# Annual Disability-State Transition Probabilities Estimated from a Large Sample (>6,000) of Australians Living with Multiple Sclerosis from MS-Base

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## Background and Aims

Multiple sclerosis (MS) is a chronic, neurodegenerative disease characterised by progressing disability and it is most frequently diagnosed in females between the ages of 20 and 40 [1]. MS is high cost and high burden for Australian society, costing $2.5 billion Australian dollars (AUD) in 2021. Cost increases concomitantly with disability severity; the cost per person living with MS in Australia in 2021 increased from $32,829 for no disability to $123,333 for severe disability [2]. MS prevalence is increasing. There are now 33,335 people living with MS in Australia, an increase of over 4,000 people from 2017 [2,3]. The *Atlas of MS* reveals there are 2.9 million people living with MS worldwide. This represents a 26% increase from 2013 **(Figure 1).**

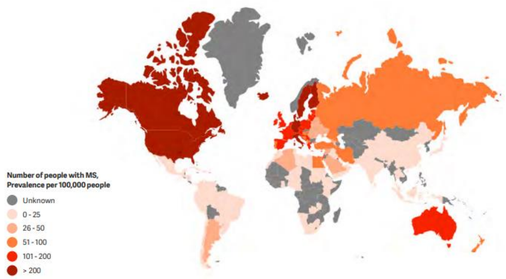


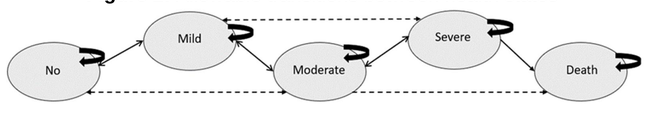

**Figure 1:** Source *Atas of MS* that reveals 2.9 million people in the world live with MS

Transition probabilities are a vital input for health economics models, including those used to inform healthcare resourcing decisions relating to MS-specific disease-modifying therapies (DMT) reimbursement decisions.

## Methods

Data was obtained from Australian participants of MS-Base, the largest international registry collecting observational data as part of routine clinical care [4]. We fitted a five-state continuous-time Markov model to describe how people living with MS transition between disability milestones or health states. These states were, as defined by the Expanded Disability Status Scale: no disability (EDSS=0), mild (EDSS=1-3.5), moderate (EDSS=4-6), severe (EDSS=6.5-9.5), and death (EDSS=10). **Figure 2** comprises a diagram of the allowable transitions between health states for the final model. Model covariates included sex, DMT usage, MS-phenotype, and disease duration.

**Figure 2:** Allowable transitions between health states




## Preliminary Results

**Figure 3** displays the flow of participants into the study. Participants were retained if they represented a complete case, had more than one review, and did not utilise stem cell therapy.

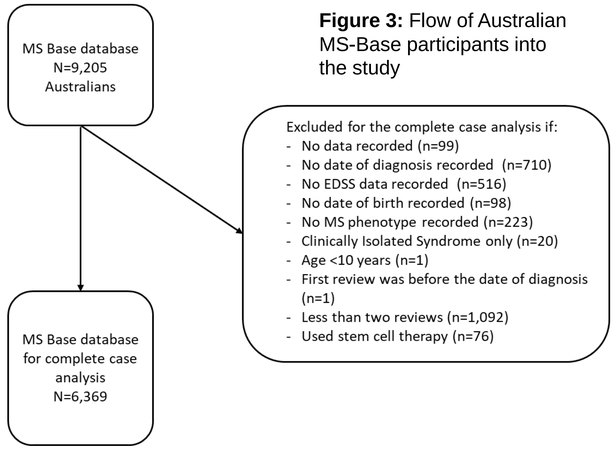



**Figure 3:** Flow of Australian MS-Base participants into the study

**Table 1** provides a summary of the sociodemographic and clinical characteristics of the study participants. **Table 2** shows summary statistics pertaining to observation times and numbers of clinical reviews.

