

# Challenge for COVID-19 vaccines to protect the New Zealand population

Stephen T Chambers, Nigel J Raymond

**N**ew Zealand faces a major challenge this year to use the COVID-19 (SARS-CoV2 virus) vaccination programme to optimise protective immunity, in order to protect our largely non-immune population. The practical goal is to achieve a high uptake of vaccination while not leaving any parts of the community unprotected. Never before has the country had such a programme of vaccinating so many people within such a short time frame.

This challenge is made more acute as the New Zealand health system has a long and challenging experience of responding to seasonal winter increases in respiratory viruses, particularly influenza. The uptake of publicly funded influenza vaccine has remained modest, with ongoing equity gaps for important high-needs populations (eg, Māori) despite the well-publicised effects on the health system. The immunisation rate for influenza was reported as 63% overall for 2019 despite ongoing improvement from previous years and some reductions in equity gaps.<sup>1</sup> These infections routinely cause unseemly bed shortages and compromised delivery of healthcare services across the country. At present we do not know what shape future possible winter outbreaks of COVID-19 infections will take, but COVID-19 added to the normal pattern of winter viral infections creates a daunting prospect. The combination of a winter increase in influenza cases plus COVID-19 cases in similar numbers would undoubtedly lead to a substantial increase in morbidity and mortality from these infections, because of the overall burden on the health system and the severity of COVID-19 infections.

We now have tools to mitigate the epidemic curve of both COVID-19 and influenza, as well as other viral infections, given the effectiveness of the COVID-19

vaccine, the relatively good effectiveness of influenza vaccine and the current public acceptance of social distancing and improved personal hygiene. No one strategy alone will deliver all of the health benefits we need. The health professional community and the public both have important roles if our country is to make the most of this opportunity.

## COVID-19 vaccine response

New Zealand is well placed to roll out the COVID-19 vaccination programme as there are purchase agreements for sufficient Pfizer vaccine (PfizerBioNTech) to give two doses to the population. This is a mRNA-based vaccine that stimulates cells to make spike protein antigen, but does not incorporate itself into human DNA.<sup>2,3</sup> The vaccine vials require an ultra-cold chain for transportation to New Zealand where they are held in -80°C freezers. These facilities are already in place across the country. The vaccine can then be stored at 2–8°C for up to five days after thawing for distribution to use at vaccine administration sites around the country. Use of standard pharmaceutical freezer temperatures (-20°C) for up to two weeks, recently approved in New Zealand by MedSafe, should considerably aid distribution.<sup>4</sup> Vials have sufficient content for 5–6 doses and must be used within a few hours of opening. The second dose should then be administered at least three weeks (or longer) after the first dose.

The Pfizer vaccine has been found to be both highly efficacious in adults of all ages and children as young as 12 years from evidence of large clinical trials, and highly effective in subsequent large-population experience.<sup>2,5</sup> The vaccine has been found to be highly immunogenic and produces higher levels of neutralising antibodies than following wild-type COVID-19 infection,

even in older adults (55–85 years). The most important phase 3 clinical trial was conducted across multiple sites in the United States, Argentina, Brazil, South Africa, Germany and Turkey.<sup>2</sup> The study enrolled 43,448 people and was conducted in accordance with rigorous FDA standards. Failure was defined as being symptomatic and having laboratory confirmed COVID-19 seven days after the second dose was administered. In those with no evidence of prior infection the vaccine efficacy was 95% (95% CI 90–98%). Vaccine efficacy among subgroups (age, sex, race, ethnicity, obesity and comorbidities) was consistent with that observed in the overall population. There are limited published studies as yet on the effectiveness in the ‘real world’, but reports we have so far show impressive results in preventing hospitalisation and death. For example, Public Health England has reported that a single dose of either the Pfizer or AstraZeneca vaccines cut the risk of hospital admission by 80% in people over 80 years.<sup>6</sup> In Israel, two doses of the Pfizer vaccine administered to a cohort of 596,681 people reduced hospitalisations by 87% (95% CI 55–100) and severe disease by 95% (95% CI 75–100) compared with unvaccinated controls.<sup>7</sup> Experience in Scotland found a vaccine efficacy of 85% (95% CI 76–91) for COVID-19 related hospitalisation at 28–34 days post vaccination.<sup>7</sup> More recently, a study showed a similarly high vaccine efficacy in children age 12–16 years.<sup>5</sup>

