ISSN 2624-0106

RESEARCH NOTE

Safer arrivals and the path to 2022

THE NEW ZEALAND INITIATIVE

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6 October 2022

Summary

Until August 2021, New Zealand laudably maintained elimination. Elimination was fragile. Risky practice in MIQ and inadequate travel safeguards meant constant risk of outbreaks. Policy that amounted to constant testing of luck could not withstand a more contagious variant. September's lockdown in Auckland failed to re-establish elimination, and October brought an abandoning of elimination in favour of active suppression.

Covid seems established in Auckland. Vaccination rates are far too low to avoid substantial pressure on the health system, illness, and death without strong suppression measures being in place. Redoubled efforts to encourage vaccination are critically important.

Modelling published in *The Lancet* suggests that if vaccination rates are 90%, including those under the age of twelve currently ineligible for vaccination, even ten infected arrivals daily into the community would put strain on hospital capacity; at rates less than that, that strain would be unbearable in the absence of additional layered protections.[2]

Where more than ten percent of the population is currently not eligible to be vaccinated, restrictions into 2022 are likely. Even at full vaccination, some measures, like improved ventilation in schools, will make sense.

Models are contentious. Regardless of models, experience abroad suggests far higher vaccination rates remain necessary.

By early August, over 70% of people in Spain had received at least one vaccination dose, and 60% were fully vaccinated. In late August, there were 38 Covid patients in Spanish intensive care units [ICU] per million population.

In Alberta, Canada, over 70% of the population over the age of 12 were fully vaccinated by mid-September – or 61% of the full population. Alberta's Premier had eased Covid restrictions in pursuit of a summer of freedom. On 15 September, in early autumn, the Alberta government re-imposed substantial restrictions in response to a sharp warning from the province's doctors that their medical system would fall apart within the month absent restrictions.[3]

When Alberta's restrictions were re-imposed, 50 Albertans for every million population were in ICU with Covid, and about 90% of those Covid patients were unvaccinated. By 28 September, 268 Albertans were in ICU with Covid, of a population of 4.4 million. Or over 60 per million population.

New Zealand has only 46 ICU per million population. OECD statistics from before Covid had New Zealand on about a third of the OECD average ICU capacity, per capita.[4]

Absent strong measures to reduce transmission, Auckland's outbreak will temporarily severely strain New Zealand's healthcare system.

We here present measures that could assist in keeping case numbers down while vaccination progresses.

Our recommendations would enhance safety during the current outbreak, reduce the costs of new outbreaks that emerge, and enable the country to open as much as is possible, as safely as is possible, early in the year ahead. It recommends options that enable flexible responses to changing circumstances and governance arrangements that would result in better options being taken up.

Summary of Recommendations:

1. At-school vaccinations should be provided to those aged 12-18, particularly at schools serving communities with low vaccination rates. This should begin immediately as Auckland's schools re-open. Parents could be welcomed to be vaccinated with their children.
2. That non-mRNA vaccination options be made available to encourage vaccination among those hesitant about mRNA vaccines.
3. That MedSafe move in parallel with the FDA in assessing vaccines for those under 12, with New Zealand not being slower than authorities abroad to approve. FDA approval for 5-12 year-olds may come as early as end-October 2021.[5]
4. That the Government prepare to distribute vaccines at primary and intermediate schools as soon as vaccines are approved for younger age groups.
5. That MedSafe ensure any appropriate variant-specific boosters that might be developed are assessed expeditiously so that they can be quickly ordered. Government should quickly signal intent to purchase effective Delta-specific booster shots, conditional on their development and approval.
6. That the Government build on innovative successes emerging within different District Health Boards. Targets for DHBs could help.
7. That the Government prepare for weekly saliva-based PCR testing at every primary and secondary school, for staff and students, so that it can be rapidly deployed if community transmission becomes more established. Having the systems in place ahead of need enables their use when needed. Contracting procedures should ensure that any contracted test is appropriately validated and meets international standards.
8. That the Government procure large volumes of rapid antigen tests for widespread distribution to essential workplaces during periods of restrictions for daily testing of essential workers, if PCR testing is not sufficiently frequent, and for broader roll-out in case of any very widespread outbreak in which other testing systems cannot keep up.
9. That the Government enable firms, venues, universities and others to require vaccination and/or a recent negative test result for entry into their premises, if they wish to set such requirements, by making clear that it is legal to do so, and by providing reliable proof of vaccination and recent testing status.
10. That a Public Health Order be issued requiring vaccination for those in roles dealing with the vulnerable, including children too young to be vaccinated and the immunocompromised. The Order should, in the first instance, encompass health workers, aged care workers, emergency services, early childhood educators, teachers, corrections staff, and other occupations that routinely deal with the vulnerable.
11. That the Government prepare and publicise differential Covid alert restrictions that might apply between places catering exclusively to the vaccinated and those that do not in future outbreaks that threaten health system capabilities, in hope that they not be needed.
12. That the Government ensure that those in the new residence visa queue are treated as residents while their applications are in progress – exempt from bans on residential property purchases, able to access education for their children at domestic student rates, and with work rights for their children as they reach the age of majority.
13. That the Government prioritise entry into MIQ and residence visas for health workers currently based abroad to avoid erosion in hospital and ICU capacity.
14. That the government quickly procure pharmaceutical Covid treatments proving effective and being stockpiled overseas so that they are here available if needed.
15. That the Ministry of Education supply schools with inexpensive carbon dioxide monitors as a simple way of checking classroom ventilation, while encouraging teachers to open windows if

carbon dioxide levels rise. That the Ministry consider all of the measures suggested by Kvalsvig et al, 2021, for improving classroom ventilation – and that Government consider these measures in other public buildings, like police stations, courtrooms, libraries and government offices. They should also strongly be recommended for households where one member is self-isolating – especially if increasing case numbers require positive cases to isolate at home.

16. That the Government trial air filtration units in quarantine facilities to assess their potential use in reducing transmission in hospital and educational settings.
17. That the Government set a specialist Infectious Disease Agency as part of ongoing health sector restructuring. A special category of viruses of extreme concern could be set as pandemics caused by bioengineered agents posing existential risk are not impossible.
18. That that the governance of the Infectious Disease Agency include industry expertise.
19. That the Agency, when public health measures are in force, also report to an Epidemic Response Committee of Parliament chaired by a member of the Opposition.
20. That all travellers to New Zealand, barring those with medical exemptions, be fully vaccinated and screened for Covid at the airport before boarding flights to New Zealand to reduce the number of infected arrivals – in addition to current PCR testing requirements. Travellers departing New Zealand with return flights should also be vaccinated.
21. That the MIQ system implement daily PCR saliva-based testing of all guests and workers while collecting data on Covid incidence among returning visitors, providing a better evidence base for easing restrictions as vaccination rates increase.
22. That those leaving MIQ be required to present for a post-MIQ Covid test at an interval after leaving MIQ and maintain accurate details using the Covid tracer app.
23. That the proposed trial of self-isolation for business travel from New Zealand proceed.
24. That improved information on Covid onset among arriving passengers from places with different Covid risks, as well as information on compliance with post-isolation testing, be used in informing future decisions about duration of MIQ or home isolation for arrivals when the vaccination programme has further progressed. Ideally, when vaccination has completed, fully vaccinated travellers from safer places, PCR tested before travel, antigen tested at the airport abroad, and tested again on arrival, would need only to present for a post-arrival test a suitable interval after landing.
25. That dedicated MIQ facilities be constructed in case new and more dangerous variants emerge, and to facilitate arrivals from riskier places should supervised isolation continue to be necessary.
26. That the Government allow MIQ providers to handle their own bookings and charge their own rates, while the Government charges providers for the cost of the services it provides. The Government could provide flat-rate vouchers to returning Kiwis whose travel the Government wishes to subsidise.
27. Alternatively, the government could allocate a third of MIQ spaces by auction while using other methods for the remaining spaces. This would enable those with urgent travel needs to find spaces while allowing those whose needs are less pressing to use the normal system.
28. The shift to active suppression in Auckland could allow more dramatic easing of MIQ requirements if fully vaccinated travellers arriving through an augmented screening system have a lower rate of Covid than is likely to be already prevalent in Auckland. The system could change to permit incoming travel to Auckland without facility-based quarantine.
29. That the Government, in consultation with the shipping companies, the Employers and Mnaufacturers Association, and Business New Zealand, establish better systems for crossing the Auckland boundary.

Introduction

From May of 2020 through August 2021, New Zealand enjoyed the benefits of having attained Covid elimination. Barring a brief spell of restrictions in Auckland in August 2020, in mid-February, and then again in the first week of March 2021, New Zealanders were able to enjoy a largely Covid-free existence. For those without family connections abroad, without a business need to travel abroad, and without international students or international visitors as normal customers, life during the pandemic was laudably similar to life before the pandemic.

While the pandemic raged abroad, overwhelming hospitals, closing schools, and disrupting normal business and family connections, Kiwis were able to enjoy lives more normal than anywhere else in the world except perhaps for Taiwan. It is entirely plausible that New Zealanders were able to enjoy more real freedom than people in any other country in the world, full-stop.

