



**Beyond Clinical Efficacy: A Stage-Specific Comparative Framework for Evaluating
Multiple Sclerosis Therapies**
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Abstract

Multiple sclerosis (MS) is a chronic autoimmune disease of the central nervous system characterized by inflammatory demyelination and progressive neurodegeneration. Because disease mechanisms evolve from early inflammatory activity to later irreversible neuronal loss, therapeutic effectiveness varies substantially across disease stages.

This review comparatively evaluated major therapeutic strategies used in clinically isolated syndrome (CIS) and primary progressive multiple sclerosis (PPMS), examining their mechanisms of action, clinical efficacy, treatment burden, and accessibility. In addition to conventional literature synthesis, treatments were evaluated using a novel Stage-Specific Ideal Treatment Proximity Score (SITPS), an exploratory composite metric integrating efficacy, evidence status, cost accessibility, administration frequency, and route of administration through disease-specific weighting to estimate each therapy's proximity to an ideal treatment profile.

Immune-targeting therapies demonstrated the greatest benefit during early disease. Interferon β -1b and glatiramer acetate reduced progression from CIS to clinically definite MS by approximately 50% and 45%, respectively, whereas ocrelizumab slowed disability progression in PPMS by approximately 24%. Potassium-channel blockade improved neurological function but did not modify disease progression. SITPS analysis further demonstrated that highly effective therapies were often associated with greater treatment burden, while lower-burden interventions generally provided less disease modification. Overall SITPS values were consistently lower for PPMS therapies than for CIS therapies, reflecting the persistent therapeutic gap in progressive disease.

These findings support a stage-specific, patient-centered approach to MS management in which treatment selection considers not only biological efficacy but also accessibility, administration burden, and quality of life. The SITPS framework provides an exploratory method for integrating these factors into comparative therapeutic evaluation and may inform future patient-centered decision-making and refinement of treatment assessment models.

Keywords: multiple sclerosis, patient burden, treatment, clinically isolated syndrome, primary progressive multiple sclerosis

Introduction

Multiple Sclerosis (MS) is a chronic autoimmune disease of the central nervous system (CNS), affecting the brain, spinal cord, and optic nerves. It is characterized by multifocal inflammation, demyelination of nerve fibers, and progressive neurodegeneration. MS typically emerges in young adulthood (ages 20-40) and is approximately two or three times more prevalent in women than in men. Despite major advances in disease-modifying techniques and therapies, it remains incurable with highly variable disease progression and response to treatment among individuals with MS (Compston & Coles, 2008; Reich et al., 2018).

At the core of MS is damage to the myelin sheath, a lipid insulating layer produced by oligodendrocytes that surrounds axons in the CNS. Myelin is important for efficient neural communication and enables saltatory conduction, where electric impulses propagate between nodes of Ranvier, the points uncovered by the myelin, which increases conduction speed and reduces metabolic cost. In addition, myelin provides metabolic and structural support to axons, helping maintain long-term neuronal integrity. When it is compromised, conduction becomes slowed, distorted, or blocked (Nave & Werner, 2014; Franklin & French-Constant, 2017).

In MS, the immune system erroneously identifies myelin proteins as foreign antigens and mounts an autoimmune attack against them. This is driven by T lymphocytes, particularly CD4+T helper cells of the Th1 and Th17 subsets. After activation, these cells migrate toward the CNS and cross the blood-brain barrier (BBB), a specialised endothelial interface that normally restricts immune entry into neural tissue. Pro-inflammatory cytokines and adhesion molecules expressed by T cells disrupt BBB integrity, enabling immune infiltration into the CNS (Dendrou et al., 2015; Reich et al., 2018).

Once immune cells penetrate the CNS, they initiate a sustained inflammatory response in which activated T cells secrete cytokines that allow additional immune cells like macrophages and microglia to phagocytose myelin debris and generate reactive oxygen species. B cells further contribute by producing antibodies against myelin proteins and forming inflammatory aggregates in the meninges. Cytotoxic CD8+T cells directly damage oligodendrocytes and neurons, resulting in focal demyelinating lesions, or plaques, distributed throughout the brain and spinal cord (Dendrou et al., 2015; Lassmann, 2018).

The loss of myelin has direct functional consequences for neuronal signals. It exposes voltage-gated potassium channels along the axon, allowing excessive potassium efflux that impairs depolarization and disrupts action potential propagation along the axon. As a result, neural signals slow or fail. Clinical symptoms produced include muscle weakness, sensory disturbances, impaired coordination, fatigue, and visual degeneration such as optic neuritis. Because lesions arise in diverse CNS regions, symptoms vary widely across patients. Importantly, demyelination also increases axonal vulnerability, accelerating neurodegeneration and contributing to irreversible damage to the brain (Judge & Bever, 2006; Nave & Werner, 2014).