A growing body of evidence also demonstrates that fully vaccinated people are less likely to have asymptomatic infection and potentially much less likely to transmit SARS-CoV-2.<sup>8</sup> The few cases of infection following vaccination that have been reported are associated with a shorter mean duration of symptoms and often lower viral load than infection in unvaccinated people.<sup>9</sup> For example, a study of 3,950 front-line health workers, most of whom had been vaccinated with either the Pfizer and Moderna vaccine (another RNA vaccine), found a 90% reduction of symptomatic and asymptomatic infections following the second vaccine dose.<sup>10</sup>

There are clearly areas of uncertainty that need to be clarified. These include the effectiveness of the vaccine in children. There is good evidence from a recent study

for excellent efficacy and safety of the Pfizer vaccine in subjects aged 12–16 years.<sup>5</sup> This is welcome news. While children are less prone to both asymptomatic and symptomatic COVID-19 infections and play a lesser role in transmission within families to more vulnerable members, there has been of lingering concern that this could provide an under-recognised pathway for transmission.

As yet there is little information on how long protection is likely to last and how effective the Pfizer vaccine will be against COVID-19 variants. Studies using a rapid neutralising antibody assay of serum taken from patients who have had a natural infection or two doses of the Pfizer vaccine found that the faster spreading COVID-19 variants acquired a partial resistance to the neutralising antibody.<sup>11</sup> This was most marked for the B.1.351 variant, suggesting that the vaccine may be less effective against this organism. The poorly controlled spread of COVID-19 in large populations in Europe, South America and South Asia is almost certain to allow more variants to emerge. In addition, piecemeal or poorly rolled out vaccination programmes are likely to create further evolutionary pressure towards the selection of escape variants of COVID-19. It is likely that booster vaccines will be needed with new antigens added to the suite of vaccines against COVID-19 over time.<sup>12</sup>

## Community immunity

The implementation of the public health measures in New Zealand to ‘suppress the curve’ during the first half of 2020 was remarkably effective and showed that elimination was possible. Most vaccination programmes aim at disease reduction to some ‘tolerable’ level, and it remains to be seen whether prevention of endemic transmission by ‘herd protection’ is possible.<sup>5,13–16</sup> Both elimination and control strategies aim at protecting the maximum number of individuals at risk. Following completion of the current vaccination programme, it seems unlikely that we will be going straight back to ‘normal’, and we may need to navigate a pathway to a hopefully low level of endemic infection. It is doubtful that aiming for an arbitrary target, such as 70% of the adult population being vaccinated, would be sufficient to control COVID-19, as the degree of asymptomatic spread reduction is still not

established and immunity is rarely uniform across a population. So we will need to ensure subpopulations are adequately protected. To do this we need to specifically address some challenging factors.

Firstly, it is essential that all sections of society are reached with vaccination, especially those with comorbidities, including Māori and Pacific Island communities, advanced age (eg, rest-homes), and particularly if their community may be more likely to be exposed (eg, South Auckland). It will be a huge operational challenge to reach most of New Zealand's population with COVID-19 vaccination during the year. The national COVID-19 immunisation register is a vital component of this strategy and will be needed for future vaccines delivery.