That freedom rested on a fragile base. Throughout the pandemic, obvious risks in the border system were not remedied. Obvious opportunities for strengthening testing and tracing capabilities were not taken up. And the pandemic management system, including the Ministry of Health, the Ministry of Business, Innovation and Employment, the Department of Prime Minister and Cabinet, and Cabinet, proved largely impervious to external advice – with the Ministry of Health drawing strongest critique.

Reports recommended improvements to border systems, to contact tracing, and to testing regimes. The need to strengthen ICU capacity was obvious. Regardless of the government's stated intentions, necessary improvements were not undertaken.

The system that held together through 2020 and 2021 is not fit for purpose as the pandemic and the pandemic response moves to its next phase. As vaccination rates increase and border restrictions ease, the Covid response system will need to be far nimbler. It will need to be able to take external advice, to adapt as circumstances change, ensuring that necessary and promised measures are actually undertaken, and to deliver the more nuanced set of protections appropriate for a vaccinated country wishing to prevent outbreaks.

We do not wish to relitigate inadequacies identified earlier this year and in 2020.

We believe better systems are needed for the year ahead.

In February 2020, public health experts at the University of Otago encouraged the establishment of a dedicated public health agency.[6] They saw the fragmentation of expertise across agencies as having contributed to the 2019 measles outbreak. In September 2020, the Simpson-Roche review found that the pandemic response model was not fit for ongoing purpose.[7] Calls for a dedicated agency were repeated in late 2020 and again by Professor Des Gorman and Dr Murray Horn in July 2021.[8] In September 2021, contact tracing systems remained inadequate, testing regimes had not been updated to suit novel and more infectious variants, and border systems remained fragile.

This brief Research Note suggests immediate measures to be implemented to prepare for 2022. And it proposes an Infectious Disease Agency to take responsibility for the pandemic response and maintain preparedness for future epidemics.

The Path to 2022: Vaccination

Everyone understands the need for high rates of vaccination.

Vaccination is important not only in reducing the risk of infection and of severe medical consequences if infected but also in reducing the risk to others. Vaccinated people are less likely to catch Covid. While those who catch Covid while vaccinated can pass it on to others, as vaccination does not provide sterilising immunity, a reduced risk of catching Covid combined with a reduced risk of transmitting it if infected[9] means a reduced total risk of passing the virus on.

Additionally, because vaccinated people are less likely to develop more severe illnesses as result of Covid, if they catch Covid, they are less likely to take up scarce spaces in intensive care units. Vaccination also seems to reduce the risk of long-Covid, though evidence there is still developing.

Vaccination provides a strong public good as economists define the term. It provides non-excludable Pareto-relevant benefits to others over and above the benefits enjoyed individually. Those external benefits operate both directly, by reducing the risk that you infect others, and indirectly by reducing the burden on the public health system.

These latter external benefits are contentious in the economic literature. Normally, external benefits that run through the public health system would be considered fiscal externalities: they change the identity of who bears a set cost but do not change the quantum of cost. For example, if a sedentary lifestyle increases your risk of heart attack, the public health system changes who pays the hospital bill. But unless that offloading of cost increases your likelihood of taking on a sedentary lifestyle, the external cost should be considered as a pecuniary externality. Pecuniary externalities can be important on equity grounds but have no bearing on efficiency.

External costs running through the public health system become categorically different in pandemics that risk overwhelming the health system. A public health system builds up steady-state capabilities consistent with its normal loading. If many people choose less healthy lifestyles, spending on the health system is higher than it otherwise might be, with either less spending elsewhere or higher taxes to cover that cost. But it should not result in direct health costs to others, and especially where those with high effective demand for health services can take up private insurance options.

In a pandemic in which Covid patients take up substantial proportions of ICU capacity, surgeries are delayed for want of ICU beds. These externalities operate directly through the production function for the health system and through the utility function for those whose surgeries are delayed; they do not operate merely indirectly through the budget constraint. That makes the experienced externalities technological rather than pecuniary, and highly relevant for policy.

Where vaccines are less than fully protective against infection, but where the unvaccinated present substantially higher risks of infecting others, including those who have been vaccinated, the case for policy measures encouraging vaccination strengthens – as is obvious by considering the counterexample.

If a vaccine were completely effective in preventing infection, and if everyone wishing to be vaccinated could be vaccinated, including children, then the unvaccinated would impose no direct external cost on the vaccinated. The only potential externality would run through hospital and ICU capacity.

But where vaccination is less than entirely effective, external costs will be imposed. In the absence of policy changes, the unvaccinated will impose costs on the vaccinated in the same way that a drunk driver imposes costs on sober drivers and pedestrians: they impose a substantially increased risk on others.

Alternatively, policy changes mandating vaccination in some high-risk occupations, and allowing businesses and public facilities to set vaccination requirements for entry, would impose costs on the unvaccinated in the same way that rules against drunk driving impose costs on those who prefer to drive while intoxicated.

The government has been reluctant to set a firm target for vaccination rates, potentially because vaccination rates less than 90% of the total population, including children currently considered too young to be vaccinated and who constitute more than 10% of the total population, continue to present risks of outbreaks.[10] Universal vaccination is best if it can be achieved.

It is difficult, from outside of government, to know what measures are already underway.

It was not long ago that those urging the government to purchase vaccine booster shots for 2022 were told that doing so would hinder global vaccination efforts and that the government had no intention of making such orders.

On 8 September, the government announced that Novavax is the most likely candidate for boosters in 2022 and that over 5 million doses are on order,[11] with MedSafe approval still in progress. In August, Novavax had delayed submitting its vaccine for US Food and Drug Administration [FDA] approval until the last quarter of 2021.[12] It is easier to bank on MedSafe approval of vaccine candidates already approved by other trusted regulators and in widespread use overseas. We hope that other options are also on order in case MedSafe approval is not secured.

We also hope that the measures we here encourage are already in progress. If they are not, we urge that they be considered.

Recommendations:

1. At-school vaccinations should be provided to those aged 12-18, particularly at schools serving communities with low vaccination rates. This should begin immediately as Auckland's schools re-open. We recommend that all students receive vaccines, with the option to opt-out. In an ideal scenario, local physicians could provide information about vaccination to students at school before an in-school program is implemented. Parents could be welcomed to be vaccinated with their children at school.
2. That non-mRNA vaccination options be made available to encourage vaccination among those hesitant about mRNA vaccines. If boosters in 2022 are likely to be non-mRNA, the government could seek to bring forward delivery of a small quantity for use as first-doses for those groups.
3. That MedSafe move in parallel with the FDA in assessing vaccines for those under the age of 12, with New Zealand not being slower than authorities abroad to approve if authorities abroad provide approval. FDA approval for 5-12 year-olds may come as early as end-October 2021.[13]
4. That the Government prepare to distribute vaccines at primary and intermediate schools as soon as vaccines are approved for younger age groups.
5. That MedSafe ensure any appropriate variant-specific boosters that might be developed are assessed expeditiously so that they can be quickly ordered. Where Delta is the globally most-prevalent strain, new variants are likely to emerge from Delta, and vaccines tuned to Delta may be more effective in dealing with new variants than vaccines developed for the original Wuhan strain of the virus. Government should quickly signal intent to purchase effective Delta-specific booster shots, conditional on their development and approval.
6. That the Government build on innovative successes emerging within different District Health Boards. Auckland began Pasifika mass vaccination events on 9 September.[14] Te Whānau o Waipareira began training young Māori to administer vaccines to help encourage greater vaccination.[15] Even hard-to-reach groups can be reached: the Mongrel Mob Kingdom plans to hold a Covid-19 education workshop,[16] including a pop-up vaccination site for members and

whanau. The Ministry of Health collates vaccination outcome data by ethnicity and by District Health Board. DHBs having difficulty in reaching some communities should learn from those who have had greater success. Targets for DHBs could help.

The Path to 2022: Layered protection

The Government has rightly emphasised layered protection in reducing the risk of Covid entering the country, and in reducing its spread.

As vaccination progresses, different opportunities present for additional layered protection. Other places that have had to deal with high Covid rates have found some sets of policies that have helped reduce transmission. Some of these will be helpful here as well, in reducing transmission in the current outbreak and in increasing safety as border restrictions ease.

Some of these options may already be under current consideration.

Testing Systems

Appropriate testing systems evolve as technology and circumstances change.

Currently, New Zealand relies heavily on relatively expensive but accurate swab-based PCR tests. Saliva-based PCR tests that are at least as accurate as New Zealand's pharyngeal swab tests,[17] but that are less costly, more easily scalable, and that do not require nursing staff to collect samples have been available abroad since August 2020, and have been available in New Zealand since January 2021. They are largely not part of the Government's testing system, but private companies have contracted for those tests for their employees. They have also been in use for travellers needing PCR results within 72 hours of travel.

Rapid antigen tests are less accurate than PCR tests at low viral loads. At higher viral loads, when someone is most likely to be infectious, they have been shown to be reliable. The Johns Hopkins University Center for Health Security maintains a database listing the sensitivity and specificity of commercial tests.[18] A test's sensitivity indicates the probability of a positive test result among those with the condition. Rapid tests listed by Johns Hopkins range in sensitivity from 80% to 97.6%. But the database is not clear about the use cases – whether they refer to sensitivity at all viral loads or just at higher viral loads.

