PUBLIC HEALTH COMMUNICATION CENTRE AOTEAROA

To ensure success of the trans-Tasman travel “green zone”, we need to reduce system failures at the NZ border

29 March 2021

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While succeeding very well with its elimination strategy, NZ still does not have optimal border control. We find since July 2020 there have been 13 identified border failures and at least 6 internal MIQ facility failures. The forthcoming quarantine-free “green zone” between NZ and Australia provides an opportunity for NZ to benchmark its MIQ/border management policies and practices with

Australian States and Territories to identify improvements in both countries.

Overall, Aotearoa NZ has done very well with its COVID-19 pandemic response. NZ is ranked first in the world by the Lowy Institute in Australia [1] and its economic indicators, such as GDP impacts, also compare favourably to countries using a “suppression” strategy against the pandemic [2]. A recent favourable development has been the roll-out of the vaccination programme – starting with border workers. NZ’s success is due to political leadership, government officials, science advisors, iwi [3], health workers, border workers and indeed the whole “Team of 5 million”.

However, an upcoming challenge is to ensure that the forthcoming quarantine-free travel between NZ and Australia (also known as a “green zone”), works well. This green zone means that our biosecurity status will become more intertwined with Australia. Therefore, it is even more important to lower the risk of border failures that could disrupt green zone travel, especially if outbreaks are not initially well contained. This situation gives us the opportunity to benchmark our current measures with those used by the 8 states and territories in Australia.

In this blog we take a systems approach to the border failure issue, and use definitions that we have used before [4]. As we have noted previously, these are system design issues and do not reflect the hard work done by workers at the border and in MIQ facilities.

Image by Luke Pilkinton-Ching, University of Otago Wellington.

An update of known border failures and MIQ facility failures

As detailed in the Appendicised tables below, we consider that since July 2020, NZ has probably had a total of at least 13 border control failures (10 via MIQ facilities and three via

non-MIQ pathways). The largest of the subsequent outbreaks caused 179 cases with three deaths. Two of these failures resulted in Auckland moving to Alert Level 3 on three occasions and the rest of the country to Alert Level 2 on two occasions. The economic costs of these failures have been large. For example, at Alert Level 3, Auckland Council's Chief Economist estimated the loss of 250 jobs and $60-75 million in GDP each day [5]. Most recently for February 2021, Westpac economists estimated that the cost to the economy with Auckland at Level 3 and the rest of NZ at Level 2, was about $300 million per week [6].

Our analysis also suggests that there have been at least six "internal MIQ facility failures" involving spread between returnees (see Appendix). Nevertheless, this latter figure is likely to be a large underestimate as some of those who test positive at day 12 of their stay in MIQ are likely to have become infected within MIQ facilities (and this an issue where data are not published on the Ministry's website).

What needs to be done to upgrade the NZ border

The NZ border measures have recently been strengthened with the vaccination of border workers beginning in February 2021 with the Pfizer/BioNTech vaccine. Nevertheless, vaccination may not fully protect against SARS-CoV-2 transmission (the details around this are still uncertain), and also returnees can still potentially infect other returnees. The five actions we would most like to see are as follows, with additional measures in the Appendix:

1. Reducing the number of infected travellers arriving in MIQ facilities, which requires a particular focus on high-risk "red zone" countries such as the US, UK, and India (with the arguments and legal issues discussed elsewhere: [7]). Pre-departure testing, and guidance on reducing Covid-19 infection risk behaviours, could be strengthened with enhancements to the MIQ booking system and periodic audits to ensure valid testing was carried out.
2. Exploring the idea of offering vaccination to all returnees immediately on arrival. Even though this will offer only partial immunity while in MIQ, this measure might still be worthwhile.
3. Only using MIQ facilities in large cities for the lowest-risk travellers (eg, those from Australia until the green zone starts or during periods when the green zone is suspended) and exploring purpose-built facilities outside of all cities (as discussed elsewhere: [7]).
4. Eliminating use of all shared areas (including exercise and smoking areas), with returnees staying in their rooms throughout the full MIQ process as is routine in some overseas jurisdictions, such as in Australia [8]. There should be practical support for returnees who wish to exercise in their rooms, and smokers should be offered nicotine replacement therapy and other smoking cessation treatments and support.
5. Mandating daily PCR-based testing of saliva for MIQ workers. This option could also be explored for travellers in MIQ in addition to the current testing regimen to allow for comparative assessments. This testing is being used in parts of Australia [9] and in other countries.

