



Briefing

VACCINATION MODELLING IN THE INTERNATIONAL CONTEXT

To: Rt Hon Jacinda Ardern
Prime Minister

Hon Chris Hipkins
Minister for COVID-19 Response

Hon Ayesha Verrall
Associate Minister of Health

Cc: Hon Grant Robertson
Minister of Finance

Date	29/06/2021	Priority	High
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Purpose

1. The initial vaccination modelling by Te Pūnaha Matatini (TPM) will be published on Wednesday 30 June and the Institute for Environmental Science and Research (ESR) to be published later in July.
2. Following discussion of initial results (DPMC-2020/21-944 refers), Ministers and senior officials have expressed an interest in how modelling insights compare with real-world outcomes we are beginning to observe overseas. Publication of results may lead to public debate on this issue.
3. This briefing discusses international case studies, relating observable outcomes to the implications of the initial vaccination modelling results. We focus on countries which have either high rates of vaccination, recent notable community transmission events, or both.

Recommendations

1. **Note** that this briefing will be shared with the Strategic COVID-19 Public Health Advisory Group (chaired by Professor Sir David Skegg) and the Prime Minister’s Chief Science Advisor, Professor Dame Juliet Gerrard.
2. **Note** the areas of focus for ongoing monitoring of international outcomes, including that DPMC and Ministry of Health officials are engaging with Singaporean officials to discover any further lessons on outbreak management in a partially vaccinated population.
3. **Agree** to forward this briefing to the members of the Ministerial COVID-19 Strategy Group. YES NO
4. **Agree** that this briefing is proactively released, with any appropriate redaction where information would have been withheld under the Official Information Act 1982, in August 2021. YES NO

<p><i>pp Ben white</i></p> <p>Alice Hume Manager, Strategy & Policy – COVID-19 Group</p>	<p>Rt Hon Jacinda Ardern Prime Minister</p>
<p><i>21.6/2021</i></p>	<p>...../...../2021</p>
<p><i>[Signature]</i></p> <p>Hon Chris Hipkins Minister for COVID-19 Response</p>	<p>Hon Ayesha Verrall Associate Minister of Health</p>
<p><i>30.6</i> /...../2021</p>	<p>...../...../2021</p>

Contact for telephone discussion if required:

Name	Position	Telephone		1st contact
Alice Hume	Manager, Strategy and Policy – COVID-19 Group	s9(2)(a)	s9(2)(a)	✓
George Whitworth	Principal Policy Advisor	N/A	N/A	
Anna Ferguson	Policy Advisor	N/A	N/A	

Minister's office comments:

- Noted
- Seen
- Approved
- Needs change
- Withdrawn
- Not seen by Minister
- Overtaken by events
- Referred to

Proactively Released

VACCINATION MODELLING IN THE INTERNATIONAL CONTEXT

Executive Summary

1. Reviewing COVID-19 outcomes overseas is a way to assess the validity of initial vaccination modelling results, such as those produced by Te Pūnaha Matatini (TPM) and the Institute for Environmental Science and Research (ESR). This briefing explores whether these real-world, international experiences are consistent with the conclusions drawn from these initial results.
2. New Zealand's COVID-19 experience is markedly different to most other countries. By pursuing an elimination strategy – effectively 'keeping it out' and 'stamping out' small clusters of COVID-19 as they arise in the community – we have a unique context in terms of what success looks like. Most other countries are unwilling to impose the restrictions that might enable them to achieve outcomes that remain realistic for New Zealand.
3. However, useful insights can be drawn from overseas experience to help us reflect on the results of the initial vaccination modelling. This briefing considers two categories of international comparators:
 - a) countries with relatively high rates of vaccination, such as the UK and Israel, to assess conclusions on “population immunity” thresholds; and
 - b) countries that have lower rates of vaccination and have suffered recent outbreaks, to assess outbreak dynamics in populations with mixed vaccination statuses.
4. In summary, real-world outcomes elsewhere align with, and do not give reason to doubt, the key messages from the initial vaccination modelling:
 - a) **Population immunity will require very high levels of uptake, but the vaccines are effective at reducing harms to vaccinated individuals.** The overall vaccination rates in the UK, for instance, are insufficient to stop exponential, unlimited growth in case numbers – despite ongoing restrictions on the population. Recent data in Israel also supports this conclusion. The recent Singaporean outbreak has demonstrated the benefit of reduced harm for vaccinated individuals.
 - b) **Concurrent public health controls will still be required at high levels of vaccination.** Israel, for example, still has strict “keep it out” border measures, as well as ongoing public health interventions and restrictions on daily life which are intended to safeguard against community transmission. This has enabled a sustained period with low numbers of new cases.
 - c) **Vaccination will support efforts to “stamp it out” when cases do arise, but will have implications for how we manage outbreaks.** For instance, Singapore has recently successfully contained an outbreak, in which vaccination of affected individuals has supported control of the situation. However, it has also highlighted that vaccinated people can and do play a role in transmission of COVID-19. Vaccination might create challenges for detecting potential infections, particularly as symptoms are reduced in infected, vaccinated individuals who may still be able to transmit the virus.

