PHARMACEUTICAL SCHEDULE APPLICATION

To: Immunisation Advisory Committee

From: Funding Application Advisor

Date: May 2022

Influenza vaccine widened access options [P- 001779]

QUESTIONS TO IMMUNISATION ADVISORY COMMITTEE

Note to Committee members: These questions have been identified by Pharmac staff as being particularly relevant to the application. Please feel free to provide additional information as appropriate.

Need

1. Considering the currently available vaccines for influenza, is there an unmet health need? If so, why?

   1.1. What is the strength and quality of evidence for these needs?

2. Does influenza disproportionally affect:

   - Māori?
   - Pacific people?
   - Other groups already experiencing health disparities relative to the wider New Zealand population (eg NZ Dep 9-10 deprivation, refugees/asylum seekers)?

   2.1. What is the strength and quality of evidence for populations disproportionally affected by influenza?

Health benefit

3. Do high dose quadrivalent influenza vaccines (hdQIV), adjuvanted quadrivalent influenza vaccines (aQIV) or live attenuated influenza vaccines (LAIV) provide any additional health benefit or create any additional risks compared with other funded treatment options? If so, what benefits or risks are different from alternative vaccines?

4. Does reduction of community spread through widened access to any of the following groups provide any additional health benefit of create any additional risks compared with currently funded treatments?

   - universal vaccination of the whole population
   - universal vaccination of school-aged children
   - direct and indirect protection within households

5. What is the strength and quality of evidence, including its relevance to NZ, for health benefits that may be gained from influenza vaccine for the reduction of community spread by vaccination of each of these groups?

6. Does individual protection of any of the following groups provide additional health benefit of create any additional risks compared with currently funded treatments?

- universal vaccination of children under 5 years of age
- Māori and Pacific peoples from an earlier age than 65 years

7. What is the strength and quality of evidence, including its relevance to NZ, for health benefits that may be gained from influenza vaccine for individual protection by vaccination of children under five years of age or Māori and Pacific peoples from an earlier age than 65 years?

8. Which patient population would benefit most from each of the following types of influenza vaccines?

   - QIV
   - aQIV
   - hdQIV
   - LAIV

9. Which direct or indirect protection strategies does the Committee consider would be most effective in the New Zealand setting? Please describe the patient population that would benefit from each preferred strategy.

10. What is the strength and quality of evidence, including its relevance to NZ, for health benefits that may be gained from influenza vaccine for the preferred direct or indirect protection strategies?

Suitability

11. Are there any non-clinical features of the different influenza vaccines that may impact on use, either by the patient, by family, or by healthcare workers, that have not been considered in this paper?

12. Are there any features of QIV that may impact on its use in school-age children?

    12.1. Are there any age groups where an intranasal vaccine (such as LAIV) would be preferred over an injectable vaccine (such as QIV).

General

13. Is there any data or information missing from the application, in particular clinical trial data and commentary?

Recommendations

14. Which of the following influenza vaccine types should be considered for a future listing in the Pharmaceutical Schedule (subject to product availability) and be included in the next commercial process for influenza vaccine in addition to QIV?

    - aQIV
    - hdQIV
    - LAIV

15. Should widened access to include any of the following groups be listed in the Pharmaceutical Schedule?

    - Universal vaccination of the whole population

- Universal vaccination of school-aged children (please specify age ranges)
- Universal vaccination of all children younger than 5 years of age
- Māori and Pacific peoples from an earlier age than 65 years (please specify age ranges)
- Healthcare workers
- Family or whānau of high-risk groups
- Any other groups not described above

16. If widened access is recommended, what priority rating would you give to each patient group within the context of vaccines and immunisation? [low / medium / high / only if cost-neutral]?
17. Does the Committee have any further comments or recommendations additional to the application?

PURPOSE OF THIS PAPER

The purpose of this paper is to stimulate discussion about possible influenza vaccination strategies and seek advice from the Committee regarding alternative approaches to seasonal influenza vaccination. It introduces a Pharmac initiated application to widen access criteria for influenza vaccine.

This paper summarises the evidence for vaccinating the following groups:

- Universal vaccination of the whole population
- Universal vaccination of school aged children
- Universal vaccination of children younger than 5 years of age
- Māori and Pacific peoples from an earlier age than 65 years
- Healthcare workers
- Family or whānau of high-risk groups

DISCUSSION

BACKGROUND

Previous consideration of influenza vaccine

The Pharmaceutical Schedule currently lists two influenza vaccines (Afluria Quad Junior and Afluria Quad), each with specific funding criteria, which is further discussed below under *The availability and suitability of existing medicines, medical devices and treatments*.

Previously considered applications for the funding of influenza vaccines in different population groups and the recommendations made are shown in Table 1:

Table 1: Funding recommendations for influenza vaccines

Population	Recommendation	Status
Inactivated influenza vaccine		
Influenza in patients with serious mental health conditions and addiction	Immunisation Subcommittee Oct 2019: Decline Immunisation Subcommittee Aug 2021: Medium	Options compared
Ring protection for high-risk group, Māori people from an earlier age than 65 years, Pacific people from an earlier age than 65 years	Immunisation Subcommittee May 2018: Decline	Options compared
Adjuvanted quadrivalent influenza vaccine		
Influenza vaccination for people aged 65 years and over	PTAC Aug 2020: Decline Immunisation Subcommittee Sep 2020: Cost Neutral	Options compared
Adjuvanted trivalent influenza vaccine		
Influenza vaccination for people aged 65 years and over	Immunisation Subcommittee Sep 2018: Decline PTAC Feb 2019: Decline	Declined

Additional advice sought from the Committee about widened access options

Pharmac staff sought email clinical advice from the members of the Immunisation Advisory Committee in late February 2022. Advice was sought on a number of options for widened access that had been discussed with the Ministry of Health for widened access during the 2022 influenza season:

- Māori and Pacific peoples aged 55 to 64 years
- Children aged six months to five years
- Eligible people and their whānau who live in the same dwelling (also known as "whānau approach" or "ring protection")

Most members' preferred option was open access ("universal coverage") of all ages, or some priority groups such as school age children or those from six months to five years of age.

While open access was a preferred option, most members were supportive of widened access for Māori and Pacific peoples from an earlier age. It was also suggested by members that Pharmac consider extending this down to 50 years age as this is when immune response starts to wane due to ageing.

Members noted that currently Māori and Pacific rates for influenza vaccination are much lower in those aged 65 years and over, compared to non-Māori, non-Pacific peoples. Members also noted that Māori and Pacific peoples are at increased risk from seasonal influenza. Māori and Pacific populations have a younger age distribution than other population groups and high incidence of comorbidities. Widening access from an earlier age would increase coverage in Māori and Pacific Peoples as a greater proportion of the population would be able access funded vaccination.

The eligibility criteria for influenza vaccine were widened from 1 April 2022 to include Māori and Pacific people who are 55-64 years of age, for the duration of the 2022 calendar year. This widened access was intended to reduce the impact of influenza to at-risk populations during the COVID-19 pandemic. Many Māori and Pacific people in this age range may already have been eligible for funded influenza vaccine if they had comorbidities, however, additional criteria including age and ethnicity was considered to reduce health system barriers to accessing funded influenza vaccine, as these eligible people would not have to have already accessed health services to receive a diagnosis of a qualifying condition. Other options for widened access considered by Committee members in February 2022 were also evaluated, but this option was progressed taking into account the planned vaccine supply, particularly in relation to constrained paediatric vaccine supply.