Perhaps NZ should aim to have a failure rate that at least matches the lower one of Australia (which we compared with NZ in a recent study of hotel quarantine failures [8]). As of 29 March, NZ's MIQ system has a 7-day rolling average of 4 new positive cases/day, indicating that the risk of transmission within MIQ may still be substantial [10].

In summary, we find since July 2020 there have been 13 identified border failures and at least 6 internal MIQ facility failures. To ensure the success of the forthcoming quarantine-

free green zone between NZ and Australia, more preventive interventions are needed to reduce the frequency of such failures. Conducting a benchmarking exercise of MIQ and wider border management measures in Australian States and Territories could identify potential improvements in policies and practices in both countries.

APPENDIX

Table 1: List of COVID-19 border control failures in NZ since July 2020 up to 29 March 2021

Event	Extent of known spread	Details
"MIQ facility failure" (including one being "probable")		
Auckland outbreak (August 2020)	A total of 179 cases, with 3 deaths [11]	The cause of this outbreak remains unknown, but we consider this to "probably" have been a MIQ facility failure. This is because of the genomic work as we have previously described [12], and as detailed in the work of the genomics experts [13]. Nevertheless, there is still a small chance it was from an infected port worker (eg, as per the last row of this table), and perhaps an extremely small chance it was from an infected imported food product (with our assessment based on the likely extreme rarity of surfaces being involved in SARS-CoV-2 transmission [14] [15]).
Border facility maintenance worker infected (August 2020)	A single worker	A shared lift environment in a quarantine hotel (the Rydges Hotel in Central Auckland) was the suspected source [13] [16]. The genomic sequencing found a link with a returnee in this facility [13]. While officials hypothesise the role of touching a lift button, we suspect that shared air space is far more likely given what is now known about the likely rarity of transmission via surfaces [14] [15].
Border facility health worker infected (September 2020)	A single worker	This was a work-related infection at the Jet Park Hotel, in Auckland, with the genomic work linking the case to 3 cases within the facility [17]. This was a rare situation where part of the investigation report was made available to the media [18].
Returnee-related outbreak (Crowne Plaza, Christchurch), (September 2020)	The 2 returnees and 4 others	Two returnees (Cases D and E) were thought to have been infected within a hotel quarantine facility (see Table 2) before then moving into the community [19] [20]. These infected returnees appear to have then infected another person (Case G), potentially on a charter flight after leaving the facility [19] [20]. A household contact of Cases D and E was also infected (Case F) [19] [21]. Two household contacts of Case G were also infected [19].

