Rapid Reviews COVID-19 •

Review 1: "SARS-CoV-2 Aerosol Transmission in Schools: The Effectiveness of Different Interventions"

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RR:C19 Evidence Scale rating by reviewer:

- **Reliable.** The main study claims are generally justified by its methods and data. The results and conclusions are likely to be similar to the hypothetical ideal study. There are some minor caveats or limitations, but they would/do not change the major claims of the study. The study provides sufficient strength of evidence on its own that its main claims should be considered actionable, with some room for future revision.

Review:

This paper relies on the CARA risk assessment tool to produce SARS-CoV-2 transmission risk estimates given several interventions scenarios against a baseline scenarios in the absence of interventions.

A generic school building environment in terms of spacing and number of students present is selected for the analysis and schools looking to use the recommendations from this report, may wish to compare, for example, their space volume, occupancy numbers, and exposure time, with those assumed in the present analysis. Overall, this concern is minor, yet it highlights the utility of a dynamic risk estimator tool (several of these exist, which consider different parameters and types of input) with dynamic risk estimates based on various input measurements, to promote greater generalizability, given the larger heterogeneity in school building structures related to ventilation, climate, and central filtration/HVAC systems.

The relationship between viral load in upper respiratory mucosa (NP swab and nasal swabs reported in Jacot et al.) and that expected into respiratory aerosols is done using a rational approach, but could also be compared further against new data from Adenaiye et al. 2021 recently accepted in CID (<https://www.medrxiv.org/content/10.1101/2021.08.13.21261989v2>) which shows even lower viral load detected in exhaled breath compared with midturbinate swabs. This could mean that the infectious dose via aerosols is actually lower than what has been suggested elsewhere (noting the range 10-1000 per infectious dose cited in the current manuscript). Results from the Adenaiye et al paper also show that alpha versus "wildtype" virus are shed at a rate of 18-times greater, after controlling for viral load increases in the nasal mucosa, suggesting an increase in viral aerosol generation as the mechanism for increased variant infectiousness (in addition to potential other

mechanisms mentioned in the discussion). Ultimately exposure to infectious doses generated from a source (described by the quantum generation rate, q) are another way to describe risk using the Wells-Riley or Rudnick-Milton approaches that can be estimated based on knowledge of infectious dose generation rate and ventilation rate or CO₂ level. What might the effect of increased infectiousness (emerging variants) have on the results?

Discussion of CO₂ monitoring as a tool could benefit from review of Rudnick-Milton's 2003 paper on this topic. Assuming a single infector in the space, higher indoor CO₂ (e.g., above 1000 ppm) rates in more highly occupied spaces will correspond with similar risk in a space with lower CO₂ (e.g., below 1000 ppm) with fewer people, thus highlighting the potential for some nuance in discussion of use of CO₂. However, there is great need for using interventions and having clear guidance on their use in the public, so some of these minor concerns are for research sake only and the type of risk analysis done in the current manuscript should consider how to best communicate risk to the schools and simple steps for immediate action regarding use of interventions to mitigate risk.

Breathing rate may be of less concern given similar levels of breathing rate among classrooms of students performing similar tasks and the assumption that students and teachers would shed similar amounts of virus into exhaled breath at similar rates. What is the basis for the Figure S1d? This could be added to the legend to potentially improve clarity. One might consider ignoring inactivation due to aerosol settlement since this doesn't necessarily apply at a meaningful level to the aerosols $\leq 5\text{-}20\text{ }\mu\text{m}$ upon exhalation which will shrink to $\leq 5\text{ }\mu\text{m}$ upon evaporative equilibrium. The size range of aerosols considered could be highlighted for clarity.

Less-than-HEPA efficiency filters could be evaluated as they may be more cost effective and the MERV13 filter is widely promoted as a helpful strategy in the USA. The effect of filtered recirculated air and use of outdoor air via HVAC systems was not address but could contribute additional layers of protection that might be worth mentioning or quantifying.

There could be more discussion regarding the relationship between mean viral concentrations and mean cumulative dose (the 2 y-axes) since this is a main idea illustrated in the figures. The dose is less affected by the concentration in the air and the reasons for this could be clarified and/or discussed.

Overall the paper provides a helpful evaluation of interventions on SARS-CoV-2 transmission risk in school settings using reasonable assumptions. It provides helpful suggestions for how to reduce inhalation exposure to contaminated air via ventilation and masking and filtration.