Rapid Reviews COVID-19

Review 1: "Optimal SARS-CoV-2 vaccine allocation using real-time seroprevalence estimates in Rhode Island and Massachusetts"

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RR:C19 Evidence Scale rating by reviewer:

- **Strong.** The main study claims are very well-justified by the data and analytic methods used. There is little room for doubt that the study produced has very similar results and conclusions as compared with the hypothetical ideal study. The study's main claims should be considered conclusive and actionable without reservation.

Summary

In this paper, Tran et al ask how Pfizer and Moderna vaccines should be prioritized over age groups in RI and MA to prevent COVID-19 infections, hospitalizations, and death. They take a strategy that has been proven to be both theoretically valuable (i.e. lots of other papers have successfully used this approach) and practically valuable (because past theoretical models have directly and successfully informed policy changes for influenza vaccination in the past). The approach is conceptually straightforward: calibrate an age-stratified transmission model to local data, extend the model to include vaccination, and use forward simulation to identify the most impactful strategies. However, this conceptually straightforward approach is detailed and sophisticated, and the authors explore various nuances, including consideration of (1) waning immunity, (2) mixed strategies in which vaccines are prioritized to groups non-uniformly, and (3) existing immunity due to the prevalence of naturally acquired antibodies in the population; and conclude that vaccines in MA and RI ought to be prioritized, in large part, to folks 70+ to minimize mortality.

In short, I found this paper to be high quality, and recommend acceptance after some changes to just clarify, streamline, and strengthen the manuscript. One may think of all of these suggestions as cosmetic in nature, rather than targeted at the modeling itself. I found the paper to be straightforward, clear, and creative.

Comments

My biggest comment is actually that cumulative incidence and seroprevalence may not be well linked, given evidence of seroreversion. This is further complicated by the fact that seropositives may nevertheless retain protection in spite of decreased antibody titers. In any case, I suggest that the authors be crystal clear about what they mean: it is not real-time seroprevalence that guides decisions on vaccine allocation (to quote the Conclusion) but actually model-derived estimates of cumulative incidence. These

estimates can be updated, but the study isn't based on real-time serosurveillance. Given that seroprevalence appears throughout the paper (and in the title) I just suggest being careful.

I had a few questions about how vaccination was implemented. Until reading a second time, looking for these details, I thought that vaccination was implemented as an initial condition, but I think that the last lines in Sec 2.1 suggest constant rollouts over periods between December and January/March. Is that correct? If so, I think that just a little more clarity would be good, to explicitly say that vaccination is implemented over time, at such and such (constant?) rate. If I misunderstood this point, please also clarify. Second, why choose 4.78% or 28.3% as the low and high vaccination cases? I have nothing against those numbers, but help assuage the reader like me who scratches their head. Finally, if you assume that it is in principle possible to vaccinate everyone in an age bin (i.e. no hesitancy) could you please state that explicitly?

One alternative to Co-Mix data might be to consider the patterns from Dennis Feehan and Ayesha Mahmud which were recently released.

<https://www.nature.com/articles/s41467-021-20990-2>, with links to Github and data at the bottom. I am not sure whether changing the analyses from CoMix to Feehan & Mahmud is appropriate or worth the time, but my understanding is that Tran et al. hope to directly inform policy, so confirming whether the choice of contact matrix is critical to their conclusions might be a good update. NOT a critical change to the paper, in my opinion, but I think that the authors might be interested in this U.S. contact data.

I loved the idea of running 2^{9-1} simulations and then examining the effects of inclusion/exclusion of each age bin. Nicely presented as well. Outside of the practical impact of the paper, I found this to be an interesting approach to characterizing the space of possibilities. That, followed by the sweeps of 10/90, 20/80, 30/70... etc, I found to be creative and well thought out, as far as trying to present the reader with a summary of a huge number of scenarios.

If it is straightforward to update your projections based on what has already occurred in the month since the paper was arxiv'ed, I suggest doing so.

Finally, please consider whether it would be worth it to reference your other supplemental figures in the main text at some point. I think maybe you only refer to a couple, and I was surprised that the first one was (I think) S20.