Event	Extent of known spread	Details
Border facility health worker (November 2020)	A single worker	This was a work-related infection where the worker (Case A, and “Case B” in the next row), had the virus genome sequencing linked to infection in a group of international mariners in the Sudima Christchurch Airport facility. However, there were different virus subtypes in each case [22]. See Table 2 for the spread in the facility associated with these mariners.
Border facility health worker (November 2020)	A single worker	This was a separate work-related infection in “Case B” involving a different virus subtype – see in the row above for “Case A”.
Defence Force worker outbreak (November 2020)	The worker, a co-worker and 4 others	This was a work-related infection in a Defence Force worker associated with a MIQ facility (Jet Park) in Auckland. The genome sequencing showed a direct link to two returnees in the quarantine facility [23]. The subsequent route of transmission to the first community case remains unclear (albeit the person worked in the same locality within Auckland City as the Defence Force worker).
Returnee infectious after leaving a MIQ facility “Northland case” (January 2021)	A single returnee	A returnee was identified as being infectious in the community after leaving a MIQ facility (Pullman, Auckland). The returnee reportedly had the South African variant (lineage B.1.351) of the pandemic virus [24]. Genome sequencing has linked the case to another returnee who was in the same MIQ facility [25]. Further investigations are pending, and it can’t be excluded yet that this might have been part of one single failure at the Pullman facility ie, a super-spreading event at the facility (given the cases in the subsequent row).
Returnees infectious after leaving a MIQ facility (January 2021)	2 returnees and 1 contact	Two returnees (a parent and child) were identified as infectious in the community after being infected with the South African variant (lineage B.1.351), of the pandemic virus with a link to a MIQ facility (Pullman, Auckland) [26]. A close contact (the mother of the child) also became infected [27]. Further investigations are pending (as per the other cases from the Pullman facility detailed in the row above).
MIQ worker (March 2021)	A single worker	A cleaner at the Grand Millennium Hotel MIQ facility in Auckland tested positive during routine surveillance testing on 22 March 2021 [28]. While a household contact returned a weak positive the next day [29], subsequent tests were negative [30]. The MIQ worker had recently been vaccinated (with the Pfizer/BioNTech vaccine) on 23 February, with a second dose on 16 March [29], although they tested positive before full protection from the vaccine could be expected. Their family had not yet been vaccinated [29].
“Non-MIQ border failure” or uncertain		

Event	Extent of known spread	Details
Port worker outbreak / “marine employee” outbreak (October 2020)	The worker, 2 workplace contacts, 1 household contact	This maintenance worker was probably infected in the course of working on an international cargo ship. Genome sequencing has indicated that the same virus subtype was found in the crew of the relevant ship [31]. Potentially this infection came into NZ via infected crew flying from the Philippines into NZ to join their ship (since such arrivals were not routinely tested at this time). Two of this worker’s workplace contacts also became infected [32] and also one household contact [33].
Auckland Valentine’s Day Outbreak (February 2021)	15 cases [34]	On 14 February 2021, 3 community cases were detected within a single household in South Auckland [35]. Case A was a student at Papatoetoe High School [35], while Case B handled laundry for LSG Sky Chefs [36], a company which services airlines. The results of genome sequencing indicated that the cases were infected with the COVID-19 variant B.1.1.7 first detected in the UK [37]. The genome sequencing results did not directly link to any other positive cases in NZ [37], although there was a possible genomic similarity between a previous positive case in the Four Points by Sheraton MIQ facility [38]. It is likely that the Auckland Airport precinct where Case B worked was the source of the outbreak, but testing was unable to identify potential transmission routes [38]. This outbreak resulted in two separate lockdown events for Auckland, the first from 14 February to 17 February, the second from 27 February to 7 March [39].
Air crew member (March 2021)	1 case	This air crew member was likely exposed overseas [40]. The person returned to NZ from Japan on 28 February 2021 and returned a negative test result [41]. They then returned a positive test on 7 March 2021 during routine surveillance testing [41]. The person had received the first dose of the Pfizer/BioNTech vaccine, but it is likely that they were either incubating or infectious with COVID-19 before being vaccinated [40]. There was lower risk to the public due to Auckland being at Alert Level 3 for the period during which the person was in NZ, and they were either in isolation or at home for most of that time [41].