Case Studies

5. New Zealand's elimination strategy approach to the management of the COVID-19 virus means we are almost uniquely placed in the world, as we look ahead to a strategy for *Reconnecting New Zealanders*. Few other countries have successfully maintained such low levels of COVID-19 within their community. We critically assess real-world outcomes in relation to this local context: what is deemed a successful outcome, or a tolerable risk, elsewhere might be considered a failure, or an unacceptable risk, for New Zealand.
6. Vaccination is just one tool of many in the COVID-19 management toolkit. By looking at a variety of jurisdictions with different epidemiological contexts and vaccination rates (summarised in Attachments A and B), we can:
 - a) Refine our understanding of the validity and accuracy of the modelling undertaken to date; and
 - b) Begin to "triangulate" on the best application of a suite of management tools to achieve the outcomes we desire – informing scenario selection for further, more sophisticated modelling currently underway.
7. Many countries are seeing vaccination as a tool reduce incidence or impacts where infection has been widespread. For New Zealand, along with some other countries (such as Australia and Singapore) vaccination is more important as a tool to prevent transmission in the first place.

Israel has achieved very low levels of community transmission in recent months. They have achieved high levels of vaccination, but the reduction in cases was achieved through ongoing population controls and restrictions on international travel.

8. Israel has taken a similar approach to vaccination as New Zealand: a single vaccine (Pfizer-BioNTech) administered with a 21-day second dose schedule. At 24 June 2021, about 59% of the population have received both doses of the Pfizer-BioNtech vaccine, which equates to around 80% of the population over the age of 12.
9. Israel started vaccinations in December 2020, when they were reporting a seven-day rolling average of around 2,400 new cases of COVID-19 a day. But by mid-January average cases were numbering over 8,600 cases a day.

Internal restrictions in Israel have played an important role in containing COVID-19 transmission...

10. Israeli authorities imposed a third national lockdown, due to this 'third wave'. This lasted until early February 2021, when restrictions were lifted incrementally: some workplaces were able to operate if they did not receive customers; domestic travel restrictions lifted; and open-air parks were reopened
11. The greatest lifting of restrictions has prioritised those who are vaccinated. On 21 February 2021 the 'Green Pass' system allowed those who were fully vaccinated or had natural immunity to enter higher-risk locations, such as gyms, theatres, and synagogues. This system was in place until early June 2021 and allowed 'Green Pass' holders to have a greater level of freedom of movement, than their non-vaccinated peers, as restrictions eased further from March 2021 onward.

12. This meant the greatest freedoms were reserved for those with lower chances of becoming infected, or of passing on the virus if they were infected. This may have been a significant factor in the continuing downward trend in new cases observed through March and April 2021. The interaction between transmission and vaccination of sub-populations will be explored in future modelling work.

...but stringent border controls have played a role, too - particularly as case numbers reduced to very low levels.

13. In late December 2020, Israel began to restrict foreign travellers from entering. Tourists are largely restricted from entering. Entrants are required to present a negative pre-departure PCR test, undergo a PCR test on arrival, and spend time in isolation after arrival. This includes state-designated isolation facilities for arrivals from higher-risk countries. This will have limited the number of imported cases, an important enabler of keeping case numbers low in the domestic community.

However, vaccination rates are not high enough to prevent exponential growth in cases without other measures in place.

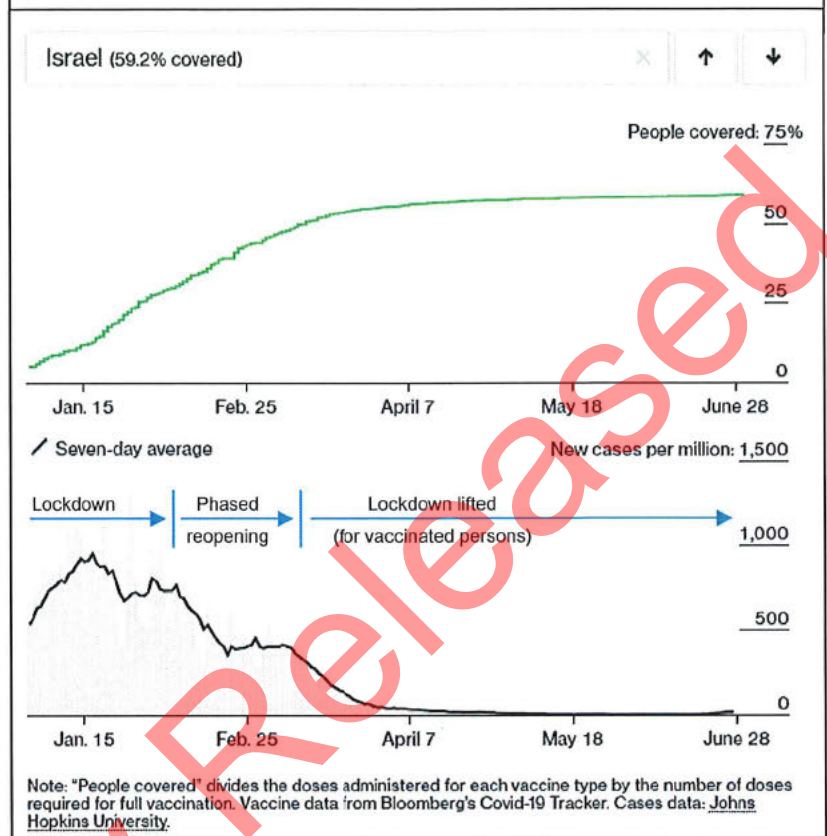
14. The combination (of domestic restrictions, border controls, and the vaccination rollout) resulted in the seven-day average reducing to around 15 cases per day, by early June 2021. More recently, new cases have been recorded at over 100 per day, with as many as 50% of new cases in the vaccinated population. Authorities are indicating that domestic controls (the "mask mandate", in particular) will be reintroduced if the situation continues to worsen.