**Table 1:** Participant characteristics

| Characteristic | Value |
|---|---|
| Number of included participants: n | 6,369 |
| Age: mean (SD) | 42.51 (12.37) |
| Sex: n (%) female | 4,777 (75.00) |
| Disability severity* n (%) | |
| No disability | 959 (15.06) |
| Mild disability | 3554 (55.80) |
| Moderate disability | 1274 (20.00) |
| Severe disability | 582 (9.14) |
| Number of deaths | |
| Death | 102 (1.60) |
| Disease duration: mean (SD) | 5.69 (7.40) |
| Multiple sclerosis phenotype: n (%) | |
| Relapsing-remitting | 5566 (87.39) |
| Secondary-progressive | 460 (7.22) |
| Progressive-onset | 343 (5.39) |
| Disease-modifying therapy usage: n (%) | |
| None | 2010 (31.57) |
| Category 1 | 539 (8.46) |
| Category 2 | 514 (8.07) |
| Category 3 | 3306 (51.91) |

**Table 2:** Observation time and clinical reviews

| | Observation Time in Years | Number of Clinical Reviews |
|---|---|---|
| Summary Statistic | | |
| Mean | 6.12 | |
| Standard deviation | 4.47 | |
| Interquartile Range | | |
| 0% | 0.02 | 2 |
| 25% | 2.43 | 4 |
| 50% | 5.40 | 7 |
| 75% | 8.87 | 11 |
| 100% | 26.62 | 48 |
| Mean | | 8.58 |
| Standard Deviation | | 6.66 |
| Total | 38,992.78 Person Years | 54,669 Clinical Reviews |

## Preliminary Results

**Figure 4** supports Table 2 and shows the frequency of observation times in years; the mean (SD) observation time was 6.12 (4.47) years.

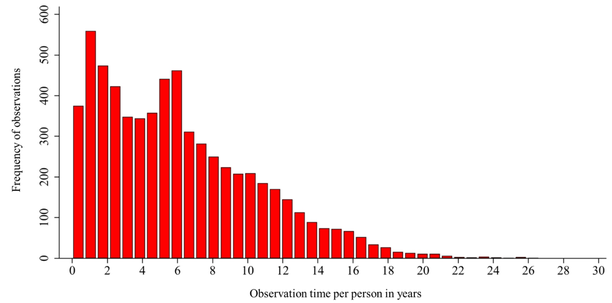



**Table 3** provides the frequency of transitions between the five health states of no disability, mild, moderate and severe disability and death. Rows are the 'from' states and columns are the 'to' states.

| | No | Mild | Moderate | Severe | Death |
|---|---|---|---|---|---|
| No | 4073 | 1815 | 41 | 10 | 1 |
| Mild | 1736 | 21818 | 1807 | 81 | 11 |
| Moderate | 36 | 1380 | 8288 | 1003 | 25 |
| Severe | 5 | 26 | 526 | 5553 | 65 |
| Death | 0 | 0 | 0 | 0 | 0 |

**Table 3:** Total number of transitions between health states

When covariates were set to mean values, one-year transition probabilities included (reported as "value [95% CI]"): remaining disability-free (54.0% [43.6%, 56.2%]) remaining in the mild state (82.0% [60.4%, 82.6%]); transitioning from the no to mild state (42.1% [40.1%, 43.9%]); from the mild to moderate state (11.4% [10.9%, 11.9%]; from the moderate to severe state (9.5% [8.8%, 10.3%]); and from the severe to death state (0.5% [0.3%, 0.7%]) (detailed data not shown; provided in our forthcoming publication)

## Conclusions

Preliminary results indicate that MS progresses quickly from no disability. Estimated transition probabilities will be applied in a health economics simulation model for Australia intended to support reimbursement decisions.

### References

**[1]** Taylor BV. What causes multiple sclerosis? Getting closer to the answers. Med J Aust. 2022 Aug 15;217(4):180-182.; **[2]** Campbell JA, Simpson S Jr, Ahmad H, Taylor BV, van der Mei I, Palmer AJ. Change in multiple sclerosis prevalence over time in Australia 2010-2017 utilising disease-modifying therapy prescription data. Mult Scler. 2020 Oct;26(11):1315-1328; **[3]** Campbell JA, van der Mei I, Taylor BV, Palmer AJ. Health economic impact of Multiple Sclerosis in Australia in 2021: an interim update on prevalence, costs and cost of illness. Commissioned Report for MS Australia https://www.msaustralia.org.au/wp-content/uploads/2023/02/health-economic-impact-of-multiple-sclerosis-in-australia-in-2021_final.pdf

### Funding

This research was supported by Dr Julie Campbell's MS Australia Research Fellowship number 19-0702

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