Secondly there has been a major effort launched to overcome vaccine hesitancy. It is imperative that healthcare professionals take responsibility to provide independent, high-quality and clear information to address legitimate concerns and counter misinformation. Health staff should be well informed so that the vaccination programme can be discussed during hospital admission and outpatient clinics, as well as general practitioner visits. The importance of taking into account behavioural and social drivers of vaccine uptake, including during healthcare interactions, has also been emphasized by the World Health Organisation (WHO) in their BeSD model in endeavouring to achieve high uptake of COVID-19 vaccines (Figure 1).<sup>17,18</sup>

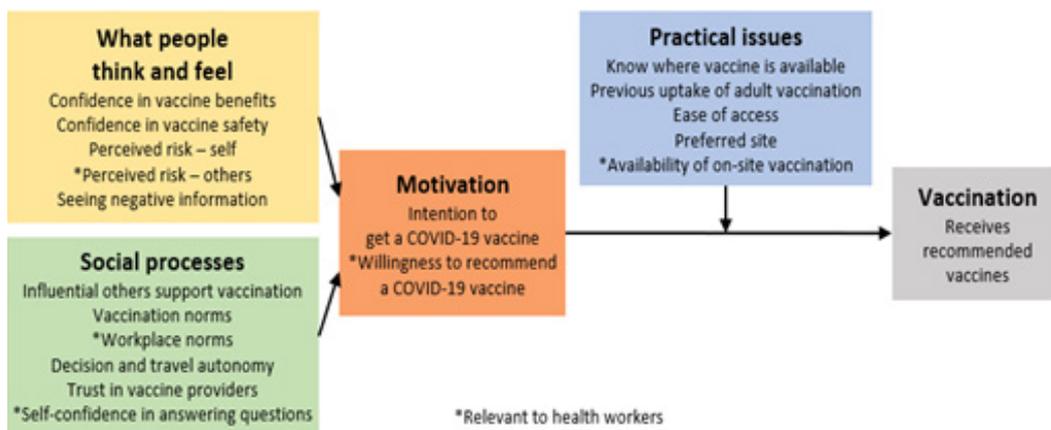
Individuals who have been affected, or whose families/whānau have been affected, by COVID-19 have an important role to play in advocating for an effective whole of community approach. This could include managed isolation and quarantine (MIQ) staff who have been vaccinated and presumably feel a significant measure of reassurance from the protection this offers, healthy people who have been affected by suffering a serious COVID-19 illness, or those who have been affected by the 'long COVID syndrome' that compromises their enjoyment of life in the long term.

### Benefits of an effective vaccination programme

The vaccination programme has important implications. Many people will be keen to break out from the restrictions of the infection prevention and control (IPC) measures, such as social distancing and use of masks on public transport. These measures have undoubtedly been effective in reducing the rate of transmission of COVID-19 and also influenza and other severe respiratory infections. The benefits of these measures should be pursued in the short term until there is a reliably high level of community immunity from COVID-19, and then they should be seen as part of the normal response to the annual winter respiratory virus epidemics.<sup>19</sup>

New Zealand has opened a 'bubble' with Australia, and other countries will soon be added to this. But there will be an ongoing

Figure 1: The BeSD of Covid-19 model.



Source: Based on the “increasing vaccination” model (Brewer et al., 2017).<sup>18</sup>

need for the MIQ border protections. These have worked well and limited community incursions to outbreaks, which have been contained by intensive work by Public Health Units (PHUs). Extensive vaccination of the staff manning these facilities will offer a further layer of protection against an importation, and high uptake of vaccination in communities who later become contacts of an infected traveller would greatly help this situation by lowering the effective transmission reproductive number (Ro) and limiting community spread to be containable. This would greatly lower the burden on PHU to contact trace and shut down outbreaks and minimise the need for lockdowns.

### Vaccine safety evidence and monitoring (high)

A comprehensive discussion of vaccine safety is beyond the scope of this paper. However, the evidence from controlled trials has found that the Pfizer vaccine is extremely safe.<sup>10,20</sup> The most common side effects include mild to moderate pain at the injection site in about 80% of subjects, fatigue in about 60% and headache in about 50% of subjects.<sup>21</sup> All were short lived. Reports of serious side effects, such as allergic reactions, have been very rare, and no long-term complications have been confirmed. The clotting problems with that have been associated with the Oxford Astra-Zeneca and possibly with Johnson & Johnson vaccines (both of which use an adenovirus

vector) does not seem to be a problem with the Pfizer vaccine. The specific clotting problems have produced very serious, if rare, clinical effects, including cavernous sinus thrombosis and deaths, which are likely to be clinically recognised within OECD medical systems. Given the intense scrutiny engendered by the publicity of clotting problems with the other vaccines, it seems very unlikely that these problems are associated with the Pfizer vaccine. Monitoring of the primary outcomes from the trials will continue until August 2021, while monitoring of the secondary outcomes will continue until January 2023.<sup>22</sup>