Commercial strategy and future funding applications

The last influenza vaccine RFP in 2018 resulted in the award of sole supply to Seqirus for Afluria Quad / Afluria Quad Junior. At its May 2018 meeting, the Committee recommended that hdTIV, aTIV and LAIV be included in the RFP that was issued at the end of 2018. In recent years there have been advances in vaccine technology and there are now a number of different vaccine technologies that may have advantages or disadvantages compared to standard inactivated influenza vaccine (IIV) in different patient subgroups. The newer technologies include high dose vaccines (hdQIV), adjuvanted vaccines (aQIV) and live attenuated influenza vaccines (LAIV). As Pharmac plans for the next RFP later in 2022, we seek the Committee's advice on which types of influenza vaccines could be included in the RFP. If suppliers of preferred types of vaccines do not yet have Medsafe approval in NZ,

they will need to submit their Medsafe application and make a funding application to Pharmac. Such applications would most likely be considered by the Committee and PTAC at a meeting in early 2023, once RFP bids have been received and analysed.

The Subcommittee should consider whether it is appropriate to continue the current model where there is one subsidised vaccine brand for all people, which allows for sole supply commercial arrangements, or if it would be preferred to fund different vaccines for different patient groups, taking into account the added implementation complexities.

The following table summarises the availability of other vaccines that Pharmac is aware of. Some of the vaccine types discussed at this meeting are not yet available in New Zealand, so suppliers will need to submit registration applications for these vaccines if they intend to participate in the influenza RFP to be issued in late 2022.

Table 2: Availability of influenza vaccines

Vaccine	Brand	Supplier	Medsafe Registration	Funding application
Cell based QIV	Flucelvax Quad	Seqirus	Approved	Expected July 2022
Adjuvanted QIV	Fluad Quad	Seqirus	Approved	Updated application to be considered at this meeting
High Dose QIV	Fluzone	Sanofi	Not yet submitted	Expected July 2022
LAIV	FluMist	AstraZeneca	Not yet submitted	Unknown

Need

Description of the disease

Influenza is a common viral infection that attacks the lungs, nose and throat and is spread through the air from people coughing or sneezing. It characteristically begins with the onset of fever, malaise, muscle aches, and headache, followed by the development of a cough, congestion, and a sore throat.

People suffering from influenza usually recover within one to four weeks, but there is a risk that some will develop complications, such as secondary infections, inflammation of the heart, brain, or muscle, and sometimes organ failure. Population groups most at risk of complications from influenza include very young children, pregnant women, and the elderly. Overall mortality rates with seasonal influenza in New Zealand are estimated around 13.5 per 100,000 population, but with wide variation according to gender, ethnicity and socioeconomic status and ranging up to 214 per 100,000 in the very elderly (Khieu et al. J infect. 2017;75:225-33).

The strains that most commonly affect humans are Type A, Type B and Type C.

Epidemiology

The influenza season in NZ usually occurs from May to August. The Southern Hemisphere Influenza Vaccine Effectiveness Research Study (SHIVERS) started in 2012 and collected data on influenza vaccines and hospitalisations associated with severe acute respiratory illness (SARI) and general practice presentations for influenza-like illness (ILI) in the Auckland and Counties Manukau District Health Boards.

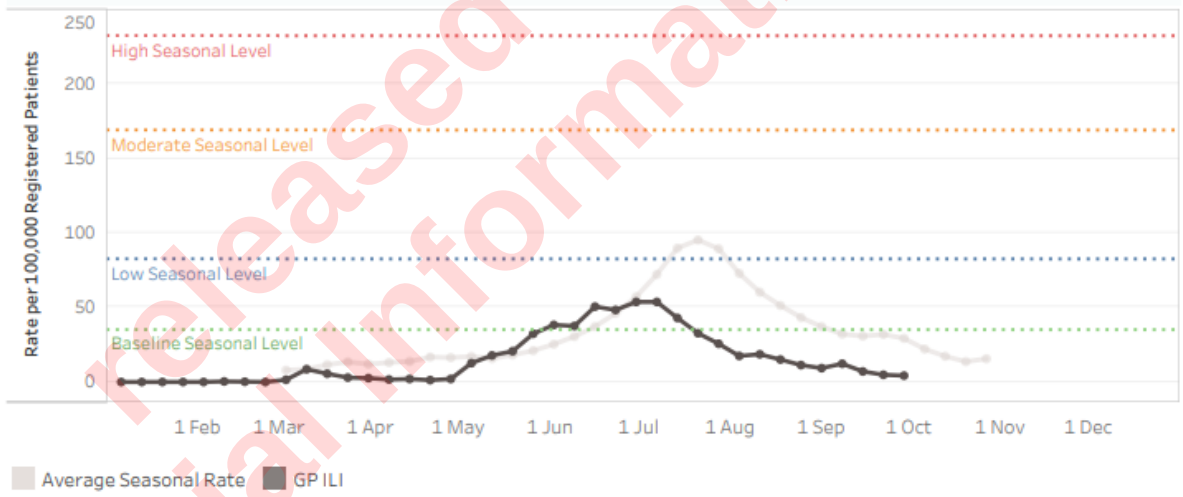
During the 2015 influenza season the SHIVERS study collected serology samples to measure the immune response to influenza infection. The serosurvey provided data on mild influenza that did not require GP consultation and information about the level of symptomatic and asymptomatic infection within the community.

The preliminary serological data suggested that around a quarter of the population would have been infected with influenza, and of these, 80% of children and adults with influenza did not have symptoms of influenza when infected. Of those with symptomatic infections, 77% did not seek medical attention.

During the 2020 and 2021 influenza seasons, ESR had reported that there had been very little, if any, influenza circulating, due to COVID-19 pandemic public health measures such as closed borders and mask wearing. For this reason, this section focuses on the 2019 season, albeit also a season with lower than usual influenza circulation.

Rates of weekly GP visits for ILI (influenza like illness) were lower than previous years in 2019 and did not exceed 60 cases per 100,000 people in any given week (Figure 1).

Figure 1: Weekly general practice ILI rates to 29 September 2019



Note: The black line denotes the 2019 rates of ILI. Grey line denotes historical rates for previous years.
Source: ESR 2019 Influenza Surveillance intelligence dashboard

Hospitalisations

The highest proportion of influenza infections resulting in hospitalisation and death is seen in adults aged over 65 years, who have decreased immune function due to their age and may have other conditions (including diabetes, heart disease, and respiratory conditions), which increase the risk of complications from influenza.

Khieu et al. Vaccine 2015;33:4087-92 (Appendix 1) used negative binomial regression models with weekly counts of hospitalisations and isolates of influenza A, B and respiratory syncytial virus for the period 1994-2008. The modelled hospitalisation rates per 100,000 are Table 3 below. Research by Khieu et al. highlights the highest disease burden in those under 65 years of age from influenza hospitalisation is in the <1 year, 1 to 4 year, 20 to 34 year and 50- to 64-year-old age groups. Noting the relative risk of hospitalisation for Māori (1.38) and Pacific peoples (1.43) across all age groups, the hospitalisation rate in each of these age groups is likely to be amplified for Māori and Pacific relative to non-Māori.

