**DisMod-MR, is it a robust model?**

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**Abstract**

**Background** The Global Burden of Disease, Injuries, and Risk Factors Study 2010 (GBD 2010 Study) required age-specific prevalence estimates for over 300 outcomes for all countries. Results of systematic reviews were often very sparse and noisy, so DisMod-MR was used to combine all available data and create estimates. We investigate the robustness of this approach by comparing the negative binomial rate model to alternative rate models for out-of-sample predictive validity.

**Methods** We compared all disease and injury models analyzed with DisMod-MR from the GBD 2010 Study with more than 4 prevalence data points in Western Europe with holdout cross-validation. For each disease/injury model, we generated 1000 replicates with the prevalence data partitioned into a random 75/25% train/test split. We fit an age-specific rate model to the training data and used the results to predict values for the test data. We compared the bias, median absolute error (MAE), and coverage probability for each replicate to determine if the negative binomial, binomial, normal, or lognormal rate model was superior.

**Findings** Each metric has its own superior rate model. For accuracy, the lognormal model is superior for having the most replicates with the smallest bias. For precision, the binomial model wins for having the smallest MAE. For calibration, the negative binomial model wins for having the highest coverage probability.

**Interpretation** Depending on the metric, different rate models are superior. This highlights the difficulty in finding a suitable metric to compare such diverse models.

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**Author contributions** BMB assisted in developing the model and contributed to the study design and analysis, ADF developed the model, HMP designed and conducted the study and analyzed the results

**Disclosure of conflicts of interest** ADF developed DisMod-MR, BMB developed the offset lognormal model

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