Clinically, MS exists along a spectrum of disease stages. Clinically isolated syndrome (CIS) is the earliest manifestation, defined by a single demyelination event that may resolve or continue

progression into definitive MS. Primary Progressive MS (PPMS) is characterized by continuous neurological decline from onset, with fewer acute inflammatory episodes and more chronic axonal loss, mitochondria dysfunction, and neurodegeneration. While CIS is dominated by immune-mediated demyelination, PPMS is a disease state in which damage becomes compartmentalized within the CNS and less responsive to anti-inflammatory therapies (Lublin et al., 2014; Thompson et al., 2018).

Current MS therapies reflect the different mechanisms and characteristics of the disease. Early-stage treatments aim to suppress immune activation and limit infiltration of the BBB, reducing lesion formation and delaying progression of the disease. Later-stage and symptomatic treatments focus on preserving neuronal function, preventing demyelination, and enhancing conduction. Although these approaches target biological mechanisms, they are often evaluated independently rather than comparatively across stages of the disease (Hauser & Cree, 2020; Reich et al., 2018).

Despite extensive clinical trial data for individual therapies and medications, direct comparisons across mechanistically distinct treatment classes, particularly the transition between CIS and PPMS, remain limited. The relationship between stage-specific pathology and treatment efficacy is not fully understood. This study aims to conduct a comparative analysis of MS medications and treatments across CIS and PPMS and seeks to clarify how treatment efficacy varies across disease stages and inform more cohesive approaches to MS management that maximizes quality of life for the patient.

Pathophysiology of Multiple Sclerosis

Immune Dysregulation

MS is fundamentally an immune-mediated disease. Autoreactive CD4⁺ T helper cells recognize myelin-associated proteins as foreign antigens and cause inflammatory response within the CNS. Th1 cells produce interferon- γ and other pro-inflammatory mediators, while Th17 cells secrete interleukin-17, a cytokine strongly implicated in BBB disruptions and immune-cell recruitment. B cells contribute to disease progression through antibody production, antigen presentation, and formation of inflammatory follicle-like structures within the meninges. Oligoclonal immunoglobulin bands found in cerebrospinal fluid provide evidence of chronic B-cell activation. CD8⁺ cytotoxic T cells directly attack oligodendrocytes and neurons, further amplifying tissue injury. Microglia and macrophages remove damaged myelin but simultaneously release reactive oxygen species and inflammatory mediators that contribute to neurodegeneration (Dendrou et al., 2015; Lassmann, 2018).

Blood-Brain Barrier Disruption

The blood-brain barrier normally prevents immune-cell infiltration into neural tissue. During MS, activated T cells upregulate adhesion molecules that allow attachment to vascular endothelium.

These cells release cytokines and proteolytic enzymes that weaken tight junctions within the BBB, enabling immune-cell migration into the CNS. BBB disruption represents one of the earliest pathological events in lesion formation and is a major target of disease-modifying therapies (Dendrou et al., 2015).

Demyelination and Potassium Channel Dysfunction

Demyelination exposes voltage-gated potassium channels distributed along the axonal membrane. Under normal conditions, these channels are largely insulated by myelin. Their exposure allows excessive potassium efflux, reducing depolarization efficiency and impairing action-potential propagation. This phenomenon contributes directly to neurological symptoms and provides the mechanistic basis for potassium-channel blockers such as dalfampridine, which improve signal conduction in partially demyelinated neurons (Judge & Bever, 2006; Nave & Werner, 2014).

Clinical Progression of Disease

Clinically Isolated Syndrome (CIS)

CIS represents the earliest recognizable manifestation of MS. Patients experience a single episode of neurological dysfunction, commonly optic neuritis, sensory disturbances, or muscle weakness. Pathology is dominated by initial immune activation, BBB disruption, and early lesion formation (Lublin et al., 2014; Thompson et al., 2018).

Relapsing-Remitting Multiple Sclerosis (RRMS)

Approximately 85–90% of patients initially develop RRMS. This stage is characterized by acute relapses followed by periods of partial or complete recovery. Active inflammation, cytokine production, antibody-mediated injury, and recurrent demyelination dominate disease activity (Compston & Coles, 2008; Hauser & Cree, 2020).

Secondary Progressive Multiple Sclerosis (SPMS)

Over time, many RRMS patients transition into SPMS. Relapses become less prominent, while chronic inflammation, axonal degeneration, cortical atrophy, and failure of remyelination drive progressive disability (Lublin et al., 2014; Lassmann, 2018).

