Reviewer’s report

Title: Dynamic models to predict health outcomes: Current status and methodological challenges

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Reviewer: Benjamin French

Reviewer’s report:

In this manuscript, the authors review approaches for refining a prognostic model over time, in order to combat the loss of accuracy that can result from changes at the patient level and system level. I believe that the field of dynamic prediction modeling is sufficiently developed to warrant such a review. The authors clearly present current methods and raise important limitations of current approaches. However, I feel that a major revision of the article is required. Overall, the organization of the results and discussion did not help the reader to distinguish between what was review material and what was new discussion offered by these authors. Better organization and focus of the Results section, along with a more comprehensive Discussion section, would improve the paper. Below are several comments, in no particular order.

1. (The authors did not include page numbers in their document.)

2. Abstract: "calibration drift" is not well defined here.

3. In the first paragraph of the Introduction, the authors appear to be more motivated by cost reduction rather than improved patient care. Both are important, but I believe that patient care comes first. In any case, I think this opening paragraph is a bit long, and could be shortened and more focused. I think the authors should particularly stress the point that with the increasing availability of large-scale data sources, more flexible and responsive approaches (models) are needed.

4. Then, in the second paragraph of the Introduction, I believe that clinical prediction models can be used for both diagnosis and prognosis, but the authors here focus on prognostic models. This should be clearer.

5. "Only models that update in calendar time are considered dynamic here." I'm not sure what the authors mean by this. Are there other time scales over which a model could be updated?

6. The search strategy and study selection appear to be appropriate.

7. I struggled most with the organization of the Results. The authors indicate that they extracted two general domains: modeling methods; and validation and evaluation. The authors then group the identified papers into three categories: discrete model updating; Bayesian model updating; and varying coefficient modeling. I would suggest that the authors drop the label for 3.1 and 3.2. Then, new subsections should be the three
categories (3.1 discrete model updating, 3.2 Bayesian model updating, 3.3 varying coefficient modeling). Under each of these, you should have subsections for your domains (3.X.1 modeling methods and 3.X.2 validation and evaluation). You might also add a 3.X.3 "limitations" or "pros and cons". Presumably, much of this is in the current section 3.3, but I found it difficult to relate these challenges back to the individual methods/categories. Any broader issues that cross-cut the categories should be moved to the Discussion section. This might require some reorganization of the Discussion section, as well.

8. Related to this, the sentence "…we also extracted any limitations and suggested further work discussed by the authors" is awkward. First, the "authors" might not have realized all the limitations of their method(s), so I'm not sure you should limit yourself to these. Second, I think you mean that you extracted the further work that the "authors" discussed, not that you're simply suggesting further work that was already suggested by the "authors." In particular, the point of a review article is for you to assess progress in this research area and provide a critical assessment. So, while the "authors" might have already done some of this, it's important for you to take a broader view in recognizing limitations and suggesting future research in this area. It's not clear that this has been done.

9. In particular, what needs to be done for these methods to be adopted more broadly in clinical practice? The clinical literature is full of prediction models that never get implemented.

10. Table 2: Grouping headers for "discrete model updating" and "Bayesian model updating" would be helpful.

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