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How best to classify and count NZ's border control failures in the COVID-19 pandemic?

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In taking a systems approach to pandemic control, it is helpful to define what is meant by a "border control failure" so that such events can be used to guide performance improvement. This blog proposes specific definitions for the current context in Aotearoa NZ. It concludes that since July 2020, NZ has had at least 10 border control failures (9 via MIQ facilities and one via a port), and at least 5 "internal MIQ facility failures" involving spread between returnees.

Aotearoa NZ has done very well overall with its COVID-19 pandemic response – as acknowledged recently by a first place in a world ranking by the Lowy Institute in Australia

[1]. NZ's economic indicators also compare favourably to countries using a "suppression" strategy, as opposed to NZ's elimination strategy [2]. Credit is owed to political leadership, science advisors, health workers, iwi [3], and indeed the whole "Team of 5 million". The staff in managed isolation and quarantine (MIQ) facilities have worked particularly hard (often despite suboptimal conditions [4] [5]) and the issues raised in this blog are not at all about them as individuals – but rather are focused on system design issues.

In this blog we focus on one particular weakness in NZ's response – the repeated failures in border protection against COVID-19. We previously detailed eight such failures up to November 2020 [6], but since then more have occurred (see Table 1). In contrast, the Ministry of Health avoids the term "border failure" but rather details "incidences" [7]. In a recent media release (albeit just focused on facility-related failures) the Ministry stated: "The infections involve 7 events across 5 facilities" [7].

Unfortunately, that report from the Ministry of Health, which received wide media coverage, underestimated the problem. In our view, some failures were overlooked. Also, we consider it useful to take a systems approach so that attention is more carefully focused on targeting future prevention efforts (ie, sectors such as aviation and healthcare delivery have repeatedly shown the importance of effective error management and learning from failures [8]). In light of this we suggest the following definitions:

> A "**border failure**" in the NZ COVID-19 pandemic control context is one where a person in the NZ community is infectious with SARS-CoV-2 at a time when the national policy is to keep the pandemic virus out of the country. A managed isolation/quarantine (MIQ) facility worker is part of "the community" (unless they are living in the facility) while a returnee in a managed setting (MIQ facility) is still regarded as being "contained at the border". But if a returnee has left a MIQ facility and entered the community while still infectious, then that is a "border failure", even if they don't trigger further cases.
>
> There are two obvious subsets of "border failure": a "**MIQ facility failure**" where the failure occurs in a MIQ facility or "**non-MIQ border failure"** where the failure results from another pathway (eg, the infection of a port worker as detailed in Table 1).
>
> An **"internal MIQ facility failure"** is where there is spread of SARS-CoV-2 infection from one returnee to another. Most of those staying in MIQ who test positive at the 12 day test are likely to be failures of this type, and genome testing can be used to help confirm such transmission events. This type of failure can sometimes also contribute to a "border failure" if it results in a new case going into the community with an undetected infection.

Our classification of border failures and MIQ facility failures to date

As detailed in the two tables below, we consider that since July 2020, NZ has probably had a total of at least 10 border control failures (9 via MIQ facilities and one via a port). There have also been at least 5 "internal MIQ facility failures" involving spread between returnees. This figure is likely to be a large underestimate as many of those who test positive at day 12 of their stay in MIQ are likely to be infections from within MIQ facilities.

There have been ongoing system improvements to address these failures, but hotel-based facilities have inherent problems with shared spaces and inadequate ventilation (as recognised in WHO guidance [9]). One approach would be to move MIQ facilities outside of

cities, as per the converted workers camp at Howard Springs in Australia or to establish mobile homes/caravans at military bases (eg, at Ōhakea air base [10]). Alternatively, purpose-built facilities could be established, as is being considered by the Queensland Government [11]. It is acknowledged that there would be some practical challenges in building and staffing such facilities, especially away from population centres.