Primary Progressive Multiple Sclerosis (PPMS)

PPMS affects approximately 10–15% of patients and is characterized by continuous neurological decline from disease onset. Unlike RRMS, PPMS demonstrates less overt inflammation and greater neurodegeneration, mitochondrial dysfunction, and irreversible tissue

loss. Treatment options are considerably more limited (Montalban et al., 2017; Lublin et al., 2014).

Comparative Analysis of Therapeutic Classes

Immunomodulatory Therapies

Interferon- β and glatiramer acetate are among the earliest disease-modifying therapies. Both reduce inflammatory activity and decrease relapse frequency through modulation of T-cell responses and cytokine signaling. These therapies are particularly effective during CIS and RRMS, where inflammation remains the dominant pathological process (Kappos et al., 2006, 2009; Comi et al., 2009).

Monoclonal Antibody Therapies

Monoclonal antibodies target specific immune-cell populations or migration pathways. Ocrelizumab selectively depletes CD20-positive B cells and has demonstrated efficacy in both RRMS and PPMS (Montalban et al., 2017). Natalizumab blocks α 4-integrin-mediated migration of immune cells across the BBB, substantially reducing lesion formation and relapse frequency (Polman et al., 2006). These therapies generally demonstrate greater efficacy than traditional immunomodulators but may be associated with increased treatment burden and safety concerns.

Conduction-Enhancing Therapy

Dalfampridine represents a unique therapeutic approach that targets symptom generation rather than immune pathology. By blocking exposed potassium channels on demyelinated axons, dalfampridine improves action-potential conduction and enhances motor function (Judge & Bever, 2006). Unlike disease-modifying therapies, however, dalfampridine does not reduce inflammation, prevent lesion formation, or slow disease progression.

Lifestyle and Supportive Interventions

Lifestyle interventions serve as important adjunctive therapies across all disease stages. Vitamin D supplementation may reduce Th17-mediated inflammation and support immune regulation (Thouvenot et al., 2025). Exercise promotes neuroplasticity, increases neurotrophic-factor production, and improves fatigue, mobility, and quality of life (Motl & Pilutti, 2024).

Therapies Under Development

Emerging therapeutic strategies aim to address limitations of existing treatments, particularly in progressive disease. Bruton's tyrosine kinase (BTK) inhibitors target B cells and microglia while potentially penetrating the BBB (Zanetta et al., 2026). Stem-cell therapies seek to reset immune

responses and promote tissue repair (Aljagthmi & Abdel-Aziz, 2025). Remyelination agents stimulate oligodendrocyte precursor cells to generate new myelin and restore neural function (Franklin & ffrench-Constant, 2017). These approaches may prove particularly important in SPMS and PPMS, where neurodegeneration becomes increasingly prevalent.

Methods

Literature Search Strategy

This review was conducted as a structured narrative review examining stage-specific therapeutic strategies in multiple sclerosis (MS). Literature was collected from peer-reviewed clinical trials, review articles, publicly available datasets, and translational animal studies investigating immune modulation, symptomatic management, and neuroprotective interventions across clinically isolated syndrome (CIS), relapsing-remitting multiple sclerosis (RRMS), secondary progressive multiple sclerosis (SPMS), and primary progressive multiple sclerosis (PPMS).

Particular emphasis was put on therapies targeting distinct mechanistic classes, including immunomodulators, monoclonal antibodies, conduction-enhancing agents, lifestyle interventions, and emerging regenerative therapies. Studies were selected if they reported clinical outcomes, biomarkers of disease activity, showed progression, relapse rates, or mechanistic findings relevant to CNS inflammation, BBB disruption, demyelination, or neurodegeneration.

To facilitate comparisons between disease stages, treatments were categorized according to their primary mechanism of action and analyzed with respect to four major outcome domains: (1) suppression of inflammatory disease activity, (2) reduction of progression to clinical definite multiple sclerosis, (3) mitigation of disability progression, and (4) improvement of patient quality of life and symptom burden.

Evidence from experimental autoimmune encephalomyelitis (EAE) models was incorporated when relevant to understanding cellular mechanisms that cannot be directly measured in human patients. These studies were primarily used to evaluate immunological pathways involving T-cell activation, cytokine signalling, and blood-brain barrier dysfunction.

The objective of this review was not to determine a single superior treatment but rather to compare therapeutic effectiveness changes as pathology changes from inflammatory demyelination toward progressive neurodegeneration (Thompson et al., 2018; Hauser & Cree, 2020).