Table 2: List of confirmed and probable internal MIQ facility failures for COVID-19 control since July 2020 up to 29 March 2021 (ie, pandemic virus spread from one returnee to another)*

Event	Extent of known spread	Details
Returnee-related outbreak (Crowne Plaza, Christchurch), (September 2020)	1 returnee and 2 others within MIQ, with subsequent community spread	This was an internal MIQ facility transmission that also resulted in subsequent transmission to the people in the community (see Table 1). A returnee (Case C) was positive on day 12 and was relocated to another section of the MIQ facility, but prior to their relocation they stayed in a room adjacent to 2 other returnees, an adult and child (Cases D and E) who had arrived on the same flight [19]. Cases D and E completed 14 days of quarantine and each returned 2 negative tests, but later showed positive results in the community [19]. In no instance were the 3 cases outside of their rooms at the same time, but there was a 50-second window between closing the door to the room of Case C and opening the door to the room of Cases D and E [19]. A review of integrated closed-circuit television observations, genomic and epidemiological evidence, and review of the ventilation system has indicated that suspended aerosol particles were the probable mode of transmission within the MIQ facility [19]. Transmission from the surface of communal rubbish bins was considered less probable because contact with the bin lid occurred more than 20 hours apart for the involved cases [19]. Furthermore, shared air space is far more likely given what is now known about the likely rarity of transmission via surfaces [14] [15].
Probable infection in a MIQ facility (September/ October 2020)	1 returnee	As part of an outbreak investigation associated with spread of SARS-CoV-2 on an aircraft travelling to NZ [42], the authors state: “Passenger G was a travel companion of passenger F, and their date of symptom onset was consistent with infection during their stay in an MIQ facility, where they resided in the same room.”
Outbreak at the Sudima Christchurch Airport (November 2020)	19 mariners within MIQ, 2 workers	The investigation by Canterbury DHB estimated that 12 of the mariners involved were infected on arrival in NZ, but there was subsequent spread within the MIQ facility so that a total of 31 mariners were ultimately infected [43]. See Table 1 for the subsequent infection of 2 workers (ie, 2 separate border failures given 2 virus subtypes). The cause of infection spread among the mariners appears to have been a mix of system design failures (allowing double bunking and allowing use of a shared smoking area), along with the mariners breaking rules around sharing objects and socialising, etc. We have grouped this failure in this table as just a single one, but in reality it is likely to have involved many separate transmission events (all of which reflect a failure of the MIQ system), as opposed to a single super-spreading event.
Infection in a MIQ facility (January 2021)	1 returnee	See details in Table 1 regarding the “Northland case” and the Pullman MIQ facility.

Event	Extent of known spread	Details
Infection in a MIQ facility (January 2021)	2 returnees and a contact	See details in Table 1 regarding the Pullman MIQ facility.
Infection in a MIQ facility (January 2021)	1 returnee	A returnee from India via the United Arab Emirates (arrival date 16 January 2021) tested positive on Day 10 in the Pullman MIQ facility in Auckland [44]. Genome sequencing revealed that the case was infected with the B.1.1.7 strain of COVID-19 and suggested that this case was closely linked to another case in the facility [45]. The other case in the facility was genomically related to two cases in Australia: one air crew member who tested positive on 13 January 2021 and a subsequent case in a MIQ facility who was on the same flight as the crew member (G. Hall, Ministry of Health, personal communication to Prof David Skegg, 16 March 2021 in response to an OIA request). “Genomic and epidemiological evidence indicate possible transmission within the MIQ” (G. Hall 2021, ibid). Given this evidence and the time frame around first testing positive on Day 10, we would regard this as a “probable” infection within the MIQ facility.
Infection in a MIQ facility (March 2021)	1 returnee	A returnee in MIQ at Auckland’s Grand Mercure Hotel returned a positive day 12 test [46]. The case travelled from the UK via Singapore [46], but results from genome sequencing showed a link to another case at the Grand Mercure [47]. The two returnees arrived on separate flights within two days of each other, and they were staying in separate rooms on different floors [47]. One of the positive cases shared a bus to an exercise area in Mt Albert with other returnees on two separate occasions (19 March and 21 March) [46]. Fourteen of these other returnees were classified as close contacts and had their MIQ stays extended as a precaution, with additional tests scheduled [46, 47]. Additionally, 272 returnees who had left the facility since 10 March were asked seek a test immediately and self-isolate until a negative result was returned as a precautionary measure [10].

