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Preventing outbreaks of COVID-19 in NZ associated with air travel from Australia: New Modelling study of alternatives to quarantine

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In this new study, we estimated the risk of COVID-19 outbreaks associated with air travel from Australia (with a low prevalence of COVID-19 infection) to NZ. We found that the combined use of exit and entry screening, two PCR tests (on days 3 and 12 in NZ), mask use and contact tracing, reduced the risk from one outbreak every 1.7 years (no interventions) to every 29.8 years (95% uncertainty interval: 0.8 to 110). This risk is similar to that achieved by the current system of

14 days quarantine, at one outbreak every 34.1 years (0.86 to 126). In conclusion, multi-layered interventions can markedly reduce the risk of importing the pandemic virus into a COVID-19-free nation like NZ. Whatever approach is chosen, careful management and evaluation will be needed.

NZ is one of the few countries that has eliminated transmission of the SARS-CoV-2 pandemic virus within its borders, in line with the goal it adopted to achieve this [1]. Some Australian states may also be approaching elimination status, but for Australia as a whole, elimination might not be achievable and the country could persist with a suppression strategy with ongoing cases and outbreaks until a vaccine is available. Nevertheless, quarantine-free travel between the two countries is a goal envisaged by the Prime Ministers of Australia and NZ in terms of a trans-Tasman "bubble" [2].

Another development is that many major airlines are also bringing in procedures to improve safety on flights to reduce the risk of SARS-CoV-2 transmission. These measures include physical distancing procedures and requirements for passengers and cabin crew to wear masks [3].

What did our new study find?

We used a stochastic version of the SEIR model CovidSIM v1.1, designed specifically for COVID-19. The model was populated with data for both Australia and NZ, and with parameters for SARS-CoV-2 transmission and control measures (see Figure 1). We assumed one Australia to NZ flight per day.

When no control interventions were in place, an outbreak of COVID-19 in NZ was estimated to occur after an average time of 1.7 years (95% uncertainty interval [UI]: 15 days to 6.1 years). However, the combined use of exit and entry screening (symptom questionnaire and thermal camera), masks on aircraft and two PCR tests (on days 3 and 12 in NZ), combined with self-reporting of symptoms and contact tracing, and mask use by the passengers until the second PCR test, reduced this risk to one outbreak every 29.8 years (95% UI: 0.8 to 110 years).

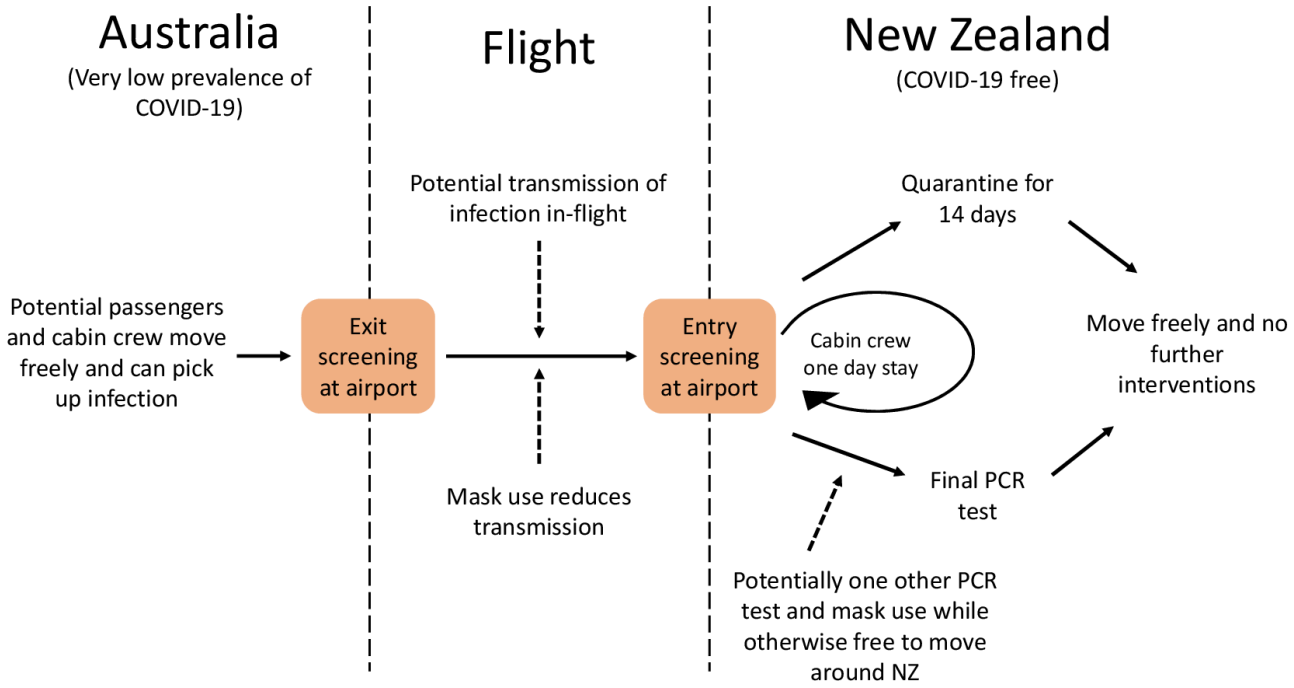
If no PCR testing was performed, but masks were used by passengers up to day 15 in NZ, the risk was one outbreak every 14.1 years. However, 14 days quarantine (NZ practice in June 2020), was the most effective strategy at one outbreak every 34.1 years (95% UI: 0.86 to 126); albeit combined with exit screening and mask use on flights.