Development of the Stage-Specific Ideal Treatment Proximity Score (SITPS)

To facilitate comparison among therapies with differing mechanisms of action, clinical effectiveness, and treatment burden, an exploratory composite index termed the Stage-Specific

Ideal Treatment Proximity Score (SITPS) was developed. The purpose of this index was to provide a standardized framework for comparing how closely each therapy approached a hypothetical ideal treatment for its respective stage of multiple sclerosis. The SITPS was designed solely for comparative analysis within this review and should not be interpreted as a validated clinical decision-making tool.

The ideal treatment was defined as an intervention demonstrating maximal clinical efficacy, regulatory approval, minimal financial burden, the lowest administration frequency, and the least burdensome route of administration. Five variables were incorporated into the model: (1) clinical efficacy, (2) evidence status, (3) cost accessibility, (4) administration convenience, and (5) route convenience. Each variable was normalized to a scale ranging from 0 to 1, where 1 represented the most favorable value and 0 represented the least favorable value among the therapies included in this analysis.

Clinical efficacy was calculated by converting the reported relative efficacy percentage for each treatment into decimal form:

where p_i represents the reported percentage reduction in the primary clinical outcome for treatment i . Hazard ratios were not included as an independent variable because relative efficacy values were derived directly from hazard ratios when applicable, and inclusion of both measures would have duplicated the same clinical information.

Evidence status was converted into an ordinal score reflecting the strength of clinical validation. Therapies approved for clinical use were assigned a value of 1.0, whereas investigational therapies were assigned a value of 0.5.

Because annual treatment costs and administration frequencies varied by several orders of magnitude across therapies, logarithmic normalization was applied to reduce the influence of highly skewed distributions while preserving the relative ranking of treatments. Cost accessibility and administration convenience were calculated as

$$C_i = 1 - \frac{\ln(1+c_i)}{\ln(1+c_{max})}$$

and

$$F_i = 1 - \frac{\ln(1+f_i)}{\ln(1+f_{max})}$$

where c_i and f_i represent the annual treatment cost and annual administration frequency for treatment i , respectively, and c_{max} and f_{max} represent the highest observed values among all therapies included in the analysis. Under this normalization, a value of 1 represents the lowest treatment cost or administration burden, whereas a value of 0 represents the greatest burden observed within the study dataset.

Route of administration was similarly converted into an ordinal convenience score based on the relative logistical burden associated with each delivery method. Oral therapies were assigned a value of 1.0, subcutaneous injections a value of 0.5, and intravenous infusions a value of 0. These values reflect the relative convenience of administration among the treatment modalities included in this review rather than absolute measures of patient preference or treatment quality.

Because therapeutic priorities differ between disease stages, separate weighting schemes were developed for clinically isolated syndrome (CIS) and primary progressive multiple sclerosis (PPMS). For CIS, preventing disease progression through early immune modulation was considered the primary therapeutic objective; therefore, efficacy received a weight of 0.50, evidence status 0.20, and cost accessibility, administration convenience, and route convenience each received weights of 0.10. For PPMS, where long-term symptom management and sustained treatment adherence become increasingly important because of limited disease-modifying options, efficacy received a weight of 0.40, evidence status 0.20, cost accessibility 0.15, administration convenience 0.15, and route convenience 0.10.

The final Stage-Specific Ideal Treatment Proximity Score was calculated as the weighted sum of the normalized variables and reported on a scale from 0 to 100, with higher values indicating greater proximity to the theoretical ideal treatment for the corresponding disease stage:

where w represents the stage-specific weighting coefficients and E , V , C , F , and R denote the normalized efficacy, evidence, cost accessibility, administration convenience, and route convenience scores, respectively.

The SITPS is intended as a hypothesis-generating, patient-centered comparative framework that integrates both clinical effectiveness and practical treatment burden. Because the weighting scheme and normalization procedures were developed specifically for this review, future studies should evaluate the robustness of the index using alternative weighting strategies and patient-derived preference measures.