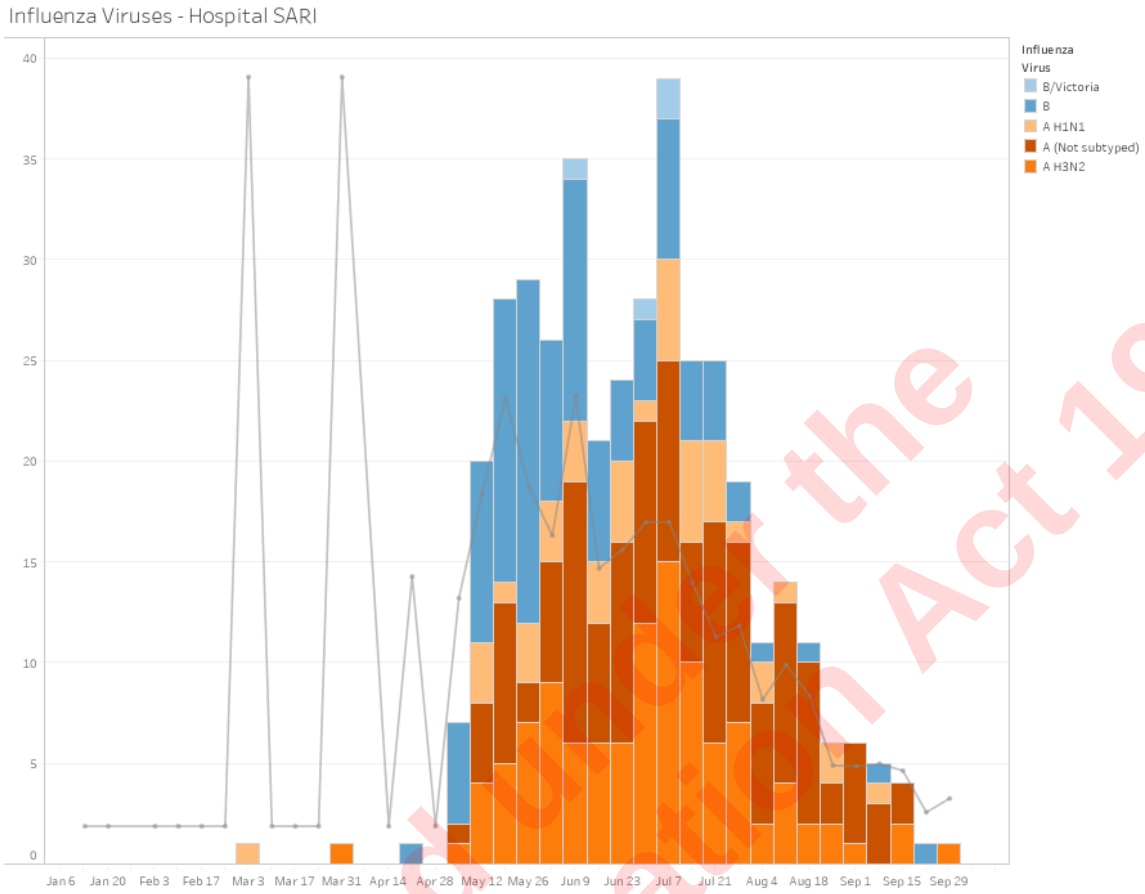
Table 3: Hospitalisation rates attributable to influenza (1994-2008), per 100,000

Description	Rate per 100,000
Hospitalisations attributable to influenza (1994-2008) – all ages, all causes*	62.4
Hospitalisations attributable to influenza (1994-2008) – <1 years, all causes*	244.5
Hospitalisations attributable to influenza (1994-2008) – 1-4 years, all causes*	161.1
Hospitalisations attributable to influenza (1994-2008) – 5-19 years, all causes*	15.8
Hospitalisations attributable to influenza (1994-2008) – 20-34 years, all causes*	52.3
Hospitalisations attributable to influenza (1994-2008) – 35-49 years, all causes*	15.7
Hospitalisations attributable to influenza (1994-2008) – 50-64 years, all causes*	53.2
Hospitalisations attributable to influenza (1994-2008) – 65-79 years, all causes*	149.9
Hospitalisations attributable to influenza (1994-2008) – >80 years, all causes*	327.8
Hospitalisations attributable to influenza (1994-2008) – Māori population all ages, all causes*	80.0 (RR vs non-Māori 1.38)
Hospitalisations attributable to influenza (1994-2008) – Pacific population all ages, all causes*	83.3 (RR vs non-Māori 1.43)
Hospitalisations attributable to influenza (1994-2008) – European/other population all ages, all causes*	58.1

*Causes included in the analysis: pneumonia and influenza, respiratory illness, circulatory illness, all medical illness, all causes

Weekly ESR surveillance data for 2019 shows that hospitalisations from influenza confirmed SARI were mostly caused by influenza A virus strains and did not exceed 40 cases per 100,000 in any given week (Figure 2).

Figure 2: 2019 rates of hospitalisation due to SARI, by influenza strain, per 100,000



Note: The grey line denotes the percentage of tested samples for that week which were influenza positive.
Source: ESR 2019 Influenza Surveillance intelligence dashboard

Mortality

Khieu et al. J Infect 2017;75:225-33 (Appendix 1) modelled seasonal influenza mortality in New Zealand, estimating the average mortality rate and identifying differences in risk by age, sex, ethnicity and socioeconomic position. Data was drawn from the New Zealand mortality dataset for the period 1994 to 2008. Mortality rates per 100,000 are shown in the Table 4 below:

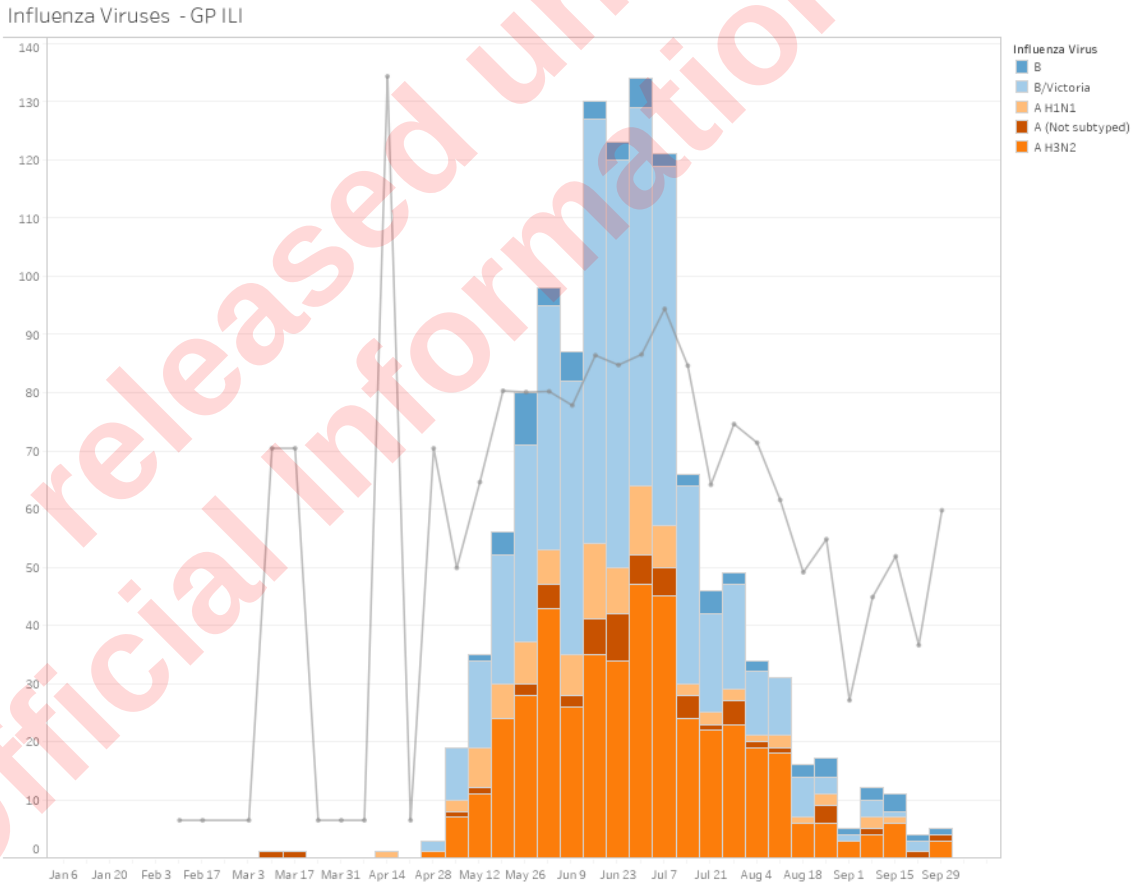
Table 4: Estimated rate of influenza-associated deaths (1994 to 2008) per 100,000