Different types of tests and testing systems are suitable for different circumstances, and New Zealand's testing regime has not proved flexible to changing circumstances.

When Covid is restricted to the border system, regularised testing systems far from the border, beyond wastewater surveillance testing and testing of those symptomatic, is unnecessary.

When Covid is in the community, broader surveillance testing regimes are necessary, even when the population is largely vaccinated. Schools and early childhood centres present particular risk because those under the age of 12 remain ineligible for vaccination.

Alberta's current outbreak has seen over 11,600 cases among the 661,000 children under the age of 12 in the past four months. 73 wound up in hospital, 59 of whom had no pre-existing condition. 13 required treatment in Intensive Care Units[19].

Every case winding up in hospital is tragic, regardless of pre-existing conditions. But those without pre-existing conditions should not imagine that they, or their children, will not wind up in hospital or intensive care.

While children are at less risk from Covid than adults, they certainly can catch Covid and experience serious health consequences. They can also transmit it to family members. This matters especially in

places where children live either with a grandparent or in multigenerational households, including the elderly. Schools can provide unvaccinated repositories for virus circulation; regular testing at schools will be important.

The American state of Illinois provides a promising example. The University of Illinois pioneered a rapid, accurate, saliva-based PCR Covid test for use on its campus over a year ago; they understood testing to be important in helping classes to be able to continue in normal fashion. In the 2020 Fall semester, the University of Illinois performed over a million tests using their testing protocol and were able to keep classrooms open as consequence.[20]

While the New Zealand Ministry of Health's position has been that saliva testing is inappropriate for surveillance,[21] over a million surveillance tests at the University of Illinois in a single semester seem to suggest the Ministry is at least somewhat misguided.

As of 10 September 2021, that testing programme had extended to almost half of Illinois's K-12 schools.[22] Over 1700 schools offered free weekly testing for almost a million staff and students at participating schools. The programme does not include schools in Chicago, which will be offering testing through a separate federally-funded programme.

Half of the state of Illinois, outside of the most urban part of the state, was able to deploy weekly saliva-based PCR testing, despite the more difficult logistical task of collecting samples outside of the most urbanised part of the state. The Illinois system seems very able to scale up for broad deployment. We understand that while testing there is currently undertaken weekly, the frequency of testing would increase in places experiencing outbreaks.

Broadening locations of regularised testing makes sense as circumstances change. Near-daily testing of workers in health and aged care facilities, will matter in places with community transmission.

But the Government should also consider broadening the range of allowable tests if broader and more frequent deployment of PCR testing proves impracticable.

When catching every case is important, for example, in ensuring that nobody leaves Managed Isolation with Covid, the small number of people involved and the importance of avoiding false negatives require tests with high sensitivity.

But in cases where the most likely alternative is no testing at all and where being able to catch a reasonable proportion of positive cases is far better than catching only those whose symptoms send them for a PCR test, cheaper rapid tests can find an important role.

In April 2020, the Government banned any rapid antigen tests that Medsafe had not approved. The ban was extended in April 2021. MedSafe has not evaluated any rapid antigen tests, so rapid antigen tests are banned in New Zealand outside of a small hospital-based trial.

On 22 September, some three hundred thousand workers were able to return to work in Auckland, under Level 3 restrictions, joining those who had been working through Level 4, during a community outbreak.

Regular workplace testing would reduce the risk of workplace transmission under Level 3. If very regular PCR testing were practicable, for example, every third day, rapid antigen tests would not be needed. Swab-based testing is too expensive, relies too heavily on scarce trained nursing staff for sample collection, and imposes too great a burden on those being tested to be practicable.

Recent evidence also suggests saliva-based testing is more accurate than swab-based testing for Delta[23], when considering breakthrough infections among the vaccinated and in catching cases earlier.[24]

If some half a million Aucklanders work while community transmission is prevalent and restrictions are in place, testing one third every day would require collecting and processing saliva samples from over 150,000 people daily. Illinois's example of school-based testing suggests scaling up saliva testing can be possible. But if there proves to be no practicable or cost-effective way of doing that here, complementing less-frequent saliva testing with daily rapid antigen testing could be advisable.

If a rapid test has a sensitivity of 85%, which is toward the lower end of the range, it will fail to catch fifteen percent of cases on any given day's test. But some of those missed on the first day's test would be caught on the second day's test, and especially if their viral load increases. With repeated testing, the ongoing probability of false negatives reduces substantially: only those with viral loads below the detection thresholds of rapid tests would fail to be caught, but those cases are less infectious. And they would be caught at the next PCR test.

It would be a mistake to rely only on rapid antigen testing. It is not sufficiently sensitive and will not catch cases with low viral load. But repeated daily low-cost testing can be a complement to less-frequent saliva-based PCR testing to catch cases that become infectious between PCR tests if the gap between PCR tests would otherwise be long. Recall that rapid antigen testing in the airport trial caught 5 cases among almost 10,000 travellers who had tested negative by PCR within the previous 72 hours.

And if the alternative to rapid antigen testing is no regular PCR testing regimen because it is impracticable in some places, banning rapid antigen tests in those cases makes the best the enemy of the good while denying workers the safety benefits of either option.

To be clear, regular saliva-based PCR testing, provided by a credible provider with a validated test that meets international standards and does not draw on existing lab capacity, is preferable to rapid antigen testing. It will catch cases before they become infectious, making it possible to isolate cases before they infect others. The critics of rapid antigen testing who highlight the tests' low sensitivity as compared to PCR testing are correct. And it is possible to increase the frequency of PCR testing using saliva-based sample collection methods so that rapid tests would play only a very limited role except in very large outbreaks. But if the Government will not take up those options, rapid tests could be useful in screening out those who develop a high viral load between PCR tests.

Finally, if the number of cases presenting at Middlemore Hospital suggests that the outbreak is broader than has been thus far established, broad distribution of Rapid Antigen Tests and encouraging every person in the Auckland region to take three tests, with tests two days apart, could help in finding currently undetected cases.

Vaccination requirements

The United States of America mainly provides cautionary tales in dealing with Covid. But American university campuses are filled with some of the world's smartest people. They have been running hundreds of different experiments over the past year to figure out how to undertake as normal of operations as possible while Covid is circulating in the community.

Those university campuses provide very useful lessons.

As of 21 September 2021, *The Chronicle of Higher Education* had tallied 1,053 universities and colleges (polytech) that had required that at least some students or employees be vaccinated.[25] Campus vaccination requirements began in March of 2021 and sharply increased after the FDA provided full approval to Pfizer's vaccine.

It appears that some 722 of the 1,053 institutions listed currently require vaccination of employees and 991 require vaccination of students.

Thus far, no New Zealand university or polytech has required vaccination of staff or students. When Covid is not in the community, such requirements are unnecessary: they protect against a risk that simply is not present. But because it takes two months for an unvaccinated person to become fully protected, with a six-week gap between doses, policy measures regarding vaccination need to be implemented two months before they are needed.

Universities, or other venues, wishing to follow similar practices would face barriers in doing so.

Current employment law seems to present a Catch-22 for employers wishing to ensure a safer employment environment. When Covid is not in the community, it is difficult for employers to make vaccination a condition of employment for current staff unless those staff are in particularly risky roles. But if Covid is prevalent in the community, and staff vaccination is essential for the protection of staff and customers, it would take two months for any requirement to fully assist in reducing risk.

The Government should *allow* private employers to require that staff be vaccinated, in anticipation of that such requirements will be consistent with strong health and safety protocols if community transmission increases. Vaccination may be the only option consistent with health and safety prudence for some employers; other employers facing different circumstances may operate safely without such requirements.

At the same time, the Government should *mandate* vaccination for staff in particularly risky roles.

Currently, border workers are required to be vaccinated. Workers in health and in aged care facilities, as well as police and corrections officials, also deal regularly with the vulnerable in situations where it can be difficult otherwise to mitigate risk.

Teachers and early childhood educators work with children too young to be vaccinated and whose best protection is being surrounded by those who are vaccinated.

Medical exemptions from vaccination requirements would be appropriate in education, where risks are not as high. But unvaccinated workers in aged care facilities during periods of community transmission present exceptional risk.

Last month, United States President Joe Biden mandated staff vaccination for employers with 100 or more workers, for those in medicine, and for federal workers.[26] Exemptions are available where an unvaccinated worker produces a weekly negative Covid test. Those requirements cover about two-thirds of American workers and are far more comprehensive than the requirements here proposed.

Vaccination is reportedly currently under consideration as a requirement for entering the Parliamentary precinct.[27] It would provide an important example for others if followed. We note that robust safety surveillance for adverse effects is underway and is especially important as vaccination mandates proceed.

Requiring vaccination as a condition of customer entry into a facility does not raise employment law issues. But if a university, or other facility, wished to require vaccination as an entry condition, reliable proof of vaccination is not yet available.

The Government has announced a hastening in deploying its proposed proof of vaccination, with a vaccine passport app to be available in November.[28] Work incorporating vaccine passports into the Covid Alert framework is reportedly underway. On 5 October, the Prime Minister announced that proof of vaccination will likely be required, from November, for attending large-scale events and may also be required in other places.