* This list is almost certainly incomplete and could be informed by a detailed analysis of people in MIQ facilities who tested negative initially (in pre-flight tests and/or in week one of their stay in the facility) and then tested positive on day 12.

Table 3: Additional options for improving border control in NZ so as to maximise the success of the travel green zone between Australia and NZ

Main aspect	Details

Main aspect	Details
Ventilation in MIQ facilities	Further improving ventilation arrangements to reduce all air flow from returnee rooms into corridors and where necessary ensuring all rooms have windows opening to the outdoors. Staggering of meal deliveries may also reduce air flow from one returnee room to another (as used in some Australian facilities).
Cohorting of returnees	Greater use of ‘cohorting’ where floors, and ideally whole hotels, take groups of travellers arriving at the same time to reduce the potential for recently arrived (and potentially infectious) returnees to infect those who are about to leave MIQ facilities.
Improving working conditions	Improving working conditions for staff in MIQ as per concerns voiced by staff [48] [49].
Post MIQ home quarantine	Introducing a post-MIQ home quarantine requirement for 5-7 days to reduce the risk that cases infected during their MIQ stay will infect others in the community. Other countries pursuing COVID-19 elimination have also focussed on this period. For example, Hong Kong recently extended the length of border quarantine from 14 to 21 days [50]. Additionally, in New South Wales testing has been extended to include day 16 [51].
Prosecuting rule breaking	Prosecuting people who breach the MIQ rules [52] [53]. Furthermore, routinely publishing all reported rule breaches and investigation reports into outbreaks on the Ministry of Health website to allow for continuous quality improvements (obviously without any identifying information on returnees). The current lack of transparency is shown by the need for journalists and others to repeatedly lodge Official Information Act requests to clarify what has happened.
QR code scanning	Mandating that all MIQ workers must scan QR codes and to have the Bluetooth part of their smartphones enabled (and if necessary, providing MIQ workers with smartphones).
CCTV monitoring	Ensuring that there are CCTV systems now comprehensively covering all MIQ facilities [54]. This can help identify near-misses, the cause of failures and, therefore, how to prevent these in the future.

Acknowledgements

The authors thank Professor David Skegg, University of Otago, for obtaining additional information from the Ministry of Health and for helpful comments on a draft of this blog.

References

1. Lowy Institute: Covid Performance Index. Lowy Institute, 2021. Available from: https://interactives.lowyinstitute.org/features/covid-performance/ (Accessed 3 February 2021).
2. Baker M, Wilson N, Blakely T: Elimination may be the optimal response strategy for covid-19 and other emerging pandemic diseases. *BMJ* 2020, 371:m4907. doi: 4910.1136/bmj.m4907.
3. Godfery M: New Zealand’s Māori tribes deserve recognition for their part in vanquishing Covid-19. The Guardian 2021;(5 February).