Description	Value
Estimated rate of influenza-associated deaths per 100,000 people (95% CI), all causes	13.5 (13.4, 13.6)
Estimated rate of influenza-associated deaths per 100,000 people, 20-64 years old (95% CI), all causes	2.5
Estimated rate of influenza-associated deaths per 100,000 people, 65+ years old (95% CI), all causes	90.3
Estimated rate of influenza-associated deaths per 100,000 people, 65-79 years old (95% CI), all causes	49.7
Estimated rate of influenza-associated deaths per 100,000 people, 80+ years old (95% CI), all causes	214
Estimated proportion of total deaths caused by influenza (%), all causes	1.8%

General practice community sentinel surveillance

According to ESR Influenza Surveillance data, 2019 GP visits for influenza confirmed ILI were predominantly caused by influenza B virus strains, mainly B/Victoria (Figure 3).

Figure 3: 2019 rates of GP visits due to ILI, by influenza strain, per 100,000



Note: the grey line denotes the percentage of tested samples for that week which were influenza positive.
Source: ESR 2019 Influenza Surveillance intelligence dashboard

Influenza immunisation coverage

Influenza vaccination claims data show that the coverage rate for adults aged 65 years and over was 65% in 2019. The coverage for pregnant women is 30% and for children aged 0-4 years was 3%.

Influenza vaccination claims data for 2021 show that the overall coverage rate for adults aged 65 years and over was 63.8%. Coverage data for people over 65 years of age overall and by ethnicity, provided by the Ministry of Health (MoH) Immunisation Team is provided in Table 5 below (both funded and unfunded). 2020 data is not presented due to the influence of the public health measures from the COVID-19 pandemic response, which affected this data.

Table 5: Influenza vaccination coverage uptake for adults aged over 65 years, by ethnicity, for the 2019 and 2021 influenza season

Group	Coverage
2019 influenza season	
Adults aged 65 and over (excludes unfunded)	66%
Māori people aged 65 and over	57%
Pacific people aged 65 and over	70%
2021 influenza season	
Adults aged 65 and over (excludes unfunded)	63.8%
Māori people aged 65 and over	50%
Pacific people aged 65 and over	62.4%

Source: MoH Immunisation Team

The health need of the person

Influenza is a viral infection that is associated with high morbidity and mortality due to the effects and complications of acute respiratory illness in young children, the elderly, pregnant women and those with a range of underlying medical conditions. However, healthy children and adults can also be at risk of serious illness following influenza infection.

The availability and suitability of existing medicines, medical devices and treatments

The funded influenza vaccine for 2022 for the adult population is AFLURIA QUAD (Seqirus), a non-adjuvanted QIV. The vaccine offers protection against strains A/Victoria/2570/2019 (H1N1) pdm09-like virus, A/Darwin/9/2021 (H3N2)-like virus, B/Austria/1359417/2021-like virus, B/Phuket/3073/2013-like virus.

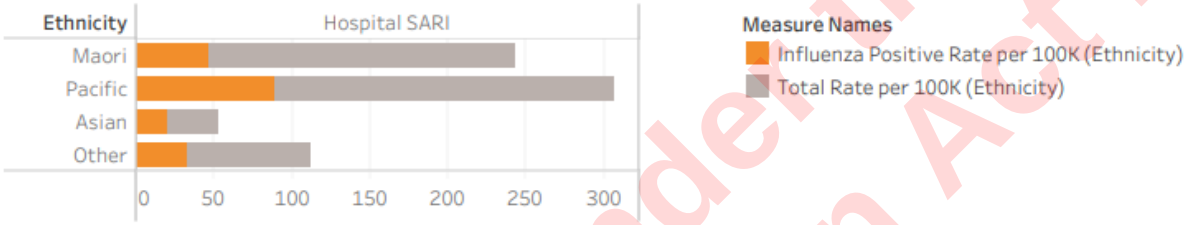
The health need of family, whānau, and wider society

Pharmac acknowledges that there may be a health need for other people as a result for caring for patients with influenza. The impact on whānau primarily comes from the risk of transmission to those living with and caring for patients with influenza.

The impact on the Māori health areas of focus and Māori health outcomes

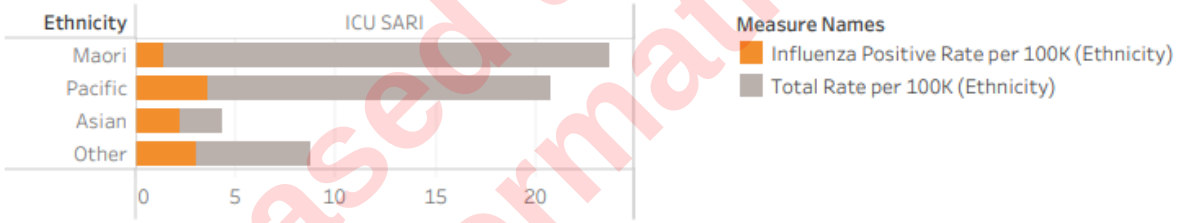
Influenza disproportionately affects Māori health outcomes, which may be in part due to lower rates of immunisation in the Māori population. Māori and Pacific peoples are more likely to be hospitalised from SARI compared with non-Māori and non-Pacific populations (Figure 4) and are also more likely to have to be treated in ICU due to SARI, though Māori rates of ICU admission from confirmed influenza are lower than for non-Māori (Figure 5).

Figure 4: Cumulative rate of hospitalisations due to SARI, by ethnicity, per 100,000



Source: ESR 2019 Influenza Surveillance intelligence dashboard.

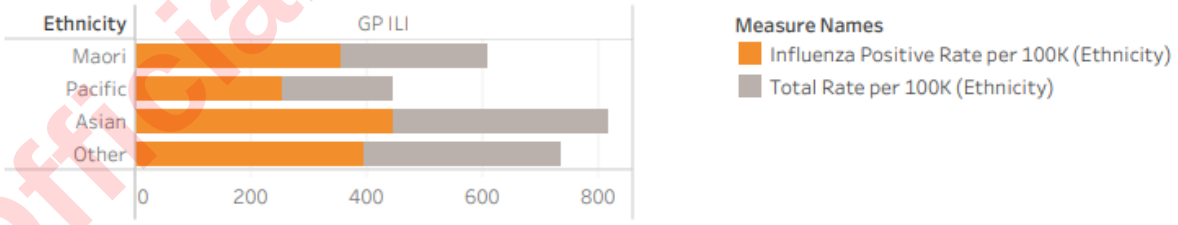
Figure 5: Cumulative rate of ICU admissions due to SARI, by ethnicity, per 100,000



Source: ESR 2019 Influenza Surveillance intelligence dashboard.