We suggest that provision should be made for those with legitimate medical reasons not to be vaccinated. A 'vaccine passport' in domestic use could signal that the bearer of the certificate is *either*

vaccinated or medically precluded against being vaccinated, without disclosing which condition applies in any particular circumstance.[29] Barring exceptional high-risk circumstances, those medically precluded against being vaccinated should not be treated differently from those who are vaccinated.

Ideally, vaccination rates will rise to levels high enough that no facility would feel the need to require proof of vaccination for entry because everyone could be assumed to have been vaccinated.

But having proof-of-vaccination systems in place could be very helpful in enabling more normal levels of activity during periods of higher community transmission if hospitals came under pressure.

For example, current Covid restrictions limit numbers in facilities serving the public under Level 2 to reduce transmission. Venues requiring proof of vaccination for entry could operate at least as safely with higher numbers of allowed attendees. Proof-of-vaccination could then be worked into the Alert Level system.

One potential objection to allowing proof-of-vaccination requirements is that if vaccination rates are higher among groups that risk being subject to discrimination, the requirements could be discriminatory in effect.[30] The best way of avoiding that discriminatory effect is by taking every possible effort to encourage strong vaccine uptake among everyone, especially among those hesitant about engaging with authorities in other circumstances.

Were the government to publicise the types of restrictions that might apply in those circumstances, it could simultaneously prepare for the worst while making it less likely that the worst case eventuates. If sporting events, bars, and restaurants could continue with minimal restrictions during periods of community transmission if they catered exclusively to the vaccinated and those with medical exemptions, but with tight restrictions on numbers otherwise, some currently hesitant to be vaccinated would see greater reason to be vaccinated.

Further layered protections

The Government could take further measures to reduce transmission risk and to bolster health system defences against larger outbreaks.

Strengthening the health system

Strengthening health system capabilities requires skilled staff. Beds in Intensive Care are useless without staff to care for patients. Strengthening the health care system to deal with the consequences of any larger outbreak while vaccination rates remain below 90% requires more doctors and nurses.

Specialists cannot be trained in a hurry. But while the Government has noted the importance of attracting skilled health staff, policy at Immigration New Zealand has led to skilled medical professionals leaving the country. Those on non-resident visas are forbidden from buying homes and, until exceptionally recently, have had no hope of seeing their residence applications progressed.

Simply granting residence to every person in New Zealand who is not resident while requiring them to present a clean police background check within a year of the grant of residence would have been simplest. It would have cleared the decks at Immigration New Zealand before any new immigration policy was implemented.

But, at minimum, in a global pandemic, the Government should not be setting immigration policies that chase scarce medical professionals out of the country.[31]

On 30 September, the Government announced that residence applications for most who have been caught in this situation will be processed in the twelve months from 1 December.[32] While those applications are underway, it should consider exempting applicants from the ban on residential

property purchases. It should also ensure that the children of those applicants are treated as domestic rather than international students for educational purposes, and that they have work rights.

Effective treatments

Skilled medical professionals are essential. So too are effective treatments. While vaccination sharply reduces the risk of severe adverse medical outcomes, it does not provide full protection. Vaccinated people, particularly the elderly, still risk finding themselves in hospital or in ICU.

And while effective treatments are being deployed overseas, Medicines New Zealand warns that they are not and will not be available in New Zealand without change in policy.[33] Where other countries are stockpiling treatment in advance of potential new Covid waves, the Government here has not signalled any interest in including these newer treatments as part of their preparations for the next phase. Without a signal of intent to purchase, companies whose products are in high demand overseas may not find it worth investing time and money into securing MedSafe certification.

The Government should quickly set purchase agreements for treatments proven effective abroad while making those agreements conditional on successful MedSafe certification.

Trials to improve ventilation

Finally, one fairly simple measure could help in reducing transmission.

Improving ventilation in enclosed spaces like lecture theatres and school classrooms is important. Covid transmits easily in enclosed, unventilated spaces. Inexpensive carbon dioxide monitors can provide a simple signal of the adequacy of room ventilation:[34] if carbon dioxide levels increase appreciably when many people are in a room, the room is likely to be inadequately ventilated. Rising readings on a carbon dioxide monitor could encourage teachers to open a window. Monitors cost about $20; they would prove very cost-effective even if models suitable for classroom use were more expensive.[35] They could also be encouraged in places like bars and restaurants as a simple signal of the adequacy of current ventilation.

Air purification could also be warranted to assist in preventing transmission in places where adequate ventilation is less feasible. A study of portable air filtration units in repurposed COVID-19 wards in Cambridge found sharp reductions in measured viral load.[36] The Government could trial candidate units in quarantine facilities and deploy effective units more broadly in public facilities while providing advice to businesses about which units had proven effective.

Recommendations:

7. That the Government prepare for weekly saliva-based PCR testing at every primary and secondary school, for staff and students, so that it can be rapidly deployed if community transmission become more established. Having the systems in place ahead of need enables their use when needed. Contracting procedures should ensure that any contracted test is appropriately validated and meets international standards.
8. That the Government procure large volumes of rapid antigen tests for widespread distribution to essential workplaces during periods of restrictions for daily testing of essential workers, if PCR testing is not sufficiently frequent, and for broader roll-out in case of any very widespread outbreak in which other testing systems cannot keep up.
9. That the Government enable firms, venues, universities, and others to require vaccination and/or a recent negative test result for entry into their premises, if they wish to set such requirements, by making clear that it is legal to do so, and by providing reliable proof of vaccination and recent testing status.
10. That a Public Health Order be issued requiring vaccination for those in roles dealing with the vulnerable, including children too young to be vaccinated and the immunocompromised. The Order should, in the first instance, encompass health workers, aged care workers, emergency

services, early childhood educators, teachers, corrections staff, and other occupations that routinely deal with the vulnerable.

11. That the Government prepare and publicise differential Covid alert restrictions that might apply between places catering exclusively to the vaccinated and those that do not in future outbreaks that threaten health system capabilities, in hope that they not be needed.
12. That the Government ensure that those in the new residence visa queue are treated as residents while their applications are in progress – exempt from bans on residential property purchases, able to access education for their children at domestic student rates, and with work rights for their children as they reach the age of majority.
13. That the Government prioritise entry into MIQ and residence visas for health workers currently based abroad to avoid erosion in hospital and ICU capacity.
14. That the government quickly procure pharmaceutical Covid treatments proving effective and being stockpiled overseas so that they are here available if needed.
15. That the Ministry of Education supply schools with inexpensive carbon dioxide monitors as a simple way of checking classroom ventilation while encouraging teachers to open windows if carbon dioxide levels rise. That the Ministry consider all of the measures suggested by Kvalsvig et al, 2021, for improving classroom ventilation – and that Government consider these measures in other public buildings, like police stations, courtrooms, libraries, and government offices. They should also strongly be recommended for households where one member is self-isolating – especially if increasing case numbers require positive cases to isolate at home.
16. That the Government trial air filtration units in quarantine facilities to assess their potential use in reducing transmission in hospital and educational settings.

The Path to 2022: Stronger institutions

In April 2021, the Government proposed a suite of health system reforms that included a centralised Public Health Agency.

Taiwan's early and effective response to the pandemic was, in part, to the credit of its Central Epidemic Command Centre.[37]

A pandemic preparedness and response agency could be well warranted.

The Ministry of Health, generally tasked with policy rather than operational matters, has not been well suited to the role into which it has been thrust since March of 2020.

The Earthquake Commission had warned, in 2009, that it could not be expected to undertake claims assessment after a major seismic event because it was not designed for that purpose. The Commission's failures when required to undertake claims assessment in Christchurch in 2010 and 2011 were predictable and predicted.[38]

Combining policy and operations in one agency, like the Ministry of Health, also removes a potential independent check and balance in case of operational failures.

The Ministry of Health's inadequacies in operating as a pandemic response agency can be viewed similarly to EQC's failings in earthquake claims assessment. Despite frequent warranted criticism of the Ministry's failings in a role for which it was poorly suited, in the broadest sense, it remains remarkable that New Zealand has fared as well as it has, given the constraints.

Public health experts have also encouraged the creation of a Public Health Agency, but with a broader remit. In February 2020, following the 2019 measles outbreak, the University of Otago's public health experts recommended a dedicated agency, *Public Health Aotearoa*, to ensure that public health concerns not be given short shrift in day-to-day health operations. They recommended that such an

agency could encompass not only pandemic risks but also health promotion, health protection, disease prevention with a view to policy changes focused on wellbeing and sustainability encompassing wealth distribution and "our relationship with the environment."[39]

The remit seems too broad for any agency that might be trusted to focus on infectious disease and pandemic preparedness. But, in describing a potential new agency in April, Associate Minister Verrall noted that such an agency would be able to provide "quality advice and strategic leadership on where we should be going with tobacco, as the ministry currently does, and some of those other non-communicable diseases and threats."[40]

In the leadup to the current pandemic, infectious disease and vaccination promotion received very little attention, even within the field of public health. When the measles epidemic broke out, the Ministry of Health had no way of knowing whether workers at hospital were vaccinated. Only one District Health Board had any records of staff vaccination.[41]

While the Ministry of Health deflected criticism by saying the issue was within the remit of District Health Boards, the Ministry of Health had been able to ensure that every District Health Board had banned soda from hospital cafeteria menus.