Our base case analysis was for only one flight per day from Australia to NZ and at a very low assumed prevalence of SARS-CoV-2 infection in Australia (i.e., at just 149 undetected infected people in a population of 25 million). So we alternatively considered a ten-fold infection prevalence in Australia and a ten-fold travel volume from Australia to NZ. For each of these individually there would typically be an outbreak every 3.0 years for using PCR testing and masks or 3.4 years for the quarantine intervention.

A full description of all our methods and results for a large number of different scenarios is detailed in this online article [4].

Figure 1: *Flow diagram of the assumed movements of passengers and cabin crew in the model including interventions (simplified and not showing the precise details for how the*

cabin crew move back and forward between countries and the details around passengers seeking medical attention when symptomatic in NZ, isolation of identified cases and contact tracing)



Comment

This analysis suggests that a multi-layered package of interventions applied to passengers travelling from Australia to NZ without quarantine appeared to markedly reduce the risk of COVID-19 outbreaks in NZ. Current practice is quarantine for 14 days, which was the most effective single intervention. Nevertheless, the package of PCR testing (with mask use, symptom self-reporting and contact tracing) might be a reasonable alternative, with an expected outbreak occurring after an average of about 30 years. Surprisingly, there was also a large benefit from just mask use alone for the first 15 days in NZ by arriving passengers.

Any move away from managed isolation/quarantine raises concerns about the effectiveness of the measure being used, and wider issues that will affect the level of risk to NZ:

- **Ensuring adherence to mask wearing** – It is not certain that adherence to mask use by passengers when in the NZ community for the first two weeks would be as high as we assumed in the modelling (90% effectiveness in transmission reduction). A lower level in the real-world is plausible given the minimal use of masks during the first pandemic wave in NZ and the problematic lack of NZ Government mandates for mass masking at any Alert Level [5]. Potentially this issue could be addressed by the use of heavy fines and threat of deportation if mask use for this two-week period was not adhered to by these passengers once in NZ.

- **Use of digital tools** – Digital tools could have an important role in tracking incoming passengers as part of ensuring their adherence with mask wearing and other requirements, especially in the first two to three weeks after arrival. Some democracies in Asia (eg, South Korea) have used such digital tracking approaches – but we recognise that unless privacy concerns were fully addressed then they might not be acceptable to New Zealanders or the NZ Government. Such tools could also be used to monitor early signs of illness. For example, some wearable devices can potentially detect changes in temperature and heart rate, and so alert individuals and health authorities of potential illness developing before overt symptoms appear. One NZ software company has developed an app (ëlarm) that can harvest data from a range of wearables to provide such early warning. In addition, arriving travellers might need to use New Zealand's digital contact tracing support, such as the proposed CovidCard.
- **Prioritising jurisdictions** – A wider issue is the selection of countries that might qualify for quarantine-free travel to NZ. A high priority could be to select those that have fully excluded SARS-CoV-2 from ever arriving, such as some jurisdictions in the Pacific, e.g. Cook Islands, Samoa, Tonga. Others that have eliminated this infection should also be considered, e.g. Fiji and possibly Taiwan which either has eliminated or is on the verge of it. Using an agreed elimination definition could assist this process, and NZ could offer Pacific nations support around surveillance and border control processes.

These issues could benefit from further investigations, along with real-world studies on the estimated cost-effectiveness, feasibility, acceptability and adherence with the traveling public, airlines and border control services, of these various interventions. The relevance of these costs to policy-makers might also be impacted by who is paying (one estimate is that 14-days of quarantine currently costs the NZ Government around $6200 per person [6]). For example, all incoming passengers could be charged a COVID-19 levy and the whole system could have a user-pays (for travellers) component.

Conclusions

This analysis suggests that an outbreak of COVID-19 in NZ might occur after an average of 1.7 years without any interventions and for just one flight per day from Australia. This risk is greatly reduced by the currently used 14-day mandatory quarantine. Our analysis shows that there is potential to replace this quarantine period with multi-layered interventions using PCR testing or other controls, including mask use by passengers in NZ, that would also maintain a low risk of importing the pandemic virus. However, all approaches require continuous careful management and detailed evaluation.

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