### Leadership from healthcare providers

New Zealand owes a great debt of gratitude to the leadership provided by the government and health leaders who have communicated so effectively with the public. The next hurdle is to roll out the vaccine in a coordinated and equitable way. There are already several effective vehicles for providing information on the ongoing evolution and response to the COVID-19 epidemic. It is important that healthcare providers support the strategy by helping to build confidence in the outcomes as we mediate between the overall policy and the concerns of our patients. Key ingredients needed in this roll-out are clarity of purpose, knowledge of the benefits and safety of the vaccine and optimism that a scientific and humane response will be effective.

**Competing interests:**

Nil.

**Acknowledgements:**

The authors thank Dr Nikki Turner and Prof David Murdoch, for reviewing and comments on the manuscript.

**Author information:**

Nigel J Raymond: Infectious Diseases & General Physician, Infection Service, Capital & Coast District Health Board; Department of Medicine, University of Otago, Wellington (Honorary CSL).  
Stephen T Chambers: Department of Pathology, University of Otago, Christchurch. Infectious Diseases Physician Christchurch Hospital.

**Corresponding author:**

Dr NJ Raymond, Infection Service, Lv6 GNB, Wellington Hospital, Private Bag, Wellington, +64-4-385-5999  
nigel.raymond@ccdhb.org.nz

**URL:**

[www.nzma.org.nz/journal-articles/challenge-for-covid-19-vaccines-to-protect-the-new-zealand-population-open-access](http://www.nzma.org.nz/journal-articles/challenge-for-covid-19-vaccines-to-protect-the-new-zealand-population-open-access)

**REFERENCES**

- Influenza. NZ Ministry of Health. <https://www.health.govt.nz/our-work/immunisation-handbook-2020/11-influenza> accessed 10 April 2021.
- Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, Perez JL, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *N Eng J Med* 2020; December 16, 1-13. <https://doi.org/10.1056/NEJMoa2034577>
- Lamb YN. BNT162b2 mRNA COVID19 vaccine: first approval. *Drugs* (2021) 81:495–501. <https://doi.org/10.1007/s40265-021-01480-7>
- Coronavirus (COVID-19) update: FDA allows more flexible storage, transportation conditions for Pfizer-BioNTech COVID-19 vaccine. February 25, 2021. <https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-allows-more-flexible-storage-transportation-conditions-pfizer> accessed 15 April 2021.
- Mahase E. Covid-19: Pfizer reports 100% vaccine efficacy in children aged 12 to 15. *BMJ* 2021;373:n881. <http://dx.doi.org/10.1136/bmj.n881>
- Lacobucci G. Covid-19: Single dose of Pfizer and Oxford vaccines cuts risk of hospital admission by 80% in over 80s, data suggest. *BMJ* 2021;372:n612 <http://dx.doi.org/10.1136/bmj.n612>
- Dagan N, Barda N, Kepten E, Miron O, Perchik S, Katz MA, Hernán MA, et al. BNT162b2 mRNA Covid-19 vaccine in a nationwide mass vaccination setting. *N Engl J Med* 24 Feb 2021. <https://doi.org/10.1056/NEJMoa2101765>
- Edelstein S, Tannous S, Jacobs MT, Ben-Amram H, Zarka S. BNT 13b2 Pfizer vaccine protects against SARS-CoV-2 respiratory mucosal colonization even after prolonged exposure to positive family members. *J Hosp Infect* (preprint, accepted 24 March 2021). <https://doi.org/10.1016/j.jhin.2021.03.023>
- McEllistrem MC, Clancy CJ, Buehrle DJ, Lucas A, Decker BK. Single dose of a mRNA SARS-CoV-2 vaccine is associated with lower nasopharyngeal viral load among nursing home residents with asymptomatic COVID-19. *Clin Infect Dis* 2021 26 Mar (accepted; preprint) <https://doi.org/10.1093/cid/ciab263>
- Thompson MG, Burgess JL, Naleway AL, Tyner HL, Yoon SK, Meece K, Olsho LEW, et al. Interim estimates of vaccine effectiveness of BNT162b2 and mRNA-1273 COVID-19 vaccines in preventing SARS-CoV-2 infection among health care personnel, first responders, and other essential and front-line workers - eight U.S. locations, December 2020–March 2021. *Morb Mort Weekly Rep MMWR / April 2, 2021;70(13):495-500.*
- Planas D, Bruel T, Grzelak L, Guivel-Benhassine F, Staropoli I, Porrot F, Planchais C, et al. Sensitivity of infectious SARS-CoV-2 B.1.1.7 and B.1.351 variants to neutralizing antibodies. *Nature Med* 2021 <https://doi.org/10.1038/s41591-021-01318-5>
- Hodgson SH, Mansatta