Lack of focus on the infectious disease side of public health promotion was also evident in the Health Research Council's funding priorities. Work that would have proved exceptionally valuable both in the measles outbreak and in the current pandemic, like work on encouraging vaccination among hesitant communities, saw little attention.

An Official Information Act request of the Ministry of Health noted eight pieces of funded research from 2012 to 2019 on immunisation uptake. MBIE separately had provided a grant to the University of Auckland's Immunisation Advisory Centre in 2015-16.

The Health Research Council provided a few small grants for research into vaccine uptake but provided many grants, often in the millions of dollars, for research into discouraging smoking and alcohol use.[42] Only very recently did infectious disease start drawing substantial Health Research Council attention: a $5 million grant announced in April 2021.[43]

Any Public Health Agency with remit over both communicable and noncommunicable disease risks shifting attention away from communicable disease. An agency focused on infectious disease, pandemic preparedness and pandemic response seems warranted. A separate agency with remit over noncommunicable disease may or may not be warranted. If it is warranted, within a combined agency, noncommunicable disease might be given short shrift during the interval immediately following a pandemic, before attention to communicable disease again wanes.

We do not here present a model of how a standalone agency might be structured; that would be its own substantial piece of work.[44] We understand that a Crown Agency model may be under consideration.

We urge that independent expertise be built into the structure of any Infectious Disease Agency.

Taiwan's Central Epidemic Command Centre (CECC) draws in expertise from across agencies and includes an external expert advisory panel.

Biosecurity New Zealand's industry partnership arrangements enable a stronger biosecurity response by drawing in industry expertise for co-management across some twenty-five industry sectors, from New Zealand Apples and Pears to the New Zealand Winegrowers.[45] In pandemic response, expertise from airlines, airports, transport and logistics companies, medical equipment suppliers, and more all seem relevant. Peak industry bodies can convey sector knowledge critical to the response as well.

And we note that effective Parliamentary oversight of the Covid response was strongest when the Epidemic Response Committee operated but weakened when partisanship stymied effective select committee oversight prior to the current outbreak.

These together suggest that an Infectious Disease Agency, overseen by an external Board that includes industry expertise and advised by an expert advisory panel, should be responsible to the Minister. When the Agency leads pandemic response and public health measures are in force, it should also report to a Parliamentary Pandemic Response Committee, chaired by the Opposition, to ensure effective scrutiny.

Recommendations:

17. That the Government consider setting a specialist Infectious Disease Agency as part of its ongoing health sector restructuring. Infectious diseases in the future may include a special category of extreme concern. Pandemics caused by bioengineered agents posing existential risk are not impossible.
18. That that the governance of the Infectious Disease Agency include industry expertise.
19. That the Agency, when public health measures are in force, also report to an Epidemic Response Committee of Parliament chaired by a member of the Opposition.

The Path to 2022: A stronger border system

New Zealand's border system will remain important in reducing the number of cases entering the community, and in providing potential bulwark against new variants that may emerge. So long as trying to track and suppress cases remains important, so too will entry restrictions.

Our recommendations here are predicated on the assumption that border settings remain important. If the current outbreak instead sees Covid become widespread, continued border restrictions would provide little discernible benefit, barring the emergence of new and more threatening variants.

Strengthening the border system reduces the risk of outbreaks while vaccination is still underway. It can also help provide far better information that can guide any easing of border restrictions when vaccination has been completed.

Modelling work published in *The Lancet* suggests that if ten infected people arrive in the community every day, outbreaks are likely at vaccination rates less than 90% of the entire population. If vaccination has prioritised vulnerable communities and vaccination reaches 90% overall, outbreaks will not overwhelm the health system.[46] But if vaccination coverage only reaches 70%, New Zealand might expect 1.5 million cases and peak hospitalisation of over 3,600 Covid patients without other public health measures to reduce transmission. It is difficult to see how the public health system could continue to provide care to Covid patients and treat others in such a scenario.

Reducing the number of infected arrivals into the community will then remain a priority into 2022 unless vaccination is near-universal or unless Covid is sufficiently widespread that a small number of cases entering through the border prove irrelevant.

At very high vaccination rates, more arrivals can be sustained; at low vaccination rates, border restrictions remain more likely if either elimination or suppression is to be maintained.

Work in *The Lancet* considers the effects of ten daily Covid-infected arrivals into the community. It provides one useful way of thinking about New Zealand's border system: How many daily infected arrivals into the community might we expect under different policy settings? Gathering better information through the current MIQ system would help in setting better policies.

The number of infected arrivals depends on the number of people boarding flights to New Zealand, the measures that prevent infected people from boarding those flights, and measures to catch infected people on arrival, including MIQ.

From March 2020 through September 2021, almost 173,000 people went through New Zealand's MIQ facilities. Over that period, 1,299 Covid cases were identified at the border: a rate of some 2.4 infected arrivals per day out of 319 daily arrivals, on average. Or about 75 infected per 10,000 arrivals. But that figure reflects arrivals over a period prior to pre-flight testing requirements and prior to Delta's emergence. Numbers will fluctuate greatly with prevalence in source countries.

As of 11 August, prior to the current community outbreak, 4,300 people were in managed isolation facilities, with 73 in Quarantine. The Ministry identified 43 active cases at the time. Cases are considered active for a period of 10 days since the onset of symptoms and for 72 hours after the end of symptoms. The period over which a case is considered active, roughly fourteen days, is similar to the 14-day duration of MIQ. If 43 out of 4,300 were infected, the recent data is consistent with about 100 infected per 10,000 arrivals.

By those figures, if MIQ requirements were dropped without other measures being put in place to limit the number of infected arrivals, New Zealand could accept no more than 1,000 daily arrivals into the country while maintaining an average of about ten infected arrivals per day. More than 1,000 daily arrivals would mean more cases and far more serious outbreaks. In 2019, an average of over 21,000 travellers arrived every day.

A strengthened border system then begins by gathering better data on arrivals, tightening restrictions for travel, and layering additional post-MIQ protections to provide additional protection and to testbed those measures in a safe environment.

The Government has been reluctant to increase testing requirements for MIQ visitors, in part because of the burden that such testing imposes on scarce nursing capacity, on the testing system, and on those being tested. If daily testing of MIQ guests were possible, we would have a more comprehensive view on Covid onset among visitors from different places. We would be able to tell whether vaccinated people from places with low levels of Covid pose little risk at all, whether they pose little risk after only a short stay in isolation, or whether a full fourteen days is essential.

Accurate PCR saliva testing has been available in New Zealand since January from Rako Science. It could be deployed immediately throughout the MIQ system for daily testing of every guest and every worker. Because it is less invasive than nasal swabs, it would pose a lower compliance burden for those being tested. Because it does not require nurses for sample collection, it would impose a lower staffing burden within MIQ. And if infected visitors were caught more quickly, they would impose less risk on others within the MIQ system. Daily testing would catch cases more quickly and saliva-based PCR testing can detect infection before it can be detected by swab-based PCR testing.[47]

We urge that daily accurate saliva-based PCR testing of MIQ visitors and staff be undertaken not just to improve current safety within MIQ but also to inform better system planning for the year ahead.

A strengthened border system would also do more to prevent infected passengers from boarding flights to New Zealand. Currently, the Managed Isolation System faces substantial capacity constraints in part because the MIQ and health systems can only accommodate a small number of infected arrivals. Space in quarantine is limited, and infected arrivals are very costly for the system.

As a consequence, the system has had to sharply limit the number of arrivals in order to limit the number of infected arrivals.

If the proportion of infected arrivals could be reduced, more travel could safely be accommodated. More families could be reunited. And more business travel could progress.

Reducing the number of infected arrivals is straightforward. Air New Zealand has announced that it will require vaccination for international travellers from February. Full vaccination could be required for entry into New Zealand, with the unvaccinated prevented from boarding flights. Unvaccinated people have five times higher risk of infection than vaccinated people.[48] Exemptions would be available for those medically precluded from being vaccinated.

Making vaccination, a condition of travel would substantially reduce the number of infected arrivals, enabling more people overall to travel because each person would impose substantially less risk on the system. A measure that would reduce travel rights for those who are not vaccinated would enhance travel rights for everyone else by making it feasible to accommodate more travellers.

Similarly, strengthening testing requirements before travel would reduce risks. Currently, results of a PCR test taken no more than three days before travel must be presented. But, in some places, the legitimacy of test certificates is questionable. And there is always risk of catching Covid in the interval between testing and travel.

Rapid antigen tests are less accurate at low viral loads than PCR tests. They should not be a substitute for PCR tests. But tests that can be administered at the airport within an hour of departure and that provide results within fifteen to thirty minutes would add an additional layer of protection by preventing those with high viral loads from boarding flights and potentially infecting others during travel.