In addition, Māori and Pacific people are less likely to visit a GP than Asian, non-Māori and non-Pacific people with ILI symptoms (Figure 6) which may contribute to the increased severity of complications from influenza seen in the Māori and Pacific population.

Figure 6: Cumulative rate of GP visits for ILI, by ethnicity, per 100,000



Source: ESR 2019 Influenza Surveillance intelligence dashboard

Khieu et al (2015) estimated that influenza hospitalisation rates were 58.1 per 100,000 for the European population compared with 80.0 and 83.0 per 100,000 for Māori and Pacific people, respectively (Khieu et al. Vaccine 2015;33:4087-92). In 2017, the same authors reported that when standardising for age, the mortality rate attributable to influenza in the

Māori population was statistically significantly higher than Other/European populations with 21.1 per 100,000 compared with 4.5 per 100,000 for European/Other. The Pacific population also experienced a statistically significantly higher rate of influenza attributable mortality compared with European/Other with a rate of 6.8 per 100,000 (Khieu et al. 2017).

Currently Māori aged 65 years and over are less likely to receive their annual vaccination. Coverage measured through claims data submitted to the Ministry of Health suggests that only 50.0% of this group were able to access vaccination in 2021; uptake in this age group for the overall population was 63.8%. By contrast, Pacific people aged 65 years and over are more likely to receive their annual vaccination; claims data submitted to the Ministry of Health suggests that 62.4% of this group were vaccinated in 2021.

The impact on the health outcomes of population groups experiencing health disparities

Baker et al. conducted a national epidemiological study of hospital admissions for infectious and non-infectious diseases in New Zealand from 1989 to 2008 to investigate trends in incidence across various socioeconomic and ethnic landscapes. They found that those living in the most deprived areas (NZDep 9&10) have a higher rate of infectious disease related hospitalisations than the least deprived areas (NZDep 1&2) (Baker et al. Lancet. 2012;379(9821):1112-9)

Khieu et al. reported the influenza-attributable death rate per 100,000 was higher for more deprived areas (NZDep 9&10) compared with least deprived areas (RR 1.8, 95% CI 1.3-2.4) (Khieu et al. 2017).

The impact on Government health priorities

This funding application aligns with the following Government health priorities:

- Child wellbeing: To improve child wellbeing and support children to have a healthy start in life, noting the impact of influenza in children
- Prevention: To improve wellbeing by preventing health conditions, which includes immunisation against infectious diseases.
- Health equity: To better population outcomes, noting the disproportionate representation of influenza infection in Māori, Pacific peoples, and those living in high socioeconomic deprivation.

Infectious disease is also listed as a priority condition, which includes immunisation to prevent infectious diseases.

Health Benefit

The health benefits to the person, family, whānau and wider society

Evidence Summary

The Immunisation Advisory Centre (IMAC) has provided a brief review of the evidence to provide insight into potential further immunisation strategies that could be implemented to reduce the spread of influenza and reduce the impact of severe influenza in New Zealand. The full text version of the references in this section are available in Appendix 1, and the review (*Role of vaccination in influenza control strategies*, IMAC 2022) is provided in Appendix 2.

The IMAC 2022 review proposes a range of vaccination strategies that address the reduction community spread or the protection of high-risk individuals. The approaches are outlined in Table 6 below:

Table 6: IMAC 2022 proposed vaccination strategies

Protection of high-risk individuals (direct protection)	• Individual protection • Broadening eligible risk groups • Age groups for Māori and Pacific peoples • Consideration of additional groups funded in other jurisdictions • Ring-fencing high-risk groups to reinforce protection
Reduction of community spread (indirect protection)	• Full universal vaccination • Universal vaccination of school aged children • Direct and indirect protection within households

Direct protection

Vaccination of children

The Ministry of Health recommends vaccination of children from six months of age, but influenza vaccine is only funded from this age for people with underlying health conditions and children under five years of age who have been hospitalised for respiratory illness or have a history of significant respiratory illness. The full eligibility criteria are available on the Pharmac website.

Immunisation coverage

A study from the US (Bleser et al. PLoS ONE 2020;15(6): e0234466) examined data from the 2011 National Immunization Survey and reported that although children six months and older are recommended to receive annual influenza vaccination, uptake was substantially lower than other schedule vaccines. The study reported that about 71% of children aged 6-23 months were up to date on routinely recommended vaccines but only 33% had the

recommended influenza vaccine by their second birthday and 44% had hidden vulnerability to influenza.

Improving vaccine uptake through universal childhood vaccination

A study in Australia (De Oliveira Bernardo et al. Hum Vaccin Immunother. 2020;16(3):630-5) reported that overall influenza vaccination coverage in general practice for children aged under 5 years increased by more than five times from 2015 (3.9%) to 2018 (19.6%). Prior to universal funding, children under five years of age in the wealthiest areas were most likely to receive the influenza vaccine. After the vaccine was funded, all children in these wealthier areas (irrespective of their individual household socioeconomic levels) benefited more than those in less advantaged areas. This was because although the vaccine was accessible to all children (under five years), there was a greater increase in coverage from 2017-2018 in the wealthier areas than the disadvantaged areas.

Reduction in influenza in children following vaccination with IIV or LAIV

A 2018 systematic review reported that vaccination of healthy children with inactivated influenza vaccines (IIV) reduced influenza infection from 30% to 11% (risk ratio 0.36, 95% CI 0.25-0.48; n=1,628) and may reduce influenza-like illness (ILI) (from 28% to 20%; risk ratio 0.72, 0.65-0.79; n=19,044) in children aged between two and 16 years. Based on this, five children would need to be vaccinated with inactivated vaccine to prevent one case of confirmed influenza and 12 vaccinated to prevent one cases of ILI. The confidence of evidence for live attenuated influenza vaccine (LAIV) was less certain but demonstrated protection against influenza (from 18% to 4%; risk ratio 0.2, 0.11-0.41; n=7,718) and a reduction in ILI in children (from 17% to 12%; risk ratio 0.69; 0.6-0.8, n=124,606). Seven children would need to be vaccinated with LAIV to prevent one case of influenza and 20 children vaccinated to prevent one case of ILI in children. (Jefferson et al. Cochrane Database Syst Rev. 2018;(2):CD004879)

Vaccination in pregnancy to protect infants

A meta-analysis (Jarvis et al. Vaccine. 2020;38(7):1601-13) that pooled two randomised controlled trials reported that maternal influenza vaccination was associated with a 34% (95% CI 15% to 50%) overall reduction in laboratory confirmed influenza, but not ILI in infants up to six months of age. Two studies that were excluded from the meta-analysis for the outcome of laboratory confirmed influenza due to different controls, reported vaccine efficacy of over 70% against influenza in maternally vaccinated infants.

Vaccination of other high-risk groups: Māori and Pacific peoples

In 2013 the Ministry of Health reported that Māori people aged five to 34 years were almost twice as likely than non-Māori to be hospitalised for asthma than non-Māori people (risk ratio [RR] 1.96, 95% CI 1.87 to 2.07) and 25% more likely to be diagnosed with chronic respiratory disease at age 15-45 years (RR 1.27, 95% CI 1.06 to 1.52). Mortality rate due to COPD was almost three times that of non-Māori from the age of 35 years in 2010-12. In 2012-14, life expectancy from birth was around seven years lower for Māori than non-Māori (Ministry of Health; Health status indicators; updated 02 August 2018).

In 2010, more than half of the Māori population were aged under 25 years, and Māori had a higher prevalence of acute and chronic respiratory tract infections than non-Māori. The factors contributing to this increased risk appear to be environmental (overcrowding, poor housing, socioeconomic status, smoke exposure, nutrition), and reduced access to health

promotion programmes, such as immunisation programmes, and health care, rather than underlying genetic or medical disorders (Byrnes et al. J Paediatr Child Health. 2010;46(9):521-6).