Results

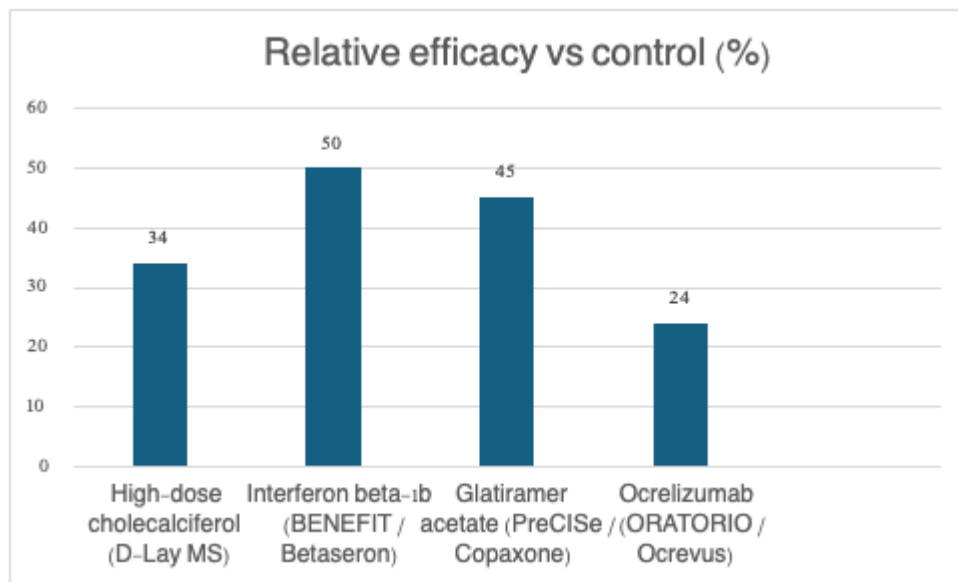


Figure 1. Relative efficacy of evaluated therapies. Relative reduction in disease progression or conversion to clinically definite multiple sclerosis reported in the primary clinical trial for each treatment. CIS therapies and PPMS therapies are shown together for comparison of disease-stage responsiveness.

Relative treatment efficacy differed substantially between therapies and disease stages (Figure 1). Among CIS interventions, interferon β -1b demonstrated the greatest reduction in progression to clinically definite multiple sclerosis (50%), followed by glatiramer acetate (45%) and high-dose vitamin D supplementation (34%). In contrast, the only approved therapy evaluated for PPMS, ocrelizumab, reduced confirmed disability progression by 24%, indicating considerably lower therapeutic responsiveness in progressive disease.

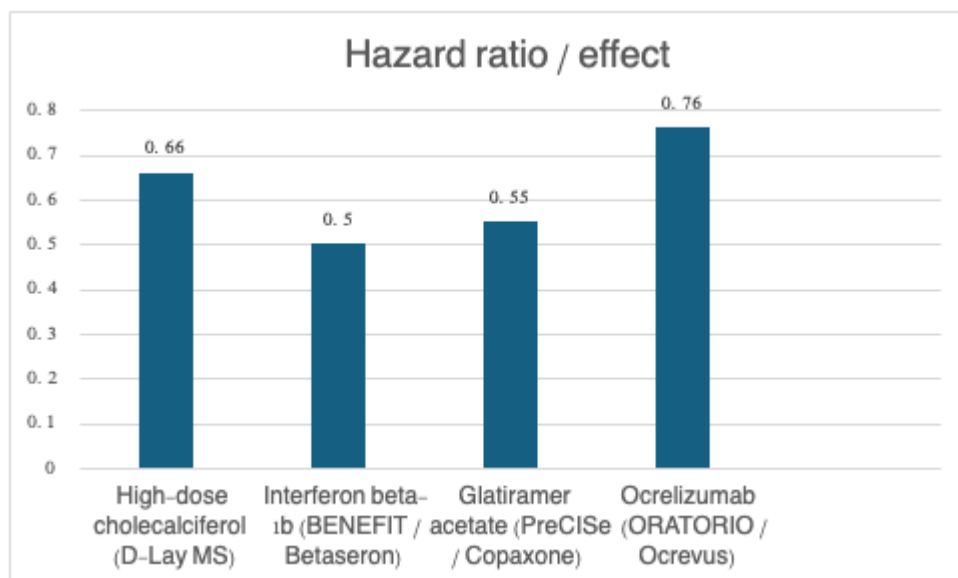


Figure 2. Hazard ratio/effect estimates. Hazard ratios or equivalent effect estimates reported in the principal clinical trials used for comparison. Lower hazard ratios indicate greater reductions in disease progression.

Hazard ratio estimates reflected the same trend observed for relative efficacy (Figure 2). Ocrelizumab demonstrated the lowest hazard ratio (0.76), consistent with a modest reduction in disability progression in PPMS. Interferon β -1b (0.50) and glatiramer acetate (0.55) produced larger effects in CIS, whereas vitamin D supplementation demonstrated an intermediate effect estimate (0.66).