The government could require that all passengers boarding flights to New Zealand provide a negative result on a rapid antigen test administered at the airport before departure, in addition to the current requirement to present a negative PCR test taken within 72 hours of departure.[49] While it is commonly asserted that New Zealand could not implement such measures because it does not have jurisdiction over foreign airports, that jurisdiction is not needed. It can be a condition of boarding flights destined for New Zealand, with those unable or unwilling to provide a negative test result barred from boarding.

This kind of system was trialled for passengers arriving in Italy from America; the evaluation of the trial was published in the *Mayo Clinic Proceedings*.[50]

Of 9,853 passengers who had already tested negative by PCR within 72 hours of departure, four were found to be positive when screened at the airport using the Abbot BinaxNOW rapid antigen test, with positive tests confirmed through molecular tests. One additional passenger tested positive on landing in Italy, using a different rapid antigen test, and was put into quarantine.

Rapid antigen screening before departure and on landing found five positive cases among about ten thousand travellers who had tested negative 72 hours before departure. Whether additional cases remained undetected is unknown, as additional testing was not undertaken. But the researchers estimate that, given the testing sequence used, the risk of a false negative result on the sequence of tests, rather than on any particular test in the sequence, is 0.00009. So, one true positive in ten thousand might have been missed. Layers of tests sharply reduce the risk of false negatives.

If the proportion of infected arrivals could be reduced to one in ten thousand, as compared to New Zealand's more recent 100 in ten thousand, substantially more travel could safely be sustained. Even thirty thousand daily arrivals would mean only three with Covid. Daily arrivals in 2019 did not exceed 27,000.[51] And the modelling work suggests ten daily infected arrivals would not overwhelm the health system if vaccination rates 90%.

The Government should require that all travellers to New Zealand be vaccinated, barring those with medical conditions precluding vaccination.

It should also add at-airport rapid antigen testing as condition of travel, as a trial.

And, it should add a post-isolation requirement that visitors present for a final Covid test a few days after leaving MIQ – if it intends on maintaining active suppression and to provide a pathway to further safe easing at the border.

A post-isolation test may seem like overkill because all passengers currently spend two weeks in MIQ and will there be tested repeatedly. But it would testbed compliance with post-isolation testing requirements in case those might substitute for some or all of MIQ in future for travellers presenting lower risk.

If rapid antigen tests proved effective in catching cases at the airport before boarding, reducing the risk of transmission in-flight and reducing the number of infected arrivals, that testing requirement could be maintained and extended. If the tests proved ineffective, they could be dropped. The study on pre-flight rapid antigen testing cited earlier was undertaken prior to Delta becoming the dominant variant; results could vary. The trial would be inexpensive, as tests are cheap, but if it proved successful, it could be highly valuable in enabling more and safer travel.

It seems obvious that this should be being done, and we hope this kind of data work is already in progress. But we understand also that the Government only began gathering information on the vaccination status of arrivals into MIQ in August, when that information would have been useful since vaccination became possible abroad. And daily saliva-based PCR testing is not in place in MIQ.

If only tiny proportions of passengers proved to be infected on arrival because of the set of restrictions, including vaccination, a PCR test, and a rapid antigen test at the airport and on landing, MIQ restrictions could confidently be lifted as vaccination rates increase. Visitors would provide contact details in case their on-arrival PCR test came back positive. They would also present for a PCR test a few days after arriving – with the duration of the gap set by data gathered in MIQ. The Government, and the public, would know that it would be safe because it would have been proven so.[52]

If higher proportions of passengers from places with higher Covid rates arrived infected despite the enhanced protocols, MIQ restrictions might need to remain in place for those very high-risk places – barring the kind of very widespread community transmission that the government must seek to avoid.

Currently, limited capacity within the MIQ system serves as a de facto ban on travel for most people.

Preventing travel by the unvaccinated, barring medical exemption, and by those testing positive at the gate would reduce travel rights for the small proportion of people who tested positive at the gate after having passed an earlier PCR test. Travellers might reduce that risk by self-isolating prior to travel.

But the reduction in risk overall would enable capacity increases that would greatly improve real access to travel for far more people. Status quo restrictions impose a far heavier burden. It is easier to access vaccines than it is to access a room in an MIQ system that is unable to expand safely.

At the same time, dedicated facilities should be constructed to accommodate riskier travellers. If the Government decides that it cannot require vaccination as condition of travel from some riskier places, because vaccines are there difficult to access, dedicated facilities could yet accommodate their needs. Similarly, a dedicated facility would prove useful if new variants yet to emerge could elude current vaccines, or in case of future pandemics.

Gathering better information on infections among arrivals while implementing tighter safety restrictions would allow an iterative reduction in restrictions as the Government learns what can safely be maintained.

After the vaccination roll-out is complete, if the set of measures here described sufficiently reduced risk, they could replace MIQ for travellers from lower risk places. But it will be difficult to tell unless better data is gathered in MIQ now.

The Government's proposed trial of self-isolation for vaccinated business travellers taking short trips abroad is now becoming formalised, with applications now open. Testing this system in a high-trust environment would help in developing protocols that would be safe for broader use. It would not only enable some critical business travel that is now impossible, but also provide the basis for adding at-home isolation for other low-risk travellers if that proves safe as vaccination rates increase.

Finally, the MIQ booking system remains unfit for purpose.

The Government has sought to ensure equitable access to MIQ by charging no price to most returnees. But when demand for spaces at zero price sharply exceeds spaces available, and when there is no way to increase capacity in the system, terrible inequities necessarily result from large shortages. Allocating spaces by lottery does not solve the problem. People have need to travel at different times based on personal circumstances invisible to an allocation system or to a lottery.

Over a year ago, the Initiative suggested flipping the MIQ system.[53] In our proposed system, facilities would manage their own bookings and set their own fees, while the Government would charge facilities a fee covering the cost of services provided by the Government in ensuring safety. And the Government would provide vouchers to eligible returning Kiwis to cover the cost of a stay at an average facility at off-peak times.

Other alternatives are possible.

Travelers could be required to book MIQ spaces through approved travel agents. Those agents would have access to the MIQ booking system and would book flights simultaneously to booking MIQ spaces; travellers would pay for booked MIQ spaces at time of booking.

Airlines travelling to New Zealand could be required to book spaces when flights are booked.

Either would help in avoiding empty MIQ rooms.

But the fundamental problem of demand exceeding supply will remain unless prices are allowed to rise or unless effective capacity substantially increases. Even allowing a third of MIQ spaces to be allocated by auction would help considerably. Rather than providing secure MIQ slots to travellers deemed to be in the national interest – trade delegations to Dubai, boat race crew, and other sportspeople, the government could invite those travellers to bid for spaces.

MIQ capacity can increase. Letting prices rise would encourage more providers to offer their facilities for use. Shifting to saliva-based testing would reduce the burden on scarce nursing staff. Shortening the duration of stays in MIQ, when it is demonstrated to be safe, would increase effective capacity by increasing turnover.

It is tempting to brush the MIQ system aside in the hope that high vaccination rates will mean MIQ will not be needed. But even if high vaccination rates are achieved, new variants could emerge that impose greater risk, and the government may wish to maintain MIQ requirements for higher risk travellers. A functional MIQ system, including a functional booking system, matters.

At the same time, better internal border mechanisms remain needed if the Government wishes to prevent Covid from leaving Auckland. Current measures rely on a weekly swab or twice-weekly saliva-based PCR testing of workers crossing the Auckland-area border. Vaccination could be required for those crossing the Auckland boundary, as has been recommended by Mainfreight's Don Braid.[54] Those travelling out of the Auckland-area and testing negative before travel could be provided with packs of Rapid Antigen Test kits for daily self-testing, in addition to current requirements.

But we most strongly urge that these systems be developed in consultation with those who will have to deal with them: the shipping companies and peak bodies like the Employers and Manufacturers Association and Business New Zealand.

We note that while a travel zone around Hamilton is impracticable because of the number of roads in the area, a ring around the upper North Island is possible if needed: only seven roads would need to be policed: State Highways 3, 45, 4, 1, 5, 38, and 2.[55]

Recommendations:

20. That all travellers to New Zealand be fully vaccinated and screened for Covid at the airport before boarding flights to New Zealand to reduce the number of infected arrivals – in addition to current PCR testing requirements. Travellers departing New Zealand with return flights should also be vaccinated.
21. That the MIQ system implement daily PCR saliva-based testing of all guests and workers while collecting data on Covid incidence among returning visitors, providing a better evidence base for easing restrictions as vaccination rates increase.
22. That those leaving MIQ be required to present for a post-MIQ Covid test at an interval after leaving MIQ and maintain accurate details using the Covid tracer app.
23. That the proposed trial of self-isolation for business travel from New Zealand proceed.
24. That improved information on Covid onset among arriving passengers from places with different Covid risks, as well as information on compliance with post-isolation testing, be used in informing future decisions about duration of MIQ or home isolation for arrivals when the vaccination programme has further progressed. Ideally, when vaccination has completed, fully vaccinated travellers from safer places, PCR tested before travel, antigen tested at the airport abroad, and tested again on arrival, would need only to present for a post-arrival test a suitable interval after landing.
25. That dedicated MIQ facilities be constructed in case new and more dangerous variants emerge, and to facilitate arrivals from riskier places should supervised isolation continue to be necessary.
26. That the Government allow MIQ providers to handle their own bookings and charge their own rates, while the Government charges providers for the cost of the services it provides. The Government could provide flat-rate vouchers to returning Kiwis whose travel the Government wishes to subsidise.
27. Alternatively, that the government allocate a third of MIQ spaces by auction while using other methods for the remaining spaces. This would enable those with urgent travel needs to find spaces while allowing those whose needs are less pressing to use the normal system.
28. That the shift to active suppression in Auckland allow more dramatic easing of MIQ requirements if fully vaccinated travellers arriving through an augmented screening system have a lower rate of Covid than is likely to be already prevalent in Auckland. The system could change to permit incoming travel to Auckland without facility-based quarantine.
29. That the Government, in consulation with the shipping companies, the Employers and Manufacturers Association, and Business New Zealand, establish safer and more workable systems for crossing the Auckland boundary.