A study investigating emergency department (ED) presentation of infants age <1 year for acute respiratory infection (ARI) at Kidz First Childrens' Hospital in South Auckland (as part of the SHIVERS project) reported that the influenza hospitalisations incidence ratio per 1,000 infants was 6.2 (95% CI 3.4 to 9.0) for Māori, 6.1 (95% CI 3.5 to 8.8) for Pacific, 0.5 (95% CI -0.01 to 1.0) for Asian, and 0.7 (95% CI 0.1 to 1.3) for European/Other (Prasad et al. Pediatr Infect Dis J. 2020;39:e176-85), in effect rates nine times higher in Māori and Pacific children compared with European/Other children.

Vaccination of other high-risk groups: Elderly

A review of literature concluded that, overall, standard influenza vaccination can attenuate the course of disease in those with breakthrough infection compared with those who are unvaccinated among community-dwelling adults ≥65 years with laboratory-confirmed influenza. A meta-analysis reported the odds of influenza-associated ICU admission was reduced by 26% (pooled odds ratio [OR] 0.74, 95% CI 0.58 to 0.93) by vaccination. The risk of death in adults hospitalised with influenza was reduced by 31% (OR 0.69, 95% CI 0.52 to0.82) compared with unvaccinated patients. Vaccination was not significantly associated with a reduction in pneumonia among adults hospitalised with influenza (OR 0.92, 95% CI 0.82 to 1.04) nor risk of hospitalisation with influenza illness seeking outpatient care (OR 0.60, 95% CI 0.28 to 1.28) (Ferdinands et al. Vaccine. 2021;39:3678-95).

Indirect protection - community (herd) immunity

Vaccination of children

A systematic review investigating vaccination of children aged six months to 17 years against influenza reported that indirect protection was conferred in some but not all settings. Across 20 out of 30 studies, the point-estimate indirect protection effectiveness (IPE) ranged from 4% to 66%. When looking at randomised controlled trials, an IPE of 60% (95% CI 41% to 72%) was shown against laboratory-confirmed influenza in members of closely connected communities when school-aged children were vaccinated, and IPE of 22% (95% CI 1% to 38%) against acute respiratory tract infection/ILI in household members of vaccinated preschool-aged children. Indirect protection against influenza mortality of the elderly was also seen by vaccinating school children who play a key role in transmission. Despite this, the review concluded that most effective way to prevent influenza at an individual level was through annual vaccination (Yin et al. Clin Infect Dis. 2017;65:719-28).

A study based in Japan observed the role of mass vaccination in schoolchildren in providing protection to the elderly and young children. During a mass vaccination campaign of school children (aged 6-15 years) from the mid-1970s to late 1980s, adjusted mortality reduced by 36% (17-51%) in Japanese seniors, which corresponded to 1,000 (400-1,800) deaths averted by annual vaccination of children. This was compared with the US, in which influenza-related mortality remained unchanged despite vaccination of the elderly population. Younger children were also reported to be indirectly protected against influenza complications during the period of mass schoolchild vaccination (Sugaya. Expert Rev Vaccines. 2014;13:1536-70).

A Dutch epidemiologic study modelled infections and argued that vaccinating young children would likely lead to an age shift in infection dynamics, which would result in limited indirect impact on the elderly from vaccinating children (Backer et al. Epidemics. 2019;26:95-103). Using a dynamic transmission model, it predicted a smaller impact and more variability in the infection attack rate. Reasons were firstly that while modelled influenza infections in young children were reduced, after years of vaccination they increased in young adults with limited natural immunity, which could drive an epidemic. Secondly, after a mild influenza season, the modelled proportion of susceptible individuals increased to result in a peak of cases the following year. The authors observed that targeting the group that plays the largest role in transmission potential requires a secure vaccine supply.

A school-based influenza vaccination programme in Autumn 2005 using LAIV were associated with directly reduced school absenteeism in elementary schools (children aged 5 to 11 years) during an influenza outbreak in Carroll County, Maryland US. With a 44% vaccination coverage, school absenteeism was observed to decline from 1.8% in the 2001-05 seasons to 0.6% in the 2005/6 season. An indirect effect was also seen in high schools (children aged 14 to 18 years) (0.3% from 1.8%); a similar trend was seen in middle schools (children aged 10 to 14 years) (Davis et al. Paediatrics. 2008;122(1):e260-e65).

A study in Israel reported that when influenza vaccine was administered in a school setting, a reduction in ILI was observed among the those vaccinated (by 60.5%) and their household members (by 27.5%). (Roseman et al. Isr J Health Policy Res. 2021;10:38). The retrospective cohort study across nine schools in Tel Aviv compared self-reported ILI within children and their households for those who were vaccinated at school in the second grade (age ~8 years) with those in the third grade (~age 9 years) who were not vaccinated a part of the school-based vaccination. In the second-grade cohort, 133/168 (79.2%) had been vaccinated. In this cohort, unvaccinated children had a higher rate of reported ILI than those who had been vaccinated (19.5% vs 7.7%, rate reduction of 60.5%, *P*<0.001); the unvaccinated children had a greater number of doctors' visits and missed school days (35.7% vs 14.9% and 42.9% vs 25.6%, respectively); and the rate of ILI among household members was also higher for unvaccinated children (35.4% vs 25.0%; rate reduction 27.3%; p = 0.03). When the second-grade cohort (52.8% vaccinated) were compared with the third-grade cohort not vaccinated as part of the programme (12.7% vaccinated), those who had been vaccinated had a 44.6% rate reduction of ILI and their household had a 22.9% rate reduction in ILI.

Ring protection

Close contacts of high-risk individuals (family members or carers)

A study in the UK reported that higher rates of vaccination rates within NHS trusts were associated with reduced sickness absence, reporting that a 10% increase in influenza vaccination rate would be associated with a 10% fall in sickness absence. (Pereira et al. Clin Med (Lond). 2017;17:484-9).

An Italian study reported that around 20% of healthcare workers were infected with influenza each year, resulting in nosocomial outbreaks and staff shortages, and that influenza vaccine coverage remained low. Over the study period, influenza vaccine coverage decreased significantly from 13.2% to 3.1% (*P*<0.001), and an associated increase in frequency of nosocomial ILI in hospitalised patients from 0.11% to 0.57% (*P*<0.001) was observed (adjusted OR of 0.97; 95% CI 0.94 to 0.99) (Amodio et al. J Hosp Infect. 2014;86:182-7).

International recommendations

International Recommendations

Table 7: International recommendations regarding the funding of influenza vaccine in different populations

Country	QIV Age group	Comments	LAIV Age group	Adjuvanted or high dose Age group	Comments
Australia 2022 season	All aged 6 months to 5 years	Funded	Not available		
	All ATSI people aged from 6 months	Funded		≥60 years	HD QIV
				≥65 years	aQIV
	All aged ≥65 years	Funded		≥65 years	aQIV
	Ages 5 to <65 years	Funded for: • Certain medical conditions • In pregnancy			
Canada	All aged 6 months to 23 months				
	Children ages 2 to 17 years with immunocompromise or severe asthma	Unless LAIV is not contraindicated	Children aged 2 to 17 years		
	18 to 64 years		18 to 59 years	≥65 years	HD QIV, aQIV, or QIVc
	Pregnant				
	HCW	QIV not LAIV			
Ireland	From 6 months		24 months to <18 years	≥65 years	aQIV
UK	All infants aged 6 months to <2 years	QIVe funded	All children aged ≥2 years	All adults aged ≥65 years	aQIV
	All aged ≥2 years	QIVc, if LAIV contraindicated			QIVr or QIVc
	At risk adults 18 to 64 years	QIVc or QIVr (or QIVe, if other options unavailable)			
	All adults aged 50 to 64 years				

Abbreviations: ATSI, Aboriginal Torres Strait Islander peoples; LAIV, live attenuated influenza vaccine; QIV, Quadrivalent inactivated influenza vaccine; QIVc, cell-based; QIVe, egg-based; QIVr, recombinant.