15. The recent worsening of the domestic situation has also been despite international travel remaining heavily controlled. Authorities had aimed to allow tourists from low-risk countries to enter from 1 July 2021 without requiring isolation. However, in light of the recent worsening of the COVID-19, these plans have been postponed to at least 1 August 2021.

The United Kingdom has achieved a comparable level of vaccination to Israel but has been unable to achieve and maintain a low level of community transmission.

16. The United Kingdom (UK) began its vaccine roll out in early December 2020. Unlike Israel and New Zealand, the UK are using a variety of vaccines including Pfizer-BioNTech, Oxford-AstraZeneca, Moderna, and Janssen. They have also prioritised first doses, extending the time between doses from 3-4 weeks to 12, allowing them to provide more first doses in a shorter timeframe and thereby increasing the proportion of the population that have a lower level of protection. To date approximately 60% of the UK population have

Figure 1: Vaccination and case rates in Israel, 2021



received their first dose of the vaccine, with 45% fully vaccinated (which equates to around 80% and 60%, respectively, of people aged 18 and over).

17. Following their winter, a “third wave” saw case numbers peak at up to 60,000 cases per day. A national lockdown meant new cases steadily fell to as low as 2,000 cases per day by May 2021.

18. Since March 2021, authorities have been taking a phased approach to lifting restrictions. The final step of the “roadmap for reopening” was due to take place on 21 June 2021, and would have lifted most population level restrictions on daily life.

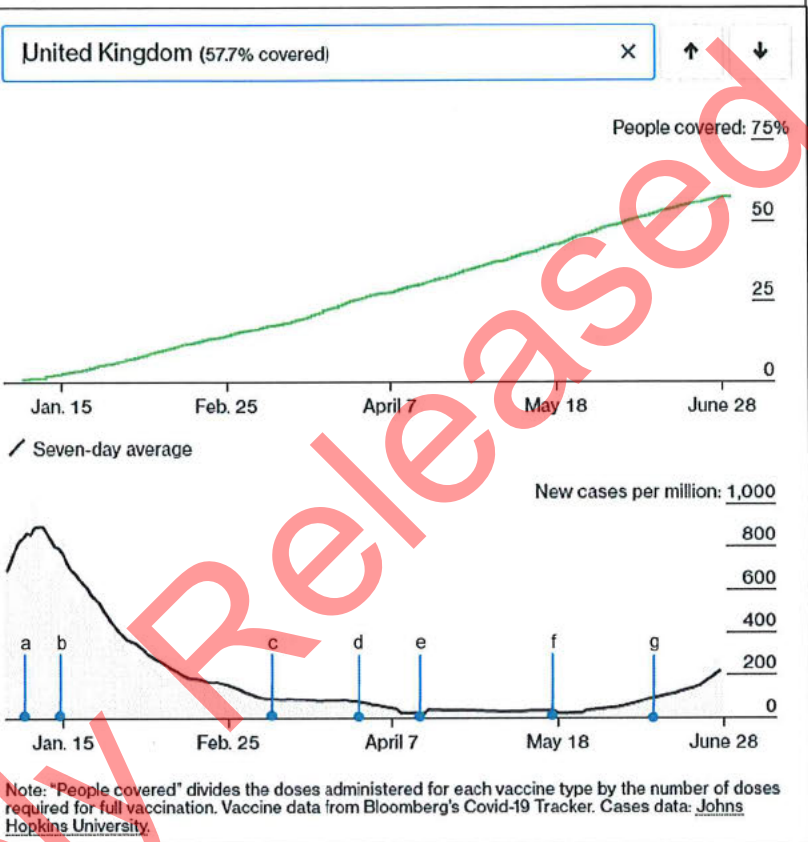
19. However, this relaxation has been postponed: despite high levels of vaccination, the easing of restrictions saw case numbers increase rapidly. The seven-day average for new cases is above 10,000 per day, and recent estimates for R values have been significantly greater than 1 and increasing.