Endnotes

[1] The author thanks Dr Oliver Hartwich, Professor Michael Plank, Roger Partridge, Dr Janine Paynter and Dr Anne Wyllie for feedback on prior drafts; all views expressed and remaining errors are the responsibility of the author. The author also thanks additional public health experts whose comments on prior drafts also greatly helped in strengthening the paper.

[2] Nguyen, Trung, Mehnaz Adnan et al. 2021. "COVID-19 vaccine strategies for Aotearoa New Zealand: a mathematical modelling study." *The Lancet Regional Health: Western Pacific* 15:100256, 1 October. Available at https://www.thelancet.com/journals/lanwpc/article/PIIS2666-6065(21)00165-6/fulltext

[3] "Everything you need to know about COVID-19 in Alberta on Wednesday, Sept. 15." *The Canadian Broadcasting Corporation*. 15 September 2021. Available at https://www.cbc.ca/news/canada/calgary/alberta-covid-coronavirus-september-15-1.6176414

[4] The most recent OECD statistics, pre-Covid, ranked New Zealand's ICU capacity, then measured at 3.6 per hundred thousand, as being a third of the OECD average. New Zealand placed higher than Mexico's 3.3 per hundred thousand, but well below Denmark's (7.8), Australia's (9.4), England's (10.5), Canada's (12.9), the United States (25.8) and Germany (33.9). See OECD. "Intensive care beds capacity". 2020. Available at https://www.oecd.org/coronavirus/en/data-insights/intensive-care-beds-capacity

[5] Taylor, Marisa and Dan Levine. 2021. "U.S. could authorize Pfizer COVID-19 shot for kids age 5-11 in October – sources." *Reuters*. 11 September. Available at https://www.reuters.com/business/healthcare-pharmaceuticals/exclusive-us-decision-pfizer-covid-19-shot-kids-age-5-11-could-come-october-2021-09-10/

[6] Baker, Michael, Nick Wilson et al. 2020. "A preventable measles epidemic: Lessons for reforming public health in NZ" *Public Health Expert*, 5 February. Available at https://sciblogs.co.nz/public-health-expert/2020/02/05/a-preventable-measles-epidemic-lessons-for-reforming-public-health-in-nz/

[7] Simpson, Heather and Sir Brian Roche. 2020. "Report of the Advisory Committee to Oversee the Implementation of the New Zealand COVID-19 Surveillance Plan and Testing Strategy". 28 September. Available at https://covid19.govt.nz/assets/Review-of-Surveillance-Plan-and-Testing-Strategy/Final_Report-of-Advisory-Committee-to-Oversee-the-Implementation-of-the-....pdf

[8] See discussion in Partridge, Roger. 2021. "Should the Ministry of Health be responsible for pandemic policy?" *The New Zealand Herald*. 7 September. Available at https://www.nzherald.co.nz/business/covid-19-delta-outbreak-roger-partridge-should-the-ministry-of-health-be-responsible-for-pandemic-policy/PTSWKDWTOLZPSK2FJNC64IFG7Y/ See also Gorman, Des and Murray Horn. 2020. "Time for a sea change in our COVID-19 management". *The New Zealand Medical Journal* 133:1520. 21 August. Available at https://journal.nzma.org.nz/journal-articles/time-for-a-sea-change-in-our-covid-19-management

[9] See, for example, Mostafa, Heba, Chun Luo et al. 2021. "SARS-CoV-2 Infections in mRNA Vaccinated Individuals are Biased for Viruses Encoding Spike E484K and Associated with Reduced Infectious Virus Loads that Correlate with Respiratory Antiviral IgG levels." *National Institutes of Health* Preprint available at *medRxiv*. 7 July. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8282117/

[10] Nguyen et al, op. cit.

[11] Malpass, Luke. 2021. "Covid 19: Novavax expected to be first Covid-19 booster vaccine in New Zealand." *Stuff* 8 September. Available at https://www.stuff.co.nz/national/health/coronavirus/126305616/covid-19-novavax-expected-to-be-first-covid19-booster-vaccine-in-new-zealand

[12] Mendez, Rich. 2021. "Novavax delays Covid vaccine emergency authorization submission to FDA until fourth quarter." *CNBC*. 5 August. Available at https://www.cnbc.com/2021/08/05/novavax-covid-vaccine-fda-emergency-use-submission-delayed-to-q4.html

[13] Taylor, Marisa and Dan Levine. 2021. "U.S. could authorize Pfizer COVID-19 shot for kids age 5-11 in October – sources." *Reuters*. 11 September. Available at https://www.reuters.com/business/healthcare-pharmaceuticals/exclusive-us-decision-pfizer-covid-19-shot-kids-age-5-11-could-come-october-2021-09-10/

[14] Foon, Eleisha. 2001. "Pasifika mass vaccination events launching around New Zealand". *Radio New Zealand* 9 September. Available at https://www.rnz.co.nz/international/pacific-news/451076/pasifika-mass-vaccination-events-launching-around-new-zealand

[15] Harawira, Tumamao. 2021. "Push to improve Covid-19 vax rates for Māori." *Te ao Māori News.* 10 August. Available at https://www.teaomaori.news/push-improve-covid-19-vax-rates-maori

[16] Savage, Jared. 2021. "Positive case at Mongrel Mob pad after patient discharged herself from Middlemore Hospital before test result." *The New Zealand Herald*. 16 September. Available at

https://www.nzherald.co.nz/nz/covid-19-delta-outbreak-positive-case-at-mongrel-mob-pad-after-patient-discharged-herself-from-middlemore-hospital-before-test-result/QX2Q2AYOF6PEO453TGHPQCPZGM/

[17] On the accuracy of high-quality saliva testing, see Tan, Steph, Orchid Allicock et al. 2021. "Saliva as a gold-standard sample for SARS-CoV-2 detection". *The Lancet Respiratory Medicine* 9:6. 1 June. Available at https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(21)00178-8/fulltext . Rako Science's implementation of the University of Illinois SHIELD protocol has been available in New Zealand since January.

[18] Center For Health Security. 2021. "Antigen and Molecular Tests for COVID-19". *Johns Hopkins Center for Health Security*. Available at https://www.centerforhealthsecurity.org/covid-19TestingToolkit/molecular-based-tests/current-molecular-and-antigen-tests.html . Accessed 28 September 2021.

[19] Alberta's Covid data is available at https://www.alberta.ca/stats/covid-19-alberta-statistics.htm#vaccine-outcomes . Data here cited current as of 5 October.

[20] See Ranoa, Diana, Robin Holland et al. 2021. "Mitigation of SARS-CoV-2 Transmission at a Large Public University". 5 August. *medRxiv* working paper available at https://www.medrxiv.org/content/10.1101/2021.08.03.21261548v1.full.pdf

[21] Burrell, Henry. 2021. "Covid swabs for level 3 workers 'unreasonable'." *BusinessDesk* 28 September. Available at https://businessdesk.co.nz/article/coronavirus/covid-swabs-for-level-3-workers-unreasonable

[22] Walker Burke, Cassie and Samantha Smylie. 2021. "As Biden calls for school COVID testing, Illinois program reaches nearly half its schools." *Chalkbeat* 10 September. Available at https://chicago.chalkbeat.org/2021/9/10/22667324/biden-student-staff-covid-19-testing-illinois-shield-schools

[23] Ke, Ruian, Pamela Martinez et al. 2021. "Longitudinal analysis of SARS-CoV-2 vaccine breakthrough infections reveal limited infectious virus shedding and restricted tissue distribution." MedRXiv Working paper available at https://www.medrxiv.org/content/10.1101/2021.08.30.21262701v1

[24] Ke, Ruian, Pamela Martinez et al. 2021a. op. cit.

