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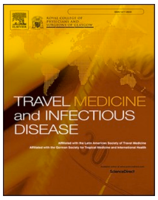

Comments on "Identifying mitigation strategies for COVID-19 superspreading on flights using models that account for passenger movement"

A R T I C L E I N F O

Keywords
Middle seat
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Letter to the Editor:

The Namilae et al. (2022) [7] study uses a gross oversimplification of in-cabin transmission to make inaccurate claims about the on-board transmission of SARS-CoV-2.

We take issue with the authors' use of the term "superspreading on flights" generally, and their specific claim that the cases they analyzed were "superspreader events." Many of the cases claimed, with little evidence, to have been acquired within the aircraft cabin were much more likely acquired elsewhere [1–3]. The authors' work is undermined by several critical flaws: (1) failure to account for the unique nature of airflow on aircraft, (2) oversimplification of risk as a correlate of distance, irrespective of airflow (3) and poor validation data.

The authors claim use of a "new infection spread" model to overcome limitations of "conventional models." Any new model should be described in great detail, but the authors provide only a handful of incomplete equations with no explanation of their connection. With such paucity of detail, the output reported is uninterpretable, let alone reproducible.

COVID-19 transmission is heavily dependent on airflow and particle dynamics [4]. The paper ignores airflow models in general and aircraft airflow in particular. Modern aircraft cabin airflow minimizes the risk of disease transmission by quickly removing particles from the cabin air. Rather than using any of the available data acquired within aircraft [1], the authors based their model on a restaurant. This erroneous equation of two deeply disparate environments leads to extremely misleading results. The assumption that there is a correlation between distance and inhaled mass is a poor assumption in the aircraft cabin environment [1,2,4].

There are no studies which have adequately quantified the number of virions required for infection to occur in an uninfected occupant, and what studies have attempted to answer the question have found a wide range of doses and a high degree of in-host variability among both infected and susceptible individuals [5,6]. Any attempt to quantify transmission using a dose-response relationship that ignores in-host dynamics will be virtually meaningless. Furthermore, the effect of movement, when considering exposure time in a correctly modeled flow environment, is exceedingly small, especially compared to the impact of airflow.

In their analysis of the effects of masks, the authors go into great detail to describe mask leakage and the relevance of airflow patterns to mask performance while completely ignoring the relevance of the airflow patterns in their chosen setting—the airplane. The airflow in commercial aircraft cabins is highly compartmentalized, flowing top to bottom at higher flow rates than any other indoor environment. The air is exchanged every 1–3 minutes with 50% outside air and 50% recirculated air that has been filtered by HEPA filters, which remove 99.97% of particles, including those that could carry SARS-CoV-2.

The authors claim another study found that vacant middle seats "lowers exposure (dose) significantly." Similar to the present study, that study used a distance model, as well as a CO_2 gas tracer. Carbon dioxide, like any gas, is not representative of particles. It will not be filtered by the HEPA filters on commercial aircraft, whereas particles, and the viruses they contain, will be. The risk reduction from leaving the middle seats vacant is not a function of distance or reduced dose.

The authors cite their own previous studies as validation, which all contain the same flaws as the current work and similarly lack strong validation. Figure 2's model results for the London flight are not in good agreement with that of Fig. 1(a), especially for the premium economy and economy seats, as it would if the model were a good fit. The paper does not explain the pattern by seat that the model result in Figure 3 displays for the Singapore flight. The authors did not connect their modeling of pedestrian movement or mask use to the resultant infection pattern by seat location. They also fail to explain how different their model's pattern in Figure 3 is from that of Fig. 1(b), the observed cases by seat location, for the premium economy seats. If the model were validated and well-calibrated, these two figures would be well-aligned. The authors did not include known *commercial* flights without secondary transmission; they instead used a study from a 14-seat private Bombardier Global 6000, which is a not a good comparison to revenue

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flights where airflow patterns and filtration may be very different.

Given the extreme simplicity of the author's distance model and its lack of airflow effects, it is not reasonable to assume that studies done with high resolution and extensive data [1,2,4] are less accurate. The authors have not proven the accuracy of their model predictions with reliable validation methods and, hence, their conclusions are suspect. Consequently, this paper's claims of mask benefits and empty middle seat benefits on the airplane are unreliable.

Credit authorship contribution statement

Stephen M. Trent: Formal analysis, Writing - Original Draft Preparation. **Rebecca A. Mereness**: Formal analysis, Writing - Original Draft Preparation, Writing - Review & Editing. **Nels Olson**: Writing - Review & Editing, Supervision. **Joshua Cummins**: Formal analysis, Supervision.

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