20. This rapid increase of cases is also occurring in a population which has been significantly more exposed to COVID-19 over the prior year. Past infection should confer some degree of protection for individuals and act to limit spread across the population. Confirmed cases account for 7% of the population, while Office of National Statistics (ONS) estimates suggest that as many as 10-15% of the population may have been exposed to COVID-19.

21. These figures, combined with high vaccination rates, are evidently insufficient to stop exponential growth in cases, at least in some communities within the population. It is not clear yet how the recent increase in case numbers will translate into more severe outcomes, such as hospitalisation and fatality.

22. This suggests that even with levels of vaccination comparable to countries such as the UK, high numbers of cases are still a realistic possibility for New Zealand if domestic risk mitigate measures are removed. As discussed in interpretation of vaccination modelling results, high rates of vaccination in New Zealand are another 'string to the bow' of the elimination strategy, but are unlikely to be sufficient on their own to allow other risk mitigations to be removed completely.

Figure 2: Vaccination and case rates in United Kingdom, 2021

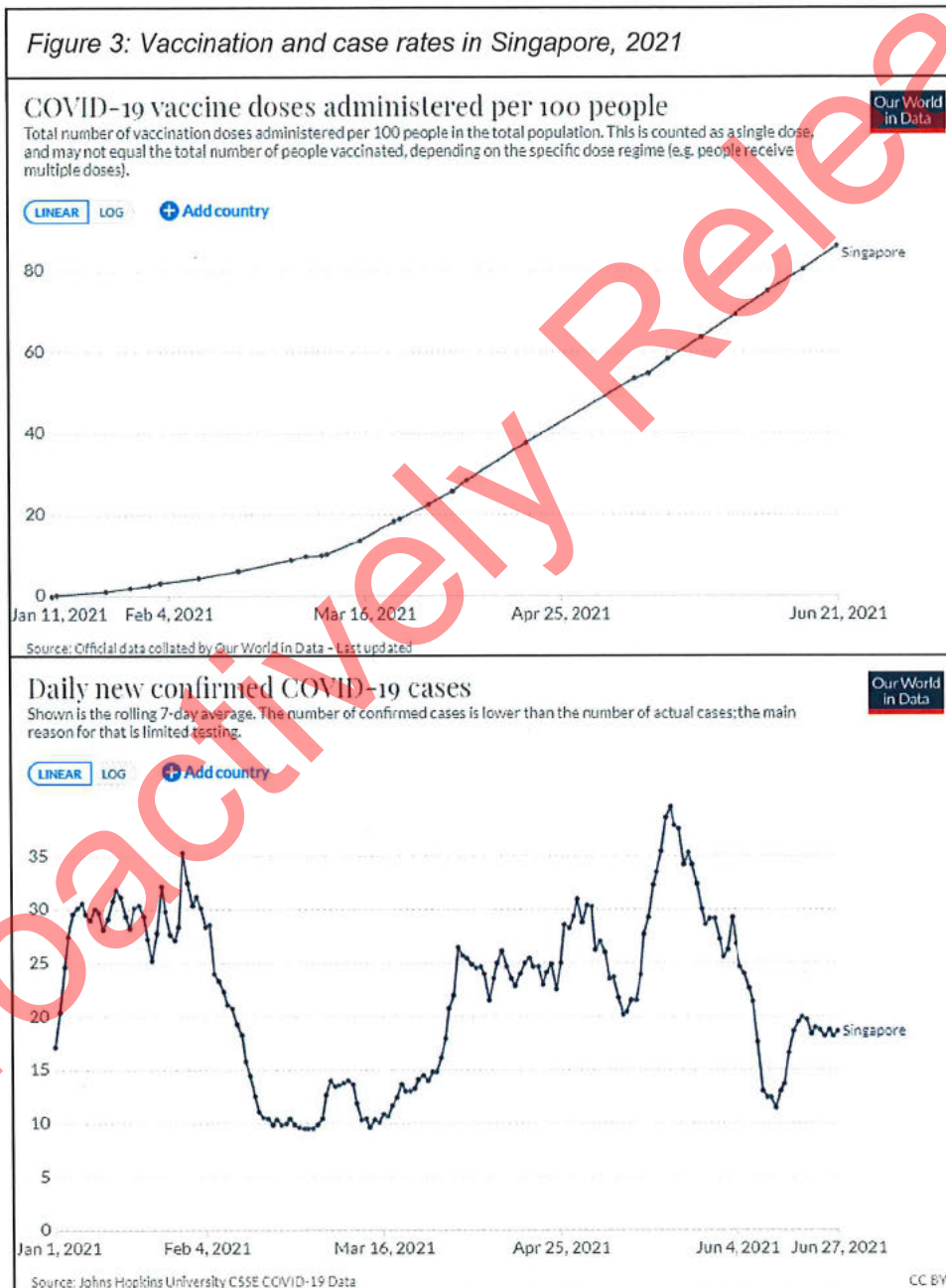


Response timeline: key phases/decisions:

- a. UK in lockdown
- b. From Jan: Travel bans from higher-risk countries introduced.
- c. 8 March: Children return to school
- d. 29 March: Stay-at-home order comes to an end
- e. 12 April: Reopening of non-essential retail
- f. 17 May: Pubs and restaurants reopen; indoor mixing allowed
- g. 14 June: England's final relaxation of restrictions (planned for 21 June) will be delayed by four weeks, until 19 July.