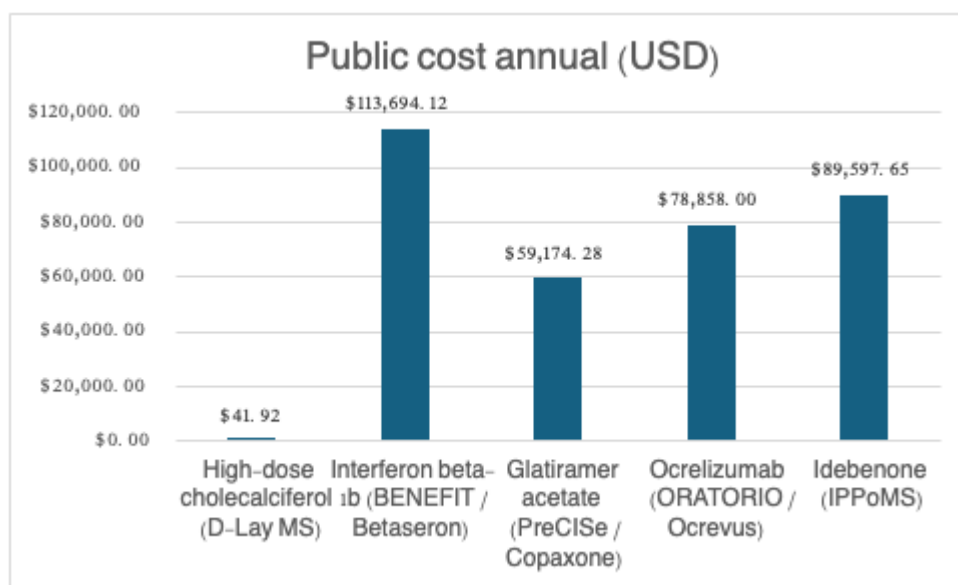


Figure 3A. Estimated annual treatment cost.

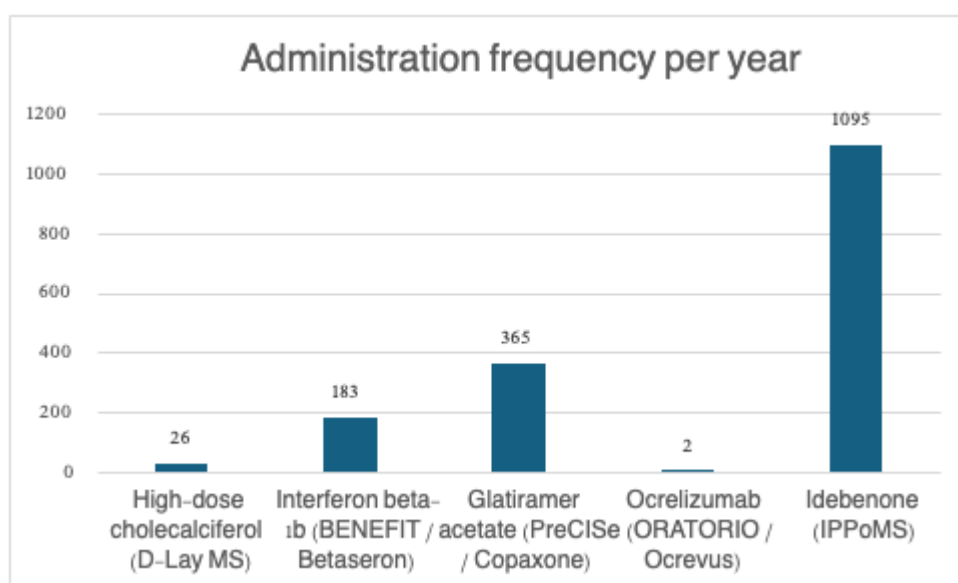


Figure 3B. Administration frequency.

Treatment burden varied markedly between therapies. Vitamin D supplementation represented the least expensive intervention, with an estimated annual public cost of approximately \$42, whereas interferon β -1b exceeded \$113,000 annually. Ocrelizumab and glatiramer acetate also required substantial annual expenditures.

Administration frequency also differed considerably. Ocrelizumab required only two administrations annually, whereas idebenone required approximately 1,095 oral doses per year. Interferon β -1b and glatiramer acetate required intermediate administration frequencies of 183 and 365 administrations per year, respectively.