Consequences for the health system

If the funding criteria for the influenza vaccine were to be widened, this would be expected to reduce the number of and complications of influenza infection, thereby reducing the pressure on and costs to the healthcare system.

Suitability

The features of the medicine or medical device that impact on use

Standard dose inactivated influenza vaccines are an injectable presentation. These are suitable to be given to most individuals, including young children, the elderly, pregnant women, and immunocompromised people.

Adjuvanted and high dose inactivated influenza vaccines are injectable presentations. Both are indicated for people 65 years of age or older. Adjuvanted vaccine is associated with injection site reactions. An adjuvanted influenza vaccine funding application is to be reviewed as a separate agenda item at this meeting. It is anticipated that a funding application for high dose inactivated influenza vaccine will be reviewed the upcoming September 2022 Committee meeting.

Live attenuated influenza vaccines (LAIV) are nasal spray presentations. They are indicated for children and adolescents from two years of age and adults up to 49 years of age. There is insufficient data around the use of LAIV in adults aged 50-64 years of age.

The intranasal presentation is more acceptable to parents / caregivers, possibly leading to increased uptake of vaccination in children compared to injectable vaccines. However, the introduction of a school or pre-school-based programme would have significant resource implications for DHBs to implement each year, and significant financial implications for the Ministry of Health funding vaccination claims.

Since live virus is administered intranasally, there is the possibility of spreading virus through viral shedding. Shedding is inversely correlated with age, with the youngest children most likely to shed virus over the longest time.

LAIV are contraindicated for immunosuppressed individuals.

LAIV are not Medsafe approved for use in New Zealand and Pharmac has not received any funding applications to date.

Costs and Savings

Costs and savings to pharmaceutical expenditure

No cost analysis has been undertaken at this time, as this paper discusses possible strategic options for widening access to influenza vaccine in New Zealand, rather than listing any

particular vaccine. Once clinical advice is obtained on the most appropriate options for widening access, cost analysis can be undertaken on those options.

The annual gross subsidy on influenza vaccine is approximately $8.0 million for 730,000 doses.

APPENDICES

Appendix 1: Key evidence

- Amodio et al. 2014
- Backer et al. 2019
- Bleser et al. 2020
- Byrnes et al. 2010
- Davis et al. 2008
- De Oliveira Bernado et al. 2020
- Ferdinands et al. 2021
- Jarvis et al. 2020
- Jefferson et al. 2018
- Khieu et al. 2015
- Khieu et al. 2017
- Pereira et al. 2017
- Prasad et al. 2020
- Roseman et al. 2021
- Sugaya. 2014
- Yin et al. 2017

Appendix 2: Role of vaccination in influenza control strategies, IMAC 2022

THE FACTORS FOR CONSIDERATION

Factors are presented here in the order they appear in the paper, without implying any ranking or relative importance.

NEED

- The health need of the person
- The availability and suitability of existing medicines, medical devices and treatments
- The health need of family, whānau, and wider society
- The impact on the Māori health areas of focus and Māori health outcomes
- The impact on the health outcomes of population groups experiencing health disparities
- The impact on Government health priorities

HEALTH BENEFITS

- The health benefit to the person
- The health benefit to family, whānau and wider society
- Consequences for the health system

SUITABILITY

- The features of the medicine or medical device that impact on use by the person
- The features of the medicine or medical device that impact on use by family, whānau and wider society
- The features of the medicine or medical device that impact on use by the health workforce

COSTS AND SAVINGS

- Health-related costs and savings to the person
- Health-related costs and savings to the family, whānau and wider society
- Costs and savings to pharmaceutical expenditure
- Costs and savings to the rest of the health system

Hot Topic: Influenza vaccination widening access

Imms SAC	CUA	Need	Maori	5Yr NPV
High	tbd	<1	Increased hospitalisation (1.28 RR ageST) Increased mortality (2.7 RR ageST)	tbd

- **Open listing**

PICO

Population	Open listing all new Zealanders	People aged 0 to 18 years of age	People aged 50 to 64 years of age	Māori and Pacific people aged 50 to 64 years of age
Intervention	Annual, single dose of Influenza Vaccine			
Comparator(s) (NZ context)	No vaccination			
Outcome(s)	Reduced inpatient events Reduced outpatient events Reduced mortality			

Outpatient events

Rates per 100,000 people for influenza positive ILI among sentinel practices
ESR surveillance reports 2016 to 2019
2021 – 0% of ILI cases positive
2022 – not reported

Age band	Influenza incidence -2019	Influenza incidence -2018	Influenza incidence -2017	Influenza incidence -2016	Average
<1	163.6	34	55.7	38.9	73
1-4	504.6	249.6	178.5	45.6	245
5-19	728.6	174.3	421	106.1	358
20-34	378.2	126.5	180	118.7	201
35-49	268.5	155.8	316	85	206
50-64	216.8	98	229	59.3	151

Estimating the contribution of influenza to hospitalisations in New Zealand from 1994 to 2008

Trang Q.T. Khieu[a,b,*], Nevil Pierse[a], Lucy Frances Telfar-Barnard[a], Q. Sue Huang[c], Michael G. Baker[a]

Background: Influenza has a substantially but poorly measured impact on population health. Estimating its true contribution to hospitalisations remains a challenge.
Methods: We used simple and comprehensive negative binomial regression models with weekly counts of hospitalisations and isolates of influenza A, B and respiratory syncytial virus for the period 1994– 2008.
Results: The estimated annual national average number of hospitalisations attributable to influenza was 822.1(95% CI: 815.3, 828.9) for pneumonia and influenza, 1861.3 (95% CI: 1842.9, 1879.7) for respiratory illness, 12.1 (95% CI: 2.6, 21.6) for circulatory illness, 2260.0 (95% CI: 2212.2, 2307.8) for all medical illness and 2419.9 (95% CI: 2356.4, 2483.4) for all causes. The contribution of influenza to total hospitalisations was about nine times larger than indicated by routine discharge data. New Zealanders 80 years of age and older had the highest annual excess rates of influenza-related hospitalisations (327.8 per 100,000); followed by infants under 1 year (244.5 per 100,000). Estimated influenza hospitalisation rates were also markedly higher in Pacific (83.3 per 100,000) and Māori (80.0 per 100,000) compared with European/Others (58.1 per 100,000).

Respiratory illness was the major contributor to all cause hospitalisations attributed to influenza accounting for 77%. Influenza hospitalisations included only a negligible contribution from circulatory illness.
Conclusion: These findings support efforts to reduce the impact of influenza, particularly for the most vulnerable population groups highlighted here. Analysis of the cost-effectiveness of such interventions needs to consider these higher modelled estimates of disease impact.

Inpatient events by age – Khieu et al 2015

Table 3
Negative binomial regression model (comprehensive) estimates for average annual number and rate (per 100,000 people) of hospitalisations attributable to influenza by age group and disease categories, New Zealand 1994–2008.