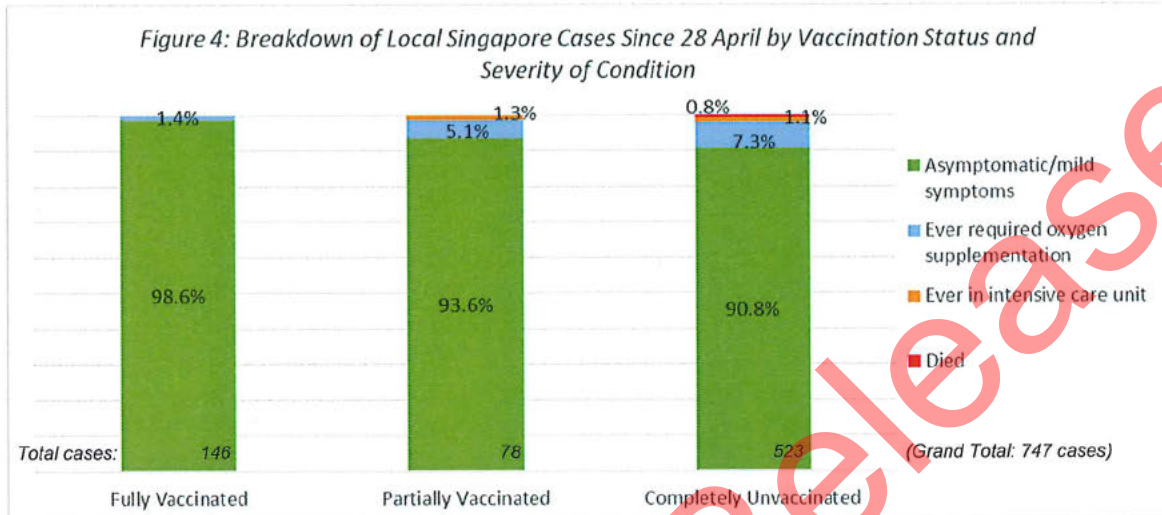
Singapore is at an earlier stage in its vaccination rollout than the UK or Israel. Its domestic situation is more similar to New Zealand, with generally very low numbers of cases throughout the duration of the pandemic.¹

- 23. Singapore has administered over 5 million doses of vaccines. Slightly more than 50% of the population have received the first dose of the vaccine, while about 36% of the population have received both doses. They are using Pfizer/BioNTech and Moderna vaccines and have good vaccination rates within those that work in high-risk settings (e.g hospitals and airports).
- 24. Singapore recently experienced an increase in community cases of COVID-19 which peaked in May 2021 with over 200 cases reported in a week. The vaccination programme was about half as advanced as it is now.



¹ This section draws on reporting from New Zealand's High Commission in Singapore.

25. Despite vaccination, there were 146 fully vaccinated and 78 partially vaccinated individuals who tested positive for COVID-19. Over the course of the outbreak, around 1 case in every 6 were among the vaccinated. These individuals have experienced milder symptoms: only 2 fully vaccinated individuals (of 146) experienced a moderate case of COVID-19 (briefly requiring oxygen) and there have been no ICU admissions within this group. This contrasts with 44 (out of 523) unvaccinated individuals with more severe cases of COVID-19.



26. Transmission of the virus by vaccinated individuals is possible, and has been documented among household contacts. Singapore has not yet analysed the duration of infectivity among those who are fully vaccinated, nor observed any differences in transmission rates between Pfizer/BioNTech and Moderna vaccinations.
27. Singaporean officials expect that cases are more likely to be unlinked as a population becomes increasingly vaccinated, because any 'breakthrough' cases are likely to be asymptomatic or result only in mild illness.
28. Ministry of Health and DPMC officials will follow up with Singaporean officials to draw further insights which can be applied to outbreak management in a partially vaccinated population.
29. Singapore continues to follow a strict approach at the border to keep new cases of COVID-19 from entering the community.