https://www.theguardian.com/world/commentisfree/2021/feb/06/new-zealands-maori-tribes-deserve-recognition-for-their-part-in-vanquishingcovid-19.
4. Wilson N, Grout L, Baker M: How best to classify and count NZ's border control failures in the COVID-19 pandemic? In: *Public Health Expert.* 2021.
5. Chief Economist Unit: August 2020: Here we go again: Covid-19 Wave Two. In: *Auckland Economic Quarterly.* Auckland Council 2020.
6. Hargreaves D: Westpac economists say the weekly hit to the economy with Auckland on Level 3 and the rest of NZ at Level 2 is about $300 million. Interest.co.nz 2021; (15 February). https://www.interest.co.nz/property/109055/westpac-economists-say-weekly-hit-economy-auckland-level-3-and-rest-nz-level-2-about.
7. Wilson N, Boyd M, Mansoor O, Delany L, Baker M: Expansion of "green zones" may provide a chance for the global eradication of COVID-19. Public Health Expert Blog 2021; (18 March). https://blogs.otago.ac.nz/pubhealthexpert/expansion-of-green-zones-may-provide-a-chance-for-the-global-eradication-of-covid-19/.
8. Grout L, Katar A, Ait Ouakrim D, Summers J, Kvalsvig A, Baker M, Blakely T, Wilson N: Estimating the failure risk of hotel-based quarantine for preventing COVID-19 outbreaks in Australia and New Zealand. medRxiv 2021;(19 February). doi: https://doi.org/10.1101/2021.02.17.21251946
9. New South Wales Government: NSW hotel quarantine worker surveillance and testing program. (Current as of 9 February 2021). https://www.health.nsw.gov.au/Infectious/covid-19/Pages/saliva-testing.aspx.
10. Ministry of Health: No new community cases; 11 cases of COVID-19 in managed isolation [press release]. 29 March 2021. Available from: https://www.health.govt.nz/news-media/media-releases/no-new-community-cases-11-cases-covid-19-managed-isolation2021.
11. Ministry of Health: Covid-19 source of cases. (Last updated 5 February 2021). https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-data-and-statistics/covid-19-source-cases.
12. Wilson N, Grout L, Kvalsvig A, Baker M: Time to Stop Dodging Bullets? NZ's Eight Recent Border Control Failures. Public Health Expert Blog 2020; (16 November). https://blogs.otago.ac.nz/pubhealthexpert/2020/11/16/time-to-stop-dodging-bullets-nzs-eight-recent-border-control-failures/.
13. Hadfield J, Douglas J, Geoghegan J, Storey M, Ren X, Freed N, Silander O, Jiménez-Silva C, French N, Drummond A *et al*: Re-emergence of community transmission in Aotearoa New Zealand – Genomic overview of the Auckland Outbreak. (Accessed 28 October 2020). ESR. https://nextstrain.org/community/narratives/ESR-NZ/GenomicsNarrativeSARSCoV2/2020-10-01?n=5.
14. Lewis D: COVID-19 rarely spreads through surfaces. So why are we still deep cleaning? *Nature* 2021, (E-publication 29 January). https://www.nature.com/articles/d41586-021-00251-4.
15. Meyerowitz EA, Richterman A, Gandhi RT, Sax PE: Transmission of SARS-CoV-2: A Review of Viral, Host, and Environmental Factors. *Ann Intern Med* 2021, 174(1):69-79.
16. Ministry of Health: 6 new cases of COVID-19 [press release]. 9 September 2020. Available from: https://www.health.govt.nz/news-media/media-releases/6-new-cases-covid-19-42020.
17. Ministry of Health: 1 new case of COVID-19 [press release]. 14 September 2020. Available from: https://www.health.govt.nz/news-media/media-releases/1-new-case-covid-19-18.