- K, Mallett G, Harris V, Emary KRW, Pollard AJ. What defines an efficacious COVID-19 vaccine? A review of the challenges assessing the clinical efficacy of vaccines against SARS-CoV-2. *Lancet Infect Dis* 2021;21: e26–35. Published online October 27, 2020. [https://doi.org/10.1016/S1473-3099\(20\)30773-8](https://doi.org/10.1016/S1473-3099(20)30773-8)
13. Fine P, Eames K, Heymann DL. “Herd immunity”: a rough guide. *Clin Infect Dis* 2011;52(7):911–916. <https://doi.org/10.1093/cid/cir007>
  14. Rashida H, Khandakera G, and Booy R. Vaccination and herd immunity: what more do we know? *Curr Opin Infect Dis* 2012, 25:243–249. <https://doi.org/10.1097/QCO.0b013e328352f727>
  15. Zachreson C, Chang SL, Cliff OM, Prokopenko M. How will mass-vaccination change COVID-19 lockdown requirements in Australia? April 2, 2021 <https://arxiv.org/abs/2103.07061>
  16. Mallory ML, Lindesmith LC, Baric RS. Vaccination-induced herd immunity: successes and challenges. *J Allergy Clin Immunol*. 2018 July ; 142(1): 64–66. <https://doi.org/10.1016/j.jaci.2018.05.007>
  17. Data for action: achieving high uptake of COVID-19 vaccines. Gathering and using data on the behavioural and social drivers of vaccination. A guidebook for immunization programmes and implementing partners. Interim Guidance. W.H.O. 3 February 2021. <https://apps.who.int/iris/rest/bitstreams/1331778/retrieve>. Accessed 25 April 2021
  18. Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing vaccination: putting psychological science into action. *Psychol Sci Pub Interest* 2017; 18(3) 149–207. <https://doi/10.1177/1529100618760521>
  19. Moore S, Hill EM, Tildesley MJ, Dyson L, Keeling MJ. Vaccination and non-pharmaceutical interventions for COVID-19: a mathematical modelling study. *Lancet Infect Dis*, March 18, 2021 [https://doi.org/10.1016/S1473-3099\(21\)00143-2](https://doi.org/10.1016/S1473-3099(21)00143-2)
  20. Medsafe. Adverse events following immunisation with COVID-19 vaccines: Safety Report #1. 7 April 2021. <https://www.medsafe.govt.nz/COVID-19/safety-report-1.asp> Accessed 15 April 2021.
  21. COMIRNATY™ COVID-19 Vaccine. New Zealand Datasheet; Medsafe. <https://www.medsafe.govt.nz/profs/Data-sheet/c/comirnatyinj.pdf> Accessed 20 April 2021.
  22. Clinical trial number NCT04368728 for “NCT04368728: Study to Describe the Safety, Tolerability, Immunogenicity, and Efficacy of RNA Vaccine Candidates Against COVID-19 in Healthy Individuals” at [ClinicalTrials.gov](https://ClinicalTrials.gov)