hospitalizations, skilled nursing facility stays, and ER visits made up more than 26% of these non-DMT costs^{9,a}
- The unadjusted average monthly non-DMT cost among patients with DMT use (\$1571) was approximately 27% lower (\$588) than among those without DMT use (\$2159). Potential confounding factors—age, gender, and disease duration—were not adjusted for in this analysis^{9,a}
- Female patients with MS have higher non-DMT costs at younger ages, whereas male patients with MS have higher non-DMT costs at later ages^{9,b}



^a In the snapshot analysis for 2015.

^b In the longitudinal analysis for the years 2006 to 2017.

Health Plan Considerations

Multiple Sclerosis: New Perspectives on the Patient Journey—2019 Update by Milliman provides insights using 12 years of commercial insurance claims. The analysis provides health plans with the following important analytical implications when evaluating their members with MS, as well as insights that support expert clinical opinion in the DMT therapeutic category.

1. Claims data may be a useful source to help plans understand the patterns and progression of MS and its impairments, as well as to provide insights about related non-DMT resource utilization and costs. This implication is supported by the following relevant findings from this research⁹:
 - Disease burden in MS may be assessed through various markers of disease progression, functional impairment, and neurologic impairment
 - Patient drug transitioning can be identified
 - The MS population includes patients with diverse resource utilization as exhibited by considerable variations in allowable costs

2. There is an opportunity to increase early diagnosis and treatment of MS. The MS Coalition recommends early and ongoing DMT treatment as soon as possible after diagnosis.⁵ Yet, about 1 in 4 patients with MS did not receive DMT treatment in 2015. Furthermore, nearly 30% of newly diagnosed patients with MS remained untreated after diagnosis for 2 years after diagnosis.⁹
3. Due to the heterogeneity of patients with MS, access to a broad range of DMT options is important.⁵ In this analysis, 28.5% of newly-diagnosed patients with MS switched DMTs during a calendar year, while 1 in 5 (20%) patients with established MS on DMT therapy switched during a calendar year.⁹

**For the complete
Milliman report
*Multiple Sclerosis:
New Perspectives on the Patient
Journey—2019 Update,*
contact your
Biogen representative
or download it from the
Milliman website.**

References: **1.** Giovannoni G, Butzkueven H, Dhib-Jalbut S, et al. *Brain Health: Time Matters in Multiple Sclerosis*. <http://www.emsp.org/wp-content/uploads/2015/10/time-matters-in-ms-report-oct15.pdf>. Published October 2015. Accessed July 10, 2019. **2.** Wallin MT, Culpepper WJ, Campbell JD, et al; on behalf of the US Multiple Sclerosis Prevalence Workgroup. The prevalence of MS in the United States: a population-based estimate using health claims data. *Neurology*. 2019;92(10):e1029-e1040. **3.** Culpepper WJ, Marrie RA, Langer-Gould A, et al; on behalf of the United States Multiple Sclerosis Prevalence Workgroup (MSPWG). Validation of an algorithm for identifying MS cases in administrative health claims datasets. *Neurology*. 2019;92(10):e1016-e1028. **4.** Segal BM. Multiple sclerosis. In: Rich RR, Fleisher TA, Shearer WT, Schroeder, Frew AJ, Weyand CM, eds. *Clinical Immunology: Principles and Practice*. 5th ed. Amsterdam: Elsevier; 2019:891-902. **5.** Multiple Sclerosis Coalition. *The Use of Disease-Modifying Therapies in Multiple Sclerosis: Principles and Current Evidence*. http://www.nationalmssociety.org/getmedia/5ca284d3-fc7c-4ba5-b005-ab537d495c3c/DMT_Consensus_MS_Coalition_color. Updated June 2019. Accessed July 10, 2019. **6.** Multiple sclerosis FAQs. National Multiple Sclerosis Society website. <http://www.nationalmssociety.org/What-is-MS/MS-FAQ-s>. Accessed July 10, 2019. **7.** Hersh CM, Fox RJ. Multiple sclerosis. http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/neurology/multiple_sclerosis/. Published April 2018. Accessed July 10, 2019. **8.** Types of MS. National Multiple Sclerosis Society website. <http://www.nationalmssociety.org/What-is-MS/Types-of-MS>. Accessed July 10, 2019. **9.** Pyenson B, Tomicki S. *Multiple Sclerosis: New Perspectives on the Patient Journey—2019 Update*. New York, NY: Milliman, Inc; 2019. **10.** Kurtzke JF. Rating neurologic impairment in multiple sclerosis: an expanded disability status scale (EDSS). *Neurology*. 1983;33(11):1444-1452.