Reviewer’s report

Title: Mathematical models used to inform study design or surveillance systems in infectious diseases: a systematic review

Version: 0 Date: 08 Sep 2017

Reviewer: Richard Thomas Gray

Reviewer's report:

The authors report the results from a systematic review of mathematical models used to inform the design of observational studies, surveillance systems and clinical trials for infectious diseases. The review aims to include all studies published prior to October 2016 which described the use of mathematical models to directly inform the design of a study (theoretical or actual) such as required sample size, timing and frequency of sampling, and power calculations. The systematic review is based on a protocol and follows the PRISMA guidelines. The authors only found a limited number of studies based on their search strategy and selection criteria suggesting mathematical models have been underused in study design for infectious disease epidemiology despite their potential.

I have some minor concerns with the study. Once addressed, I think the manuscript would be suitable for publication.

1. One concern I have is performing a systematic review and only including publications which explicitly include the use of models in the study design may undersell the implicit or indirect use of models in the design of studies. For example, previous modelling studies may inform the populations a study targets and the potential efficacy of interventions which may be used in power calculations. While such information would be difficult to collect, some of the excluded studies in this review may give some insight (e.g. for "mathematical model had no design purpose" or "no mathematical model used/mentioned" could contain citations to modelling work which informed the study). At the very least I think this should be discussed in the limitations.

2. Similarly, models have often been used to inform national strategies and guidelines or are used to calculate key surveillance indicators. These strategies and indicators may then inform specific studies or surveillance activities. I think the background should provide a bit more detail about where models are currently used in terms of surveillance and policy.

3. The paper title and main text includes discussion about the use of models to inform surveillance systems. I found the references to surveillance a little confusing. It was not clear to me how the authors thought models could inform surveillance systems as opposed to
specific studies and if their strategy would find applications of models to surveillance systems design. Such applications may be described in grey literature or reports rather than published literature or trial registries.

4. The authors note that their search strategy could miss specific infections like HIV. I think it would be worthwhile to conduct a search including specific infections such as HIV, malaria, TB, etc to validate their current search strategy has found all the relevant papers.; i.e. by including a specific infection in your combined Medline search (search #21 on age 8 in Appendix File 1) do you get more than 511 results?

5. Could additional papers/documents be found by looking at the citations of the key papers advocating the use of models for study design (e.g. refs 5-9 in the main text)?

6. The authors do not describe or discuss the studies using Markov models (other than in Table 3) focusing on IBMs and compartmental models. I think it would be worth describing the advantages and disadvantages of Markov models for infectious disease study design and whether they have been under used or shouldn't be used at all. Otherwise why where they considered in the search strategy?

7. I don't agree with the authors discussion comment that the scarcity of modelling to design real studies is a lack of fundamental research. While some of the reasons stated are valid, such as the lack of a database and the poor availability of the code are reasonable. I don't think such models will ever be as easy to use as a standard sample size calculator. Many studies may require unique models to capture the demographic, epidemiological, behavioural, clinical, and infection characteristics and the specific research question being studied. Secondly, while models may be useful in study design how essential are they, given many study teams will not have the expertise to develop models. Could the standard approaches (statistical sample size calculations) provide sufficient details for a study once potential issues are accounted for? Do the authors know of any examples where models were not used and this led to a failed study or incorrect results?

8. I found a typo on line 168: diverse instead of "divers"?

Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

Yes

Does the work include the necessary controls?
If not, please specify which controls are required in your comments to the authors.

Yes
Are the conclusions drawn adequately supported by the data shown?  
If not, please explain in your comments to the authors.

Unable to assess

Are you able to assess any statistics in the manuscript or would you recommend an additional statistical review?  
If an additional statistical review is recommended, please specify what aspects require further assessment in your comments to the editors.

Not relevant to this manuscript

Quality of written English  
Please indicate the quality of language in the manuscript:

Acceptable

Declaration of competing interests  
Please complete a declaration of competing interests, considering the following questions:

1. Have you in the past five years received reimbursements, fees, funding, or salary from an organisation that may in any way gain or lose financially from the publication of this manuscript, either now or in the future?

2. Do you hold any stocks or shares in an organisation that may in any way gain or lose financially from the publication of this manuscript, either now or in the future?

3. Do you hold or are you currently applying for any patents relating to the content of the manuscript?

4. Have you received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript?

5. Do you have any other financial competing interests?

6. Do you have any non-financial competing interests in relation to this paper?

If you can answer no to all of the above, write 'I declare that I have no competing interests' below. If your reply is yes to any, please give details below.

I declare that I have no competing interests

I agree to the open peer review policy of the journal. I understand that my name will be included on my report to the authors and, if the manuscript is accepted for publication, my named report including any attachments I upload will be posted on the website along with the authors' responses. I agree for my report to be made available under an Open Access Creative Commons
CC-BY license (http://creativecommons.org/licenses/by/4.0/). I understand that any comments which I do not wish to be included in my named report can be included as confidential comments to the editors, which will not be published.

I agree to the open peer review policy of the journal.