Another approach is to improve arrangements with existing hotel-based MIQ facilities via these 12 measures:

1. Reducing the number of infected travellers arriving in the MIQ facilities – which requires a particular focus on the "red zone" countries (with the arguments and legal issues discussed here: [12]).
2. Only using MIQ facilities in large cities for the lowest-risk travellers (eg, those from Australia).
3. 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 people) to infect those who are about to leave MIQ facilities.
4. Eliminating use of all shared areas entirely (including exercise and smoking areas) and with returnees staying in their rooms throughout the full MIQ process (as is routine in some overseas jurisdictions). Smokers should be offered nicotine replacement therapy and other smoking cessation treatments and support.
5. Further improving ventilation arrangements to reduce all air flow from returnee rooms into corridors (and possibly ensuring all rooms have windows opening to the outdoors). Staggering of meal deliveries may also reduce air flow from one returnee room to another.
6. 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 [13] and in other countries.
7. Mandating that all MIQ workers must scan QR codes and to have the Bluetooth part of their smartphones enabled.
8. Fast tracking vaccination against COVID-19 for all MIQ staff (which may actually be planned already).
9. Urgently upgrading CCTV systems to comprehensively cover all MIQ facilities [14].
10. Improving working conditions for staff in MIQ as per concerns voiced by staff [4] [5].
11. Prosecuting people who breach the MIQ rules [15] [16]. Also, 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).
12. 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 [17]. Additionally, in New South Wales testing has been extended to include day 16 [18].

Table 1: List of COVID-19 border control failures in New Zealand from July 2020 up to 7 February 2021

Event	Extent of known spread	Details
"MIQ facility failure" (including one being "probable")		
Auckland August 2020 outbreak	A total of 179 cases, with 3 deaths [19]	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 [6], and as detailed in the work of the genomics experts [20]. 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 [21] [22]).
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 [20] [23]. The genomic sequencing found a link with a returnee in this facility [20]. 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 [21] [22].
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 [24]. This was a rare situation where part of the investigation report was made available to the media [25].
Returnee-related outbreak (Crowne Plaza, Christchurch), (September 2020)	The returnee and 2 others	This returnee was thought to have been infected within a hotel quarantine facility before then moving into the community [26]. This infected returnee appears to have then infected another person (potentially on a charter flight after leaving the facility) [26]. A household contact was also infected [27]. While officials hypothesise the role of touching a rubbish bin in the MIQ facility, we suspect that shared air space is far more likely given what is now known about the likely rarity of transmission via surfaces [21] [22].
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 [28]. 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".

Event	Extent of known spread	Details
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 [29]. 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)	1 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 [30]. Genome sequencing has linked the case to another returnee who was in the same MIQ facility [31]. 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) [32]. A close contact (the mother of the child) also became infected [33]. Further investigations are pending (as per the other cases from the Pullman facility detailed in the row above).
"Non-MIQ border failure"		
Port worker outbreak (October) / "marine employee" outbreak	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 [34]. 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 [35] and also one household contact [36].

Table 2: List of confirmed and probable internal MIQ facility failures for COVID-19 control since July 2020 up to 7 February 2021 (ie, pandemic virus spread from one returnee to another)*

Event	Extent of known spread	Details

Event	Extent of known spread	Details
Returnee-related outbreak (Crowne Plaza, Christchurch), (September 2020)	1 returnee in MIQ and 2 others in the community	As per Table 1 (ie, this was an internal MIQ facility transmission that also resulted in subsequent transmission to the people in the community).
Probable infection in a MIQ facility (September/October)	1 returnee	As part of an outbreak investigation associated with spread of SARS-CoV-2 on an aircraft travelling to NZ [37], 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 [38]. 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 facility. Investigations are still pending.
Infection in a MIQ facility (January 2021)	2 returnees and a contact	See details in Table 1 regarding the Pullman facility. Investigations are still pending.

* 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. We also note in a media release from the Ministry (second table [7]) a case described as “Pullman Auckland: UK variant link to Australian flight” (26 January 2021) in which infection occurred in the facility and was detected in the facility. We are awaiting more information on this case before including it in this list.

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