18. Quinn R: Covid-infected nurse ‘did everything right’, report finds. Radio NZ 2020; (6 November). Available from: https://www.rnz.co.nz/news/national/429973/covid-infected-nurse-did-everything-right-report-finds.
19. Eichler N, Thornley C, Swadi T, Devine T, McElnay C, Sherwood J, Brunton C, Williamson F, Freeman J, Berger S *et al*: Transmission of Severe Acute Respiratory Syndrome Coronavirus 2 during Border Quarantine and Air Travel, New Zealand (Aotearoa). *Emerging Infectious Diseases Journal* 2021, 27(5).
20. Ministry of Health: No new cases of COVID-19 [press release]. 2 October 2020. Available from: https://www.health.govt.nz/news-media/media-releases/no-new-cases-covid-19-502020.
21. Ministry of Health: 2 new cases of COVID-19 [press release]. 27 September 2020. Available from: https://www.health.govt.nz/news-media/media-releases/2-new-cases-covid-19-21.
22. Ministry of Health: 1 case of COVID-19 in quarantine worker [press release]. 7 November 2020. Available from: https://www.health.govt.nz/news-media/media-releases/1-case-covid-19-quarantine-worker.
23. Ministry of Health: 4 new cases of COVID-19 in managed isolation [press release]. 9 November 2020. Available from: https://www.health.govt.nz/news-media/media-releases/4-new-cases-covid-19-managed-isolation.
24. Ministry of Health: 2 cases of COVID-19 in managed isolation; update on Northland case [press release]. 26 January 2021. Available from: https://www.health.govt.nz/news-media/media-releases/2-cases-covid-19-managed-isolation-update-northland-case.
25. Ministry of Health: Update on Northland case, and 6 cases of COVID-19 in managed isolation [press release]. 25 January 2021. Available from: https://www.health.govt.nz/news-media/media-releases/update-northland-case-and-6-cases-covid-19-managed-isolation2021.
26. Ministry of Health: 3 new cases of COVID-19 at the border and an update on border-related cases in Auckland [press release]. 28 January 2021. Available from: https://www.health.govt.nz/news-media/media-releases/3-new-cases-covid-19-border-and-update-border-related-cases-auckland2021.
27. Ministry of Health: 7 cases of COVID-19 [press release]. 4 February 2021. Available from: https://www.health.govt.nz/news-media/media-releases/7-cases-covid-192021.
28. Ministry of Health: Ministry reporting positive COVID-19 case at the border [press release]. 22 March 2021. Available from: https://www.health.govt.nz/news-media/media-releases/ministry-reporting-postive-covid-19-case-border2021.
29. Covid-19: MIQ worker’s family returns three negative, one weak positive result – Hipkins. In: *Radio New Zealand.* 2021.
30. Ministry of Health: No new community cases; 3 cases of COVID-19 in managed isolation [press release]. 26 March 2021. Available from: https://www.health.govt.nz/news-media/media-releases/no-new-community-cases-3-cases-covid-19-managed-isolation-02021.
31. Ministry of Health: 1 new case of COVID-19 in managed isolation; no new community cases [press release]. 30 October 2020. Available from: https://www.health.govt.nz/news-media/media-releases/1-new-case-covid-19-managed-isolation-no-new-community-cases.

32. Ministry of Health: 25 new cases of COVID-19 [press release]. 21 October 2020. Available from: https://www.health.govt.nz/news-media/media-releases/25-new-cases-covid-192020.
33. Ministry of Health: 9 new cases of COVID-19 [press release]. 23 October 2020. Available from: https://www.health.govt.nz/news-media/media-releases/9-new-cases-covid-19-52020.
34. COVID-19: Source of cases [https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-data-and-statistics/covid-19-source-cases]
35. Ministry of Health: 4 new cases of COVID-19 [press release]. 14 February 2021. Available from: https://www.health.govt.nz/news-media/media-releases/4-new-cases-covid-19-32021.
36. Ministry of Health: 8 pm update on community cases [press release]. 14 February 2021. Available from: https://www.health.govt.nz/news-media/media-releases/8-pm-update-community-cases2021.
37. Ministry of Health: Update on genomic sequencing [press release]. 15 February 2021. Available from: https://www.health.govt.nz/news-media/media-releases/update-genomic-sequencing2021.
38. Ministry of Health: 6 border cases and 1 linked community case already in managed isolation [press release]. 22 February 2021. Available from: https://www.health.govt.nz/news-media/media-releases/6-border-cases-and-1-linked-community-case-already-managed-isolation2021.
39. Timeline: The year of Covid-19 in New Zealand. In: *Radio New Zealand.* 2021.
40. Ministry of Health: 1 border-related case announced yesterday; 5 cases of COVID-19 in managed isolation [press release]. 8 March 2021. Available from: https://www.health.govt.nz/news-media/media-releases/1-border-related-case-announced-yesterday-5-cases-covid-19-managed-isolation2021.
41. Ministry of Health: Confirmed case at the border [press release]. 7 March 2021. Available from: https://www.health.govt.nz/news-media/media-releases/confirmed-case-border2021.
42. Swadi T, Geoghegan JL, Devine T, McElnay C, Sherwood J, Shoemack P, Ren X, Storey M, Jefferies S, Smit E *et al*: Genomic Evidence of In-Flight Transmission of SARS-CoV-2 Despite Predeparture Testing. *Emerg Infect Dis* 2021, 27(3).
43. Canterbury District Health Board: International Mariners Quarantine: Summary of official information request (page updated 22 January 2021). https://www.cdhb.health.nz/about-us/document-library/international-mariners-quarantine/.
44. Ministry of Health: 4 new cases of COVID-19 in managed isolation; 1 historical case [press release]. 27 January 2021. Available from: https://www.health.govt.nz/news-media/media-releases/4-new-cases-covid-19-managed-isolation-1-historical-case2021.
45. Ministry of Health: 4 cases of COVID-19 in managed isolation [press release]. 2 February 2021. Available from: https://www.health.govt.nz/news-media/media-releases/4-cases-covid-19-managed-isolation-02021.
46. Nichols L: Covid 19 coronavirus: Officials investigating if positive MIQ case caught virus from another guest. In: *New Zealand Herald.* 2021.
47. Ministry of Health: No new community cases; 6 cases of COVID-19 in managed isolation [press release]. 25 March 2021. Available from:

https://www.health.govt.nz/news-media/media-releases/no-new-community-cases-6-cases-covid-19-managed-isolation-02021.
48. Gregan K: MIQ nurses speak out: ‘We’re going to get sloppy … we’re tired and stressed’. Radio NZ 2021; (9 February). https://www.rnz.co.nz/news/national/436036/miq-nurses-speak-out-we-re-going-to-get-sloppy-we-re-tired-and-stressed.
49. Gregan K: Covid-19: MIQ nurses concerned about staffing, instability at border facilities. Radio NZ 2021; (11 January). https://www.rnz.co.nz/news/national/434321/covid-19-miq-nurses-concerned-about-staffing-instability-at-border-facilities.
50. Government of Hong Kong Special Administrative Region: Government tightens restrictions and compulsory quarantine requirements for persons arriving at Hong Kong who have stayed in places outside China [press release]. 25 December 2020. Available from: https://www.info.gov.hk/gia/general/202012/25/P2020122500012.htm.
51. Visontay E: Day 16 test: Australian health experts weigh proposal for post-quarantine coronavirus check. The Guardian 2021;(7 February). https://www.theguardian.com/australia-news/2021/feb/07/day-16-test-health-experts-weigh-proposal-for-post-quarantine-coronavirus-check.
52. Cheng D: Covid 19 coronavirus: Chafing under the rules – 76 bubble breaches in four months. New Zealand Herald 2020; (28 November). https://www.nzherald.co.nz/nz/covid-19-coronavirus-chafing-under-the-rules-76-bubble-breaches-in-four-months/5WLODXO7S4SBCZY7UWBWKSZOUI/.
53. Cheng D: Covid 19 coronavirus: How often bubbles have been breached in MIQ (and how many people have been penalised). New Zealand Herald 2021; (9 January). https://www.nzherald.co.nz/nz/covid-19-coronavirus-how-often-bubbles-have-been-breached-in-miq-and-how-many-people-have-been-penalised/Q7MXNNMRJNGH7TM5T53VHH5MDM/.
54. Check point Radio NZ: CCTV in more than half MIQ hotels not up to scratch. Radio NZ 2021; (3 February) https://www.rnz.co.nz/national/programmes/checkpoint/audio/2018782165/cctv-in-more-than-half-miq-hotels-not-up-to-scratch.

Public Health Expert Briefing (ISSN 2816-1203)