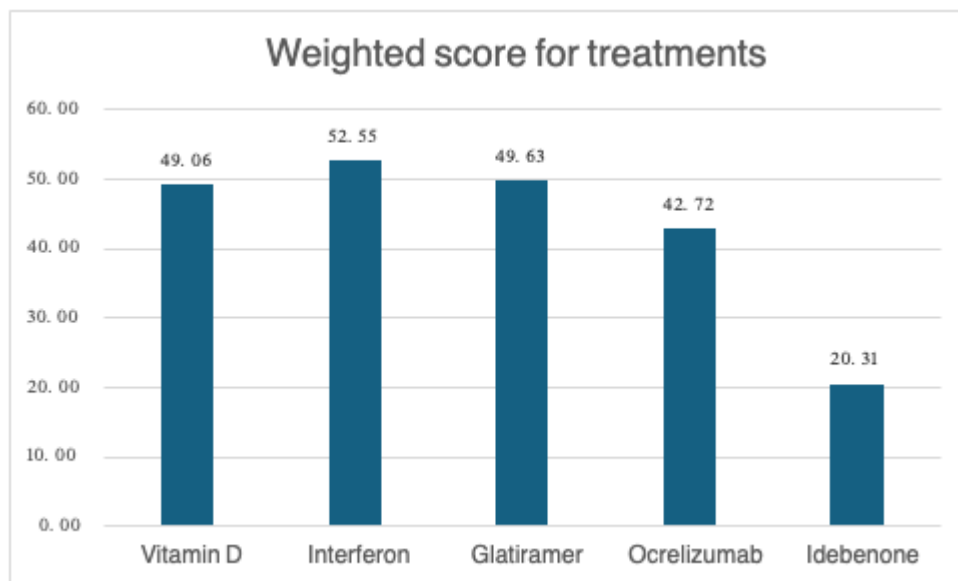


Figure 4. Stage-Specific Ideal Treatment Proximity Score (SITPS).

Integration of efficacy, evidence status, treatment accessibility, administration frequency, and route of administration into the Stage-Specific Ideal Treatment Proximity Score demonstrated differences in overall treatment practicality (Figure 4). Interferon β -1b achieved the highest composite score (52.55), followed closely by glatiramer acetate (49.63) and vitamin D supplementation (49.06). Ocrelizumab achieved a moderate score (42.72), whereas idebenone ranked lowest (20.31), primarily because of limited demonstrated efficacy despite its convenient oral route.

Discussion

The findings of this review highlight the importance of aligning treatment selection with stage-specific pathology. Early disease stages are primarily driven by immune dysfunction, making immune-targeting therapies highly effective. As disease progresses, neurodegeneration

and irreversible tissue loss become increasingly prominent, reducing responsiveness to traditional anti-inflammatory approaches (Hauser & Cree, 2020; Reich et al., 2018).

This shift explains why CIS and RRMS possess numerous effective disease-modifying therapies, whereas PPMS remains comparatively difficult to treat (Montalban et al., 2017; Lassmann, 2018). It also demonstrates why symptomatic treatments such as potassium-channel blockers remain clinically valuable despite lacking disease-modifying effects (Judge & Bever, 2006).

Importantly, treatment decisions should not be based solely on biological efficacy. Frequency of administration, cost, adverse effects, accessibility, and impact on daily life substantially influence patient adherence and quality of life. Therapies that provide moderate efficacy with low treatment burden may be preferable to highly effective interventions that significantly disrupt patients' daily lives.

Future treatment paradigms will likely involve combinations of immune modulation, neuroprotection, remyelination, and personalized medicine guided by biomarkers and disease-stage assessment.

Future Directions

The findings of this review suggest that the future of multiple sclerosis management extends beyond the development of increasingly potent immunotherapies. While advances in this area remain essential, it is equally important across all stages to improve how treatment decisions are communicated, personalized, and implemented throughout the course of disease progression. As demonstrated by the progression from clinically isolated syndrome (CIS) to primary progressive multiple sclerosis (PPMS), the biological mechanisms driving disease evolve continuously. However, clinical management often focuses primarily on pharmacological intervention rather than helping patients understand these changes and actively participate in state-specific treatment decisions due to anxiety and misunderstandings about their disease.

The patient and prescriber treatment pathways developed throughout this review illustrate that the priorities of clinicians and patients frequently differ. Healthcare providers typically organize treatment around measurable clinical outcomes, including MRI lesion burden, disability progression, relapse frequency, and inflammatory biomarkers. In contrast, patients often experience MS through symptoms that directly affect daily life such as fatigue, impaired mobility, cognitive dysfunction, uncertainty regarding future disability, and the practical burden of long-term therapy administration. Bridging this gap in perspective would make MS care more comprehensive and people-centered. Rather than viewing patients as passive recipients of treatment, future care models should emphasize shared decision-making in which both clinical evidence and patient priorities contribute to individualized treatment selection.

Furthermore, bridging this gap would decrease anxiety, something that all patients struggle with considering their condition. Patients diagnosed with CIS frequently experience considerable anxiety regarding the possibility of developing clinically definite multiple sclerosis, while

individuals with progressive disease often face uncertainty surrounding treatment effectiveness and long-term disability. Educational tools that clearly explain disease mechanisms, expected progression, treatment goals, and realistic therapeutic outcomes may improve patient understanding while fostering confidence in long-term management plans. Greater transparency regarding why specific therapies are recommended at different stages may encourage patients to become more engaged participants in their own care.

