EE663

Health Economic Impact of Software-Assisted Brain MRI on Treatment Decisions and Outcomes in Relapsing-Remitting Multiple Sclerosis: A Microsimulation Study

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BACKGROUND

- Multiple sclerosis (MS) affects ~1 million people in the US, and ~85% present with relapsing-remitting MS (RRMS)[1]
- Timely escalation to high-efficacy disease-modifying therapy (DMT) slows disability progression, however, both clinical evaluation alone and unassisted (visual-only) magnetic resonance imaging (MRI) reads can miss subclinical disease activity,[2] resulting in patients remaining on ineffective therapy for too long
- MRI lesions (inflammation) and brain volume loss (neurodegeneration) signal silent disease activity that accelerates disability;[2] software-assisted reads such as icobrain ms quantify these markers **automatically and objectively**, supporting better recognition of disease progression and more timely treatment modifications
- A 2021 microsimulation model developed previously showed software-assisted MRI strategies were dominant to standard approaches over 10 and 15 years (higher quality-adjusted life years [QALYs], lower costs)[2]
- As the treatment landscape in RRMS has evolved considerably since that time, new evidence on health-state utilities, DMT efficacy, and costs have become available

OBJECTIVE

The objective of this study was to update the published microsimulation model[2] with current utility, cost, and efficacy evidence, and reassess the value of software-assisted MRI for RRMS treatment decisions over 10 and 15 years in the context of this evolved treatment landscape.

METHODS

Model Structure

- Microsimulation of 1,000 RRMS patients entering at EDSS 0-3 (25% each), 1-year cycles, undiscounted, US perspective
- Simulates clinical (EDSS transitions, relapses) and subclinical (new lesions, brain volume loss) disease activity with strategy-specific measurement error
- All patients start on low-efficacy DMT and are assessed annually, escalating to high-efficacy DMT at the next cycle if disease activity is detected

Updated Literature

- Inflate all costs to 2026 US dollars using the Consumer Price Index (CPI) for Medical Care[3]
- Update Expanded Disability Status Scale (EDSS) utilities and relapse disutility[4,5]
- Incorporate DMT efficacy from a new network meta-analysis (NMA),[6] applying hazard ratios (HR) in place of relative risks (RR)

Table 1: Model Input Updates

Input(s)	2026 Update
EDSS utilities	EDSS (0-8): 0.906 to 0.160[4]
	EDSS (9): -0.230[4,7]
Utility per relapse	-0.101[5]
Health state costs	Inflated to 2026 USD (CPI)[3]
Disability progression (Low efficacy DMT)	Hazard Ratio†: 0.50 to 1.29[6]
Disability progression (High efficacy DMT)	Hazard Ratio†: 0.24 to 0.89[6]
Annualized relapse rate (Low efficacy)	Rate Ratio: 0.48 to 0.99[6]
Annualized relapse rate (High efficacy)	Rate Ratio: 0.21 to 0.45[6]

†New NMA reports hazard ratios; model equation updated accordingly to correctly apply HRs to transition probabilities.

RESULTS

- All MRI strategies were dominant vs. clinical assessment without MRI at 10 and 15 years, with software-assisted MRI under NEDA-3 or NEDA-4 dominant to unassisted MRI read alone (**Table 2**)
- Software-assisted NEDA-4 assessment gave the largest benefit versus clinical assessment alone, providing an additional **0.18 QALYs and $1,994 saved per year (10-yr), and +0.23 QALYs and $1,917 saved per year (15-yr)**

Table 2: Base-Case Results per Patient (2026 USD)

Strategy	Annual Cost	QALYs	Δ Cost/yr	Δ QALYs	Result
10-year					
Clinical assessment without MRI	$38,261	7.55	Ref	Ref	Ref
NEDA-3 visual	$37,459	7.61	-$802	+0.06	Dominant
NEDA-3 software	$36,684	7.71	-$1,577	+0.16	Dominant
NEDA-4 software	$36,267	7.73	-$1,994	+0.18	Dominant
15-year					
Clinical assessment without MRI	$39,746	11.03	Ref	Ref	Ref
NEDA-3 visual	$39,033	11.11	-$713	+0.08	Dominant
NEDA-3 software	$38,305	11.25	-$1,441	+0.22	Dominant
NEDA-4 software	$37,829	11.26	-$1,917	+0.23	Dominant

NEDA = No evidence of disease activity
Note: Annual health state costs include direct and indirect (productivity) EDSS state and relapse costs; DMT, MRI (including software-assisted reading), and adverse event costs are excluded.

Undetected Disease Progression

- Software-assisted MRI **reduced time in undetected disease activity by 1.9 years** versus clinical assessment only (**Table 3**)

Table 3: Time With Undetected Disease Progression on Low-Efficacy DMT

Strategy	Years (mean ± SD)
Clinical assessment without MRI	2.9 ± 2.6
NEDA-3 visual	2.0 ± 1.6
NEDA-3 software	1.3 ± 0.8
NEDA-4 software	**1.0 ± 0.2**

Dominance Robust to Updated Treatment Landscape

- Updated inputs showed high-efficacy DMTs are more effective than DMTs used in the original model,[2] and EDSS utilities were higher across most disability states (EDSS 0-3 gap narrowed from 0.36 to 0.09)[4,7], so all strategies gained QALYs; this reflects new utility evidence, not a change in MRI or software performance
- Despite these changes, software-assisted MRI remained dominant at both horizons, as faster detection and earlier escalation slowed disease progression and generated annual cost savings

DISCUSSION AND CONCLUSIONS

- Software-assisted MRI remained **dominant at 10 and 15 years** after updating utilities, costs, and DMT efficacy, confirming it **remains a valuable tool for supporting clinicians and improving patient care**
- Software-assisted MRI substantially **outperforms** clinical assessment with a **meaningful detection advantage of almost 2 years** (1.0 vs. 2.9 years of undetected disease activity)
- Software-assisted reads **slowed disease progression and reduced costs**, driven by earlier escalation to high-efficacy DMT: **80% of NEDA-4 patients were on high-efficacy DMT after year 1**, vs. 31% with clinical assessment alone
- **Limitations**: As in the original analysis,[2] costs associated with DMT therapy, annual MRI tests (including software-assisted reading), and adverse events were excluded. DMTs were modeled as two efficacy tiers, discontinuation occurred only at EDSS 7, and results vary slightly between runs due to Monte Carlo sampling.
- **Strengths:** The individual-level microsimulation captures patient heterogeneity, subclinical disease activity, and measurement error in each strategy. Model inputs reflect the latest available utility, efficacy, and cost evidence, with all costs updated to 2026 US dollars.

IN CONCLUSION: Software strategies **save approximately $1,400 to $2,000** per patient annually, supporting software-assisted MRI as a **value-enhancing strategy** for RRMS management.

Abbreviations: ARR = annualized relapse rate; CPI = Consumer Price Index; DMT = disease-modifying therapy; EDSS = Expanded Disability Status Scale; HR = hazard ratio; ICER = Institute for Clinical and Economic Review; MRI = magnetic resonance imaging; MS = multiple sclerosis; NEDA = no evidence of disease activity; NMA = network meta-analysis; QALY = quality-adjusted life year; RR = relative risk; RRMS = relapsing-remitting multiple sclerosis; SD = standard deviation; US = United States; USD = United States dollars.

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