The United States of America has some of the highest rates of vaccination in the world, but with significant differential in uptake within the population

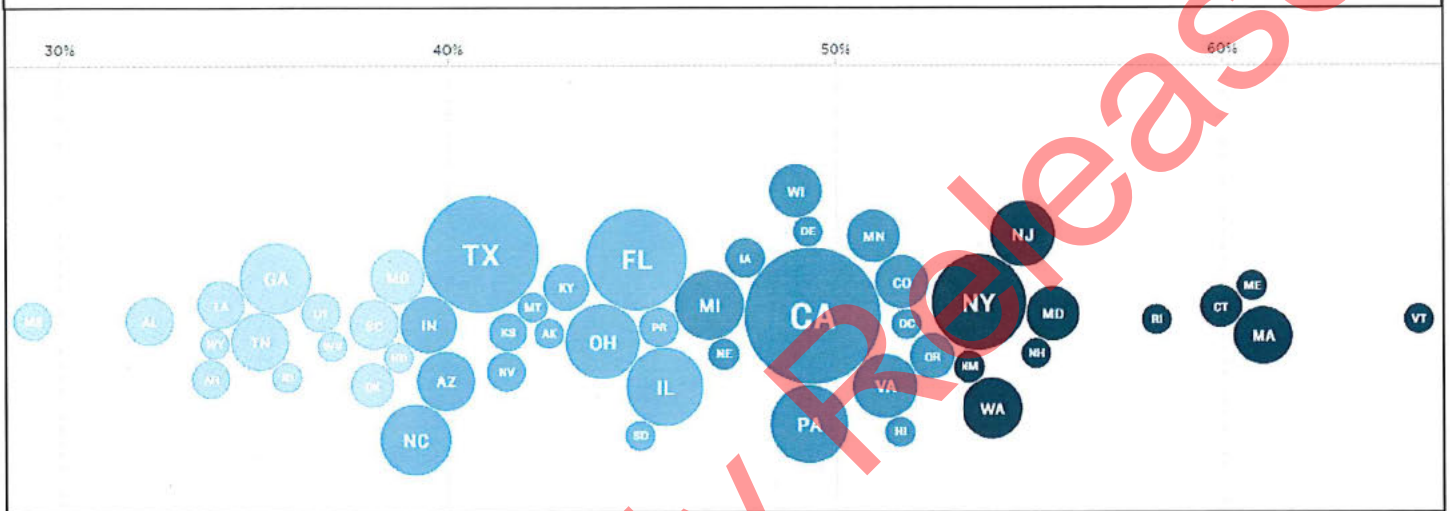
30. With nearly half of the population fully vaccinated the United States of America (the US), has also seen significant decreases in new cases being reported. Beneath this high average vaccination rate there are significant disparities at the state level. Lower vaccine uptake is correlated with a variety of factors: these states are more likely to be rural, have state governments that implemented limited risk mitigations, and have lower compliance with other public health measures. Many of these factors also correlate with citizens' political preferences.
31. A peak of over 300,000 cases reported on the 8th of January 2021 has decreased to a rolling 7-day average of around 14,000 new cases by June 2021. In March 2021, the CDC estimated that as many as 35% of the population of the US have been infected with COVID-19 since the beginning of the pandemic; natural immunity, alongside the immunisation

rollout, may have played a role in limiting community transmission without the implementation of tight restrictions – but a range of restrictions have remained in place, many at the state level.

- 32. Looking ahead, we would expect differential vaccination rates to lead to different transmission dynamics at the state-level. This may have implications for how we consider the risk of travellers from the US, given the heterogeneity in the degree of population protection we would expect.

Figure 5: Percentage of state's population fully vaccinated, 27 June. Size of circle represents state's population size.

Source: CDC. Visualisation: NPR



Summary and Next Steps

- 33. Officials do not consider there to be international evidence that refutes the key conclusions of the vaccination modelling we have seen to date. Indeed, there is emerging evidence which supports the key messages:
 - a) Population immunity (without public health controls in place) is likely to require a very high rate of vaccination.
 - b) We will continue to need risk mitigation measures in place at the border and in the community, and our calibration of these measures may need to change as vaccination rates increase.
- 34. Israel and Singapore have implemented a range of risk mitigation measures similar to those used within New Zealand as part of the elimination strategy, including border restrictions, PCR testing, isolation of high-risk travellers. Both have also used mask mandates to help reduce the spread of variants of concern within their communities.
- 35. The modelling steering group will continue to monitor international developments and consider modelling outputs in that context. There are four areas of interest as further data emerges:
 - a) Given high and increasing rates of vaccination in some adult populations – particularly in the UK and Israel - can we learn more about the susceptibility of children, their role in transmission and, hence, their importance for building population protection?

- b) As countries and regions with different rates of vaccination experience outbreaks, can we learn more about outbreak dynamics and the interventions required to control outbreaks at different points of the vaccine rollout, by:
 - i) comparing non-pharmaceutical interventions required to minimise transmission within similarly vaccinated populations? *and*
 - ii) comparing the same non-pharmaceutical interventions when applied to different populations with significantly different rates of vaccination?
- c) Officials of the Ministry of Health and DPMC will meet with Singaporean officials to gather further insights regarding outbreak management in a partially vaccinated population, given the relatively similar epidemiological context and objectives.
- d) How does the relationship between case numbers and hospitalisations or fatalities evolve in highly vaccinated populations with sustained transmission of COVID-19, such as the UK?

Consultation

- 36. Officials from the Modelling Steering Group were consulted in generating this briefing, which includes the Ministry of Health, Department of the Prime Minister and Cabinet, StatsNZ, the Treasury, Ministry of Business, Innovation and Employment and the Ministry of Social Development.
- 37. This briefing draws on open source material and conversations with/reporting from New Zealand's High Commission in Singapore, the Prime Minister's Chief Science Advisor (and team) and Rodney Jones (Wigram Capital).