Another important direction involves reducing barriers to treatment adherence. Disease-modifying therapies vary substantially in administration frequency, route of delivery, adverse-effect profiles, financial cost, and accessibility. These practical differences influence adherence independently of biological efficacy. A treatment capable of substantially reducing relapse risk provides limited benefit if financial barriers, complex dosing schedules, or intolerable adverse effects prevent patients from maintaining therapy. Future treatment strategies should therefore evaluate not only clinical effectiveness but also treatment burden, accessibility, and patient preference. Integrating these factors into therapeutic decision-making may improve long-term adherence and increase the likelihood that patients receive sustained disease-modifying benefits.

The emergence of precision medicine further offers the potential to combine biological and patient-centered approaches into a unified framework. Biomarkers such as magnetic resonance imaging activity, cerebrospinal fluid inflammatory markers, cytokine profiles, and genetic risk factors may help identify the therapies most likely to benefit individual patients before irreversible neurological damage occurs. At the same time, patient-reported outcomes—including fatigue, mobility, cognition, mental well-being, treatment burden, and quality of life—should become routine measures alongside traditional clinical endpoints. Such integration would allow treatment plans to evolve dynamically as both disease biology and patient priorities change over time.

Beyond its application as a comparative framework within this review, the Stage-Specific Ideal Treatment Proximity Score (SITPS) may serve as the foundation for future patient-centered decision-support tools. Although treatment selection should always remain individualized and guided by clinical expertise, a transparent scoring framework has the potential to make complex treatment information more accessible to patients who are navigating a new diagnosis or considering changes to their therapeutic regimen.

Currently, discussions between healthcare providers and patients often emphasize clinical endpoints such as relapse rates, MRI lesion burden, or disability progression, while patients may be equally concerned with practical factors including treatment cost, frequency of administration, accessibility, and the impact of therapy on daily life. By integrating these considerations into a single comparative framework, the SITPS provides a structured method for illustrating the trade-offs that exist between clinical efficacy and treatment burden. Rather than identifying a universally "best" therapy, the score highlights how different treatments align with different therapeutic priorities across disease stages.

In the future, an expanded version of this framework could be incorporated into patient education materials or interactive decision-support platforms that allow individuals to better



understand why certain therapies are recommended during specific stages of multiple sclerosis. Such tools may help reduce uncertainty following diagnosis, encourage more informed discussions between patients and providers, and promote shared decision-making throughout the course of disease management. Increased patient understanding of treatment options may also improve long-term adherence by aligning therapeutic decisions with both clinical evidence and individual preferences, ultimately contributing to more personalized and patient-centered multiple sclerosis care.

Conclusion

This study demonstrates that the effectiveness, availability, and practicality burden of multiple sclerosis (MS) treatments vary significantly across stages of the disease. In clinically isolated syndrome (CIS), where disease activity is primarily driven by immune-mediated inflammation, a wide range of therapies are available and show relatively high efficacy in reducing progression through immunomodulatory means. In contrast, primary progressive multiple sclerosis (PPMS) is characterized by neurodegeneration and compartmentalized inflammation within the central nervous system, resulting in less effective and diverse treatment options and therapeutic responsiveness. Therapeutic responsiveness to these treatment options as a result of these differences project onto overall patient burden and administration strategies of therapies.

The comparative analysis highlights that treatment decisions cannot be guided solely by data-driven efficacy. Frequency, dosage, and cost of administration impact patient adherence and long term quality of life. Effective therapies such as monoclonal antibodies require intensive patient-side effort, while lower-burden intervention such as lifestyle changes and symptomatic treatments offer greater convenience but limited disease-modifying effects. Patients' prescriptions and administrations of therapies change as MS progresses, yet managing lifestyles around changing schedules is often difficult on a day-to-day basis.

These findings support a stage-specific and patient-centered approach to MS management. For patients in early disease stages such as CIS, early initiation of high-efficacy, immune-targeting therapies is recommended when appropriate, as these interventions provide the best chances at altering disease trajectory. However, even at this stage, treatment selection should account for individual tolerance for treatment burden, including dosing frequency, side effects, and lifestyle compatibility to the maximum degree without compromising efficacy. As progression continues, patients transition from treatments aimed at preventing new damage to those focused on managing existing symptoms and preserving function, making quality of life exceedingly central to plans for care.

For prescribers of care, this analysis underscores the importance of balancing efficacy with feasibility for the recipients of care. Plans should be individualized and incorporate not only disease activity and mechanism of action but also preferences, access to care, financial considerations, and trade-offs and burdens of therapy. This empowers patients to make more informed decisions and promotes adherence to treatment plans.



Ultimately, MS treatments and management requires moving beyond a one-dimensional focus on efficacy, toward a more integrated framework that considers changing situations and nuances of the patient's quality of life. This approach has the potential to improve both clinical outcomes and patient well-being.

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