[25] Thomason, Andy and Brian O'Leary. 2021. "Here's a List of Colleges That Require Students or Employees to be Vaccinated Against Covid-19". *The Chronicle of Higher Education.* 20 September. Available at https://www.chronicle.com/blogs/live-coronavirus-updates/heres-a-list-of-colleges-that-will-require-students-to-be-vaccinated-against-covid-19

[26] *The Economist*. 2021. "President Joe Biden's vaccine mandate is ordinary yet controversial." 18 September. Available at https://www.economist.com/united-states/2021/09/18/president-joe-bidens-vaccine-mandate-is-ordinary-yet-controversial

[27] Scotcher, Katie. 2021. "Banning unvaccinated people from Parliament grounds could set precedent – expert." *Radio New Zealand* 23 September. Available at https://www.rnz.co.nz/news/political/452102/banning-unvaccinated-people-from-parliament-grounds-could-set-precedent-expert

[28] Tapaleao, Vaimoana. 2021. "Vaccine passport app to be available in just over a month". 28 September. *The New Zealand Herald.* Available at https://www.nzherald.co.nz/nz/covid-19-delta-outbreak-vaccine-passport-app-to-be-available-in-just-over-a-month/SLSJX27VNPFYXOACJPGMUIANBQ/

[29] We thank Wilbur Townsend for this suggestion.

[30] See, for example, Dare, Tim and Justine Kingsbury. 2021. "Why a domestic NZ Covid 'passport' raises hard questions about discrimination, inequality and coercion." *The Conversation.* 15 September. Available at https://theconversation.com/why-a-domestic-nz-covid-passport-raises-hard-questions-about-discrimination-inequality-and-coercion-167703

[31] Jones, Nicholas. 2021. "'Unwelcome' nurses leaving NZ over immigration rules". *The New Zealand Herald* 28 September. Available at https://www.nzherald.co.nz/nz/covid-19-delta-outbreak-unwelcome-nurses-leaving-nz-over-immigration-rules/QELJZ26R3UB7363TYGJRCQBPYY/

[32] Immigration New Zealand. 2021. "New 2021 Resident Visa provides certainty to migrants." 30 September. Available at https://www.immigration.govt.nz/about-us/media-centre/news-notifications/new-2021-resident-visa-provides-certainty-to-migrants

[33] See discussion with Graeme Jarvis of Medicines New Zealand on 17 September, available here: https://www.nzinitiative.org.nz/reports-and-media/podcasts/eric-crampton-speaks-to-graeme-jarvis-about-covid-19-medicines/ . On 2 September, we asked MedSafe for any information on the progress of therapeutics through the approval process; we have not yet received any information.

[34] Kvalsvig, Amanda, Julie Bennett, et al. 2021. "Improving ventilation in schools: a key protection against Covid-19 outbreaks and an enduring legacy for healthier learning." *Public Health Expert* 10 September 2021. Syndicated at *SciBlogs* and available at https://sciblogs.co.nz/public-health-

expert/2021/09/10/improving-ventilation-in-schools-a-key-protection-against-covid-19-outbreaks-and-an-enduring-legacy-for-healthier-learning/

[35] A UK programme to supply three hundred thousand CO2 monitors in England has a budget of some £25 million, which may include deployment costs. The per-unit cost is then £83, or NZD $162. See Peachey, Paul. 2021. "Back to school in England: CO2 monitors installed to curb spread of Covid." *The National News* 3 September. Available at https://www.thenationalnews.com/world/uk-news/2021/09/03/back-to-school-in-britain-co2-monitors-installed-to-curb-spread-of-covid/

[36] Conway-Morris, Andrew, Katherine Sharrocks et al. 2021. "The removal of airborne SARS-CoV-2 and other microbial bioaerosols by air filtration on COVID-19 surge units." 22 September. *MedRxiv* working paper available at https://www.medrxiv.org/content/10.1101/2021.09.16.21263684v1.full.pdf

[37] Summers, Jennifer, Hao-Yuan Cheng et al. 2020. "Potential lessons from the Taiwan and New Zealand health responses to the COVID-19 pandemic." *The Lancet Regional Health Western Pacific.* 4:100044 (1 November). Available at https://www.thelancet.com/journals/lanwpc/article/PIIS2666-6065(20)30044-4/fulltext

[38] Crampton, Eric and Bryce Wilkinson. 2018. "Recipe for Disaster: Building Policy on Shaky Ground." *The New Zealand Initiative*. 25 January. Available at https://www.nzinitiative.org.nz/reports-and-media/reports/recipe-for-disaster-building-policy-on-shaky-ground

[39] Baker, Michael, Nick Wilson, et al. 2020. "A preventable measles epidemic: lessons for reforming public health in New Zealand." *Public Health Expert* 5 February. Syndicated at *SciBlogs* and available at https://sciblogs.co.nz/public-health-expert/2020/02/05/a-preventable-measles-epidemic-lessons-for-reforming-public-health-in-nz/

[40] Daalder, Marc. 2021. "Public Health Agency 'the legacy of the pandemic'." *Newsroom*. 22 April. Available at https://www.newsroom.co.nz/cautious-optimism-for-new-public-health-agency

[41] Gibson, Eloise. 2019. "Are un-immunised hospital workers putting us at risk?" *Newsroom.* 29 October. Available at https://www.newsroom.co.nz/2019/10/29/876340/are-unimmunised-hospital-workers-putting-us-at-risk

[42] Crampton, Eric. 2021. "Health body needs one priority". *Newsroom*. 27 April. Available at https://www.nzinitiative.org.nz/reports-and-media/opinion/health-body-needs-one-priority-vaccines/

[43] Morton, Jamie. 2021. "'Decade of elimination': $5m project's big goal for NZ health." *The New Zealand Herald* 20 April. Available at https://www.nzherald.co.nz/nz/decade-of-elimination-5m-projects-big-goal-for-nz-health/QOXUDJTADB4LIISE2YMMKXFWLU/

[44] We encourage that work by Des Gorman and Murray Horn be considered. See Gorman, Des and Murray Horn. 2020. "Time for a sea change in our COVID-19 management", *New Zealand Medical Journal* 133:1520. 21 August. Available at https://journal.nzma.org.nz/journal-articles/time-for-a-sea-change-in-our-covid-19-management .

[45] A full list of signatories to Government Industry Agreements for Biosecurity Readiness and Response are available at https://www.gia.org.nz/About-GIA/Signatories

[46] See also Liu, Ying and Joacim Rocklöv, 2021. "The reproductive number of the Delta variant of SARS-CoV-2 is far higher compared to the ancestral SARS-CoV-2 virus.", *Journal of Travel Medicine*, which suggests vaccine coverage rates higher than 90% are necessary for herd immunity. Available at https://doi.org/10.1093/jtm/taab124 . Modelling work by Te Pūnaha Matatini released on 23 September is also consistent with vaccination results above 90% of the total population being best. See Steyn, Nicholas, Michael Planck, and Shaun Hendy. 2021. "Modelling to support a future COVID-19 strategy for Aotearoa New Zealand." Available at https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/d/75/files/2017/01/modelling-to-support-a-future-covid-19-strategy.pdf

[47] Ke, Ruian et al. 2021a. "Daily sampling of early SARS-CoV-2 infection reveals substantial heterogeneity in infectiousness." *medRXiv*. Working paper posted 12 July. Available at https://www.medrxiv.org/content/10.1101/2021.07.12.21260208v1 .

[48] Scobie, Heather, Amelia Johnson et al. 2021. "Monitoring incidence of COVID-19 Cases, Hospitalizations, and Deaths, by Caccination status – 13 U.S. Jurisdictions, April 4 – July 17, 2021". *Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report*, 17 September. Available at https://www.cdc.gov/mmwr/volumes/70/wr/mm7037e1.htm

[49] See Epstein, Richard. 2002. "In Defense of "Old" Public Health: The Legal Framework for the Regulation of Public Health" *John M Olin Program in Law and Economics Working Paper.* 170. Available at https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1258&context=law_and_economics Epstein discusses the English quarantine statutes of the early 1700s in which an arriving ship with infected

passengers could be compelled to return at the expense of the ship's owner, which provided ship owners with incentive to screen out infected passengers.

[50] Tande, Aaron, Matthew Binnicker et al. 2021. "SARS-CoV-2 Testing Prior to International Airline Travel, December 2020 – May 2021." *Mayo Clinic Proceedings* 1 September. Available at https://www.mayoclinicproceedings.org/article/S0025-6196(21)00644-3/fulltext

[51] Statistics New Zealand. 2021. "Daily movement across New Zealand border – January 2019 to September 2021". Available at https://www.stats.govt.nz/indicators/international-travel-provisional

[52] Passengers testing positive on arrival could be directed to MIQ. Those seated nearby could be directed to self-isolate, or to present for Covid testing at appropriate intervals. The risk of infection is lower for those who are vaccinated. These measures would be consistent with restricting the number of new cases entering the community, if suppressing those numbers remained relevant after vaccination rollout reaches completion.

[53] Crampton, Eric and Leonard Hong. 2020. "Safe Arrivals". *The New Zealand Initiative* Research Note. 24 July. Available at https://www.nzinitiative.org.nz/reports-and-media/reports/research-note-safe-arrivals/

[54] Checkpoint. 2021. "Mainfreight boss supports idea of Covid-19 vaccination mandate". 4 October. *Radio New Zealand*. Available at https://www.rnz.co.nz/national/programmes/checkpoint/audio/2018814991/mainfreight-boss-supports-idea-of-covid-19-vaccination-mandate

[55] See David Hood's map, available at https://twitter.com/Thoughtfulnz/status/1439698330511044608/photo/1