Categories	Age group								
	<1	1–4	5–19	20–34	35–49	50– 64	65–79	≥80	All ages
P&I									
Number	67.0	147.8	88.7	71.0	63.1	92.6	147.1	144.8	**822.1**
Rate	122.7	69.5	10.3	9.0	7.4	15.1	40.6	121.8	21.2
Respiratory illness									
Number	90.9	169.7	126.0	173.4	153.8	289.4	532.6	325.4	**1861.3**
Rate	166.4	79.8	14.7	21.8	18.0	47.1	147.2	273.7	48.0
Circulatory illness									
Number	1.0	−1.0	−3.4	−7.7	7.5	−1.7	−3.5	20.9	**12.1**
Rate	1.9	−0.5	−0.4	−1.0	0.9	−0.3	−1.0	17.6	0.3
All medical illness									
Number	116.4	355.6	211.7	194.7	139.0	318.9	542.0	381.8	**2260.0**
Rate	213.1	167.3	24.7	24.5	16.3	51.9	149.8	321.2	58.3
All causes									
Number	133.6	342.6	135.3	415.4	134.0	326.9	542.5	389.7	**2419.9**
Rate	244.5	161.1	15.8	52.3	15.7	53.2	149.9	327.8	62.4

P&I: Pneumonia and influenza.

Inpatient events by age – Khieu et al 2015 and ESR

Rates per 100,000 people for influenza positive SARI hospitalisations
ESR surveillance reports 2016 to 2019
2021 – 0% of SARI cases positive
2022 – not reported

Age band	Influenza incidence - 2019	Influenza incidence - 2018	Influenza incidence - 2017	Influenza incidence - 2016	Average 2016 - 2019	Kheiu et al 2015
<1	300.4	196	144.8	51.8	173.25	244.5
1-4	83	85.4	61.8	32.1	65.575	161.1
5-19	17.2	8	7.3	1.6	8.525	15.8
20-34	16.4	10.4	13.6	4.8	11.3	52.3
35-49	19.9	13.9	16.8	5.8	14.1	15.7
50-64	30.3	31.7	51.7	11.3	31.25	53.2

Khieu et al 2015 – hospitalisations by ethnicity

Reasonable to apply the relative rate ratio for Māori and pacific vs general population to inform hospitalisation rates by age group?

Item	Rate per 100,000	Rate ratio
Maori	80	1.28
Pacific	83.3	1.33
European/others	58.1	0.93
General pop	62.4	1

Table 4
Negative binomial regression model estimates for average annual number and rate (per 100,000 people) of hospitalisations attributable to influenza by ethnic group and disease category, New Zealand 1994–2008.

Disease category	Ethnic group		
	Māori	Pacific	European/Others
All causes			
Number	423.7	174.8	1821.4
Rate	80.0	83.3	58.1

Not reported as age standardised

Age band	Index	General pop hosp	Hosp - Māori	Hosp - Pacific
<1	0	244.5	313.5	326.4
1-4	1	161.1	206.5	215.1
5-19	5	15.8	20.3	21.1
20-34	20	52.3	67.1	69.8
35-49	35	15.7	20.1	21.0
50-64	50	53.2	68.2	71.0

Excess respiratory mortality and hospitalizations associated with influenza in Australia, 2007–2015

Vivian KY Leung [1,†] Jessica Y Wong,[2,†] Roseanne Barnes,[3] Joel Kelso,[4] George J Milne,[4] Christopher C Blyth,[3,5,6,7] Benjamin J Cowling,[2] Hannah C Moore[3,‡] and Sheena G Sullivan [1,8,9,*,‡]

Abstract

Background: Influenza is the most common vaccine-preventable disease in Australia, causing significant morbidity and mortality. We assessed the burden of influenza across all ages in terms of influenza-associated mortality and hospitalizations using national mortality, hospital-discharge and influenza surveillance data.

Methods: Influenza-associated excess respiratory mortality and hospitalization rates from 2007 to 2015 were estimated using generalized additive models with a proxy of influenza activity based on syndromic and laboratory surveillance data. Estimates were made for each age group and year.

Results: The estimated mean annual influenza-associated excess respiratory mortality was 2.6 per 100 000 population [95% confidence interval (CI): 1.8, 3.4 per 100 000 population]. The excess annual respiratory hospitalization rate was 57.4 per 100 000 population (95% CI: 32.5, 82.2 per 100 000 population). The highest mortality rates were observed among those aged ≥75 years (35.11 per 100 000 population; 95% CI: 19.93, 50.29 per 100 000 population) and hospitalization rates were also highest among older adults aged ≥75 years (302.95 per 100 000 population; 95% CI: 144.71, 461.19 per 100 000 population), as well as children aged <6 months (164.02 per 100 000 population; 95% CI: –34.84, 362.88 per 100 000 population). Annual variation was apparent, ranging from 1.0 to 3.9 per 100 000 population for mortality and 24.2 to 94.28 per 100 000 population for hospitalizations. Influenza A contributed to almost 80% of the average excess respiratory hospitalizations and 60% of the average excess respiratory deaths.

Conclusions: Influenza causes considerable burden to all Australians. Expected variation was observed among age groups, years and influenza type, with the greatest burden falling to older adults and young children. Understanding the current burden is useful for understanding the potential impact of mitigation strategies, such as vaccination.

De-identified line-listed mortality and hospitalization data were provided for selected ICD-10-AM codes, including pneumonia and influenza (J09–J18), respiratory diseases (J00–J99) and cardiovascular diseases (I00–I99) (Supplementary Table S3, available as Supplementary data at *IJE* online). Data were aggregated by ISO week and the analyses restricted to records in which these ICD codes appeared as the underlying cause of death or the principal cause of hospitalization. We estimated influenza-associated respiratory mortality and hospitalization in our main analysis, and

Hospitalizations	Rate per 100 000 (95% CI)
0–5 months	164.02 (–34.84, 362.88)
6 months–4 years	48.88 (13.24, 84.52)
5–14 years	24.58 (7.83, 41.33)
15–49 years	38.08 (14.37, 61.78)
50–64 years	59.06 (30.78, 87.34)
65–74 years	134.81 (40.83, 228.78)
75 years and above	302.95 (144.71, 461.19)
Under 65 years	38.83 (16.46, 61.2)
65 years and above	212.73 (92.45, 333.01)
All ages	57.37 (32.52, 82.22)

Age band	Average	Kheiu et al 2015	Leung 2022
<1	173.25	244.5	164.02
1-4	65.575	161.1	48.88
5-19	8.525	15.8	24.58
20-34	11.3	52.3	38.08
35-49	14.1	15.7	38.08
50-64	31.25	53.2	59.06

Modelled seasonal influenza mortality shows marked differences in risk by age, sex, ethnicity and socioeconomic position in New Zealand

Trang Q.T. Khieu [a,b,*], Nevil Pierse [a], Lucy Frances Telfar-Barnard [a], Jane Zhang [a], Q. Sue Huang [c], Michael G. Baker [a]

Summary *Objectives:* Influenza is responsible for a large number of deaths which can only be estimated using modelling methods. Such methods have rarely been applied to describe the major socio-demographic characteristics of this disease burden.

Methods: We used quasi Poisson regression models with weekly counts of deaths and isolates of influenza A, B and respiratory syncytial virus for the period 1994 to 2008.

Results: The estimated average mortality rate was 13.5 per 100,000 people which was 1.8% of all deaths in New Zealand. Influenza mortality differed markedly by age, sex, ethnicity and socioeconomic position. Relatively vulnerable groups were males aged 65–79 years (Rate ratio (RR) = 1.9, 95% CI: 1.9, 1.9 