Reviewer's report

Title: Dynamic modelling of costs and benefits of school closure during an influenza pandemic

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Reviewer: James McCaw

Reviewer's report:

The paper by Xue et al presents an economic analysis of the impact of school closure on a hypothetical influenza pandemic. Epidemiological outputs from a dynamic infection model are fed into an economic model to arrive at the results.

The primary findings of the paper are well supported by the Methods and Results, and limitations of the approach are highlighted, and in some places, explored in a sensitivity analysis.

Major Compulsory Revisions

The authors have unfortunately missed the highly relevant work of Halder, Kelso and Milne, published in the below listed papers. In particular, reference 4 reports on the cost-effectiveness of school closures, and attempts to account for similar direct- and indirect- costs.


The model employed by Halder et al is a detailed micro-simulation model, and so a rigorous and detailed evaluation of the similarities and differences between their findings and those in the present manuscript would be highly valuable. The comparison between Australia and Norway would also be of interest.

I see placement of the present manuscript in the context of Halder (ref 4) at the very least as necessary.

I encourage the authors to re-visit their literature search strategy in case they missed further key papers.

Minor Essential Revisions

Listed in order of appearance, the following queries should, in my opinion, be carefully addressed:

1. It is implicitly assumed that the entire population is fully susceptible to infection in the SEIR model. When using an age-structured model in particular, this is a questionable assumption. There is now a strong body of evidence to suggest that prior-immunity, even to pandemic strains, exists and is age-dependent. While with a focus on school aged children, the assumption may have a relatively minor effect, it nonetheless should be clearly stated, and the consequences considered.

2. The chosen values for the reproduction number are very high. $R = 2.5$ (which is also $R_0 = 2.5$ if we assume the entire population is susceptible) leads to particularly high infection rates (say, measured by sero-conversion to allow for lower symptomatic presentations). I would suggest the authors consider replacing $R = 2.5$ with $R = 1.2$ or $1.3$, corresponding to perhaps a more realistic “2009-like” pandemic.

3. Bringing points 1. and 2. together, if the authors refrain from mentioning $R_0$ and only refer to $R$, and also reduce the sampled values from 1.5, 2.0 and 2.5 to, say, 1.2, 1.5 and 2.0, then this will go some way to
addressing the assumption of full susceptibility. The stated reproduction numbers (now R, not R0) can refer to the hypothesised observed values in the community, accounting for prior immunity. The residual error in taking this approach now stems from ignoring prior immunity and thus using an "incorrect" proportional split of the population by age.

4. The chosen values for the serial interval are very long: 1.9 + ~6 = ~8 days. Estimates for the serial interval for 1918/9 and 2009 are consistently in the range 2 to 2.5 days.

Shorter serial intervals will result in much more rapid, higher peaking epidemics (but of course with unchanged attack rates). I would expect that optimal durations of school closure, and thus economic impacts, would vary, perhaps substantially.

A shift in the assumed baseline serial interval AND a sensitivity analysis seem warranted.

5. It is stated in the Discussion that a rebound can occur if schools are re-opened prior to the epidemic peak. While true, it is slightly misleading as a rebound can of course also occur after the peak has passed. The "intervention R" is <1, but for a time post-peak the non-intervention R is >1. Relaxation of the intervention during this time will result in double peaked behaviour. This is both a mathematical observation and also an epidemiological one (Wu, Cowling et al, EID 16(3):538 2010)

Other queries (Discretionary Revisions):

1. Did you use the physical contact or conversation based estimates of the WAIFW matrix from POLYMOD? Other work has indicated that subtly different results following from this choice. Specification of which was used would be of use.

2. Are not home heating costs increased when children stay home, (somewhat) balancing out school heating cost savings?

3. The authors neglected to mention arguably the most important effect of a delaying measure such as school closure: that it "buys time" for the production and distribution of a strain-specific vaccine which constitutes the one and only definitive control measure we presently have for influenza.

Minor issues not for publication:
1. Typo on page 12, "or care could BE provided by...". "BE" is missing.
2. Table 1: I can't see where footnote "b" appears. Is it a relic?
3. Page 14: "So we didn't present..." is a strange (conversational) sentence for a scientific paper.

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**

I declare that I have no competing interests