Communications

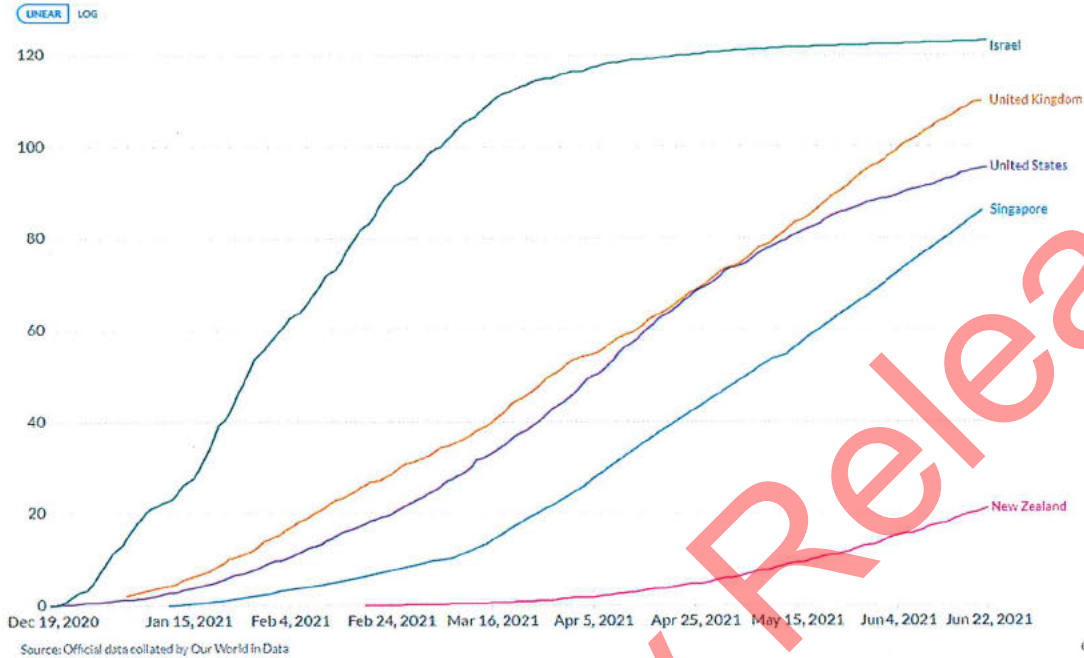
- 38. There are no direct communications implications arising from this briefing.
- 39. The content of this briefing may be useful if questions arise following the publication of initial modelling results by Te Pūnaha Matatini on Wednesday 30 June 2021.

ATTACHMENT A

Vaccination rates, cases, deaths, restrictions in selected countries

COVID-19 vaccine doses administered per 100 people

Total number of vaccination doses administered per 100 people in the total population. This is counted as a single dose, and may not equal the total number of people vaccinated, depending on the specific dose regime (e.g. people receive multiple doses).



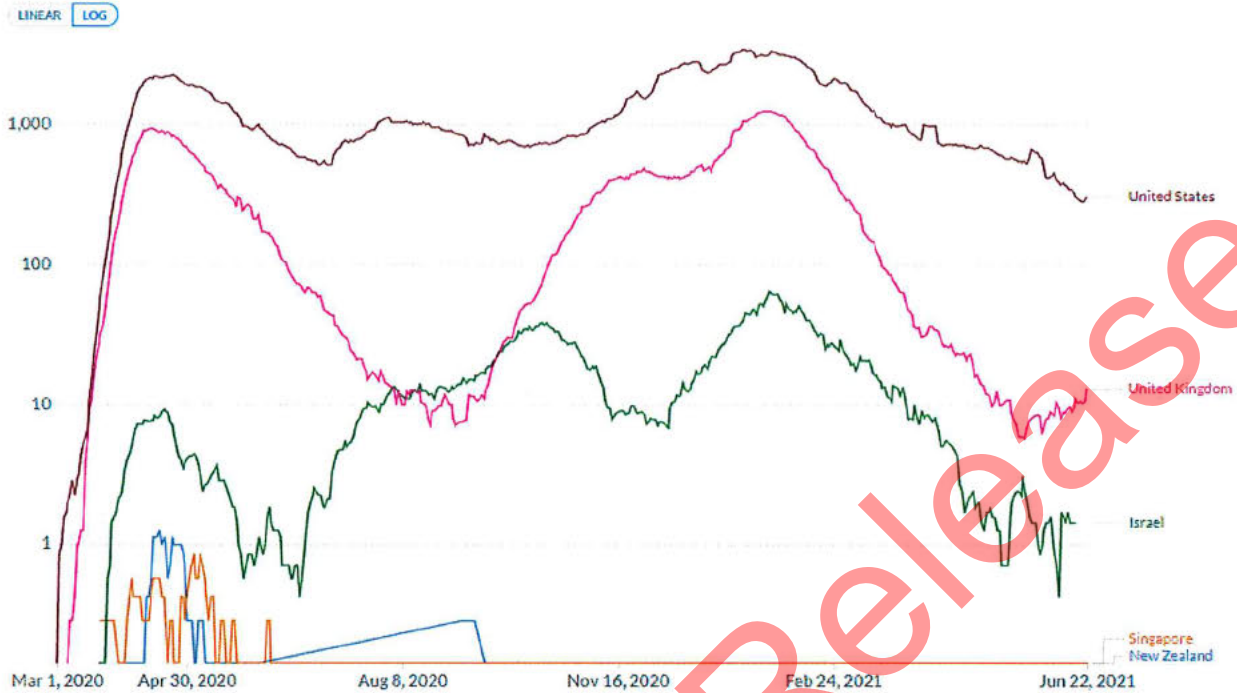
Daily new confirmed COVID-19 cases

Shown is the rolling 7-day average. The number of confirmed cases is lower than the number of actual cases; the main reason for that is limited testing.



Daily new confirmed COVID-19 deaths

Shown is the rolling 7-day average. Limited testing and challenges in the attribution of the cause of death means that the number of confirmed deaths may not be an accurate count of the true number of deaths from COVID-19.



Source: Johns Hopkins University CSSE COVID-19 Data

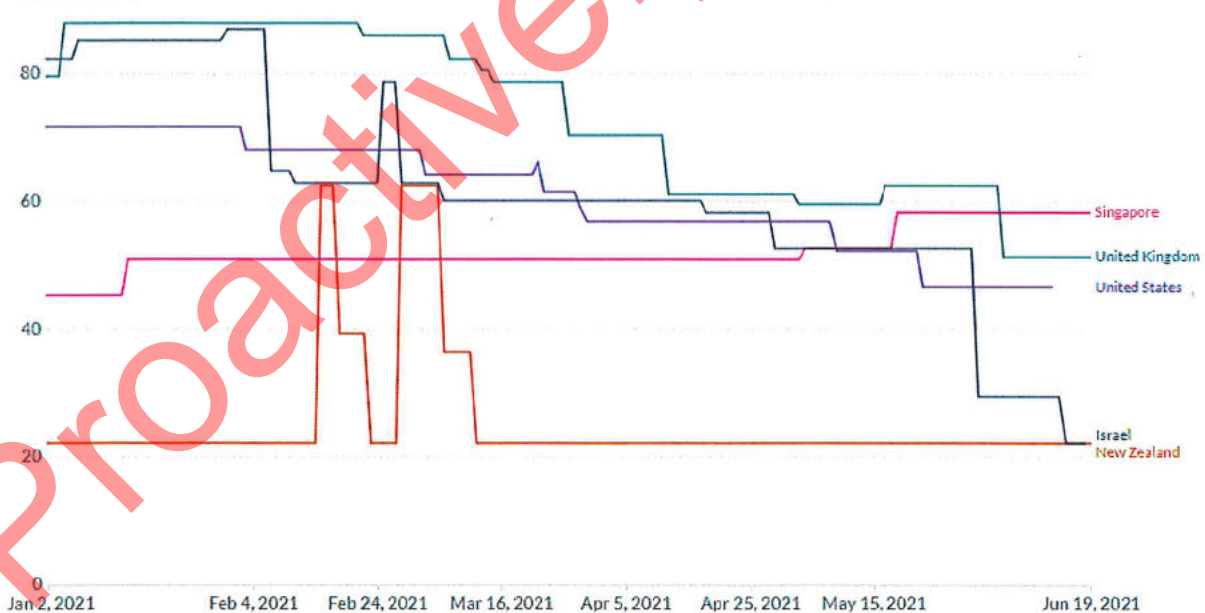
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COVID-19: Stringency Index

This is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest). If policies vary at the subnational level, the index is shown as the response level of the strictest sub-region.



+ Add country





ATTACHMENT B

Table of Vaccination and New Case Rates of Jurisdictions Reviewed in this Paper

Country (vaccines used)	Population partially vaccinated (%)	Population fully vaccinated (%)	People aged 12+ with first dose (%)	People aged 12+ with second dose (%)	New cases, June 2021 daily average	New cases per million, June 2021 daily average
Israel (Pfizer-BioNTech)	61.3	57.0	82.8	77.1	52	6
United Kingdom (Pfizer-BioNTech, Moderna, Astrazeneca, Janssen, Novavax)	66.3	48.6	75.7	55.3	8876	131
USA (Pfizer-BioNTech, Moderna, Janssen)	54.0	46.1	63.2	50.6	13615	41
Singapore (Pfizer-BioNTech, Moderna)	52.1	36.1	56.3	39.0	18	3
New Zealand (Pfizer-BioNTech)	13.0	7.7	15.6	9.4	2	0.5
Source (at 28 June)	Bloomberg vaccine tracker	Bloomberg vaccine tracker	The Economist	The Economist	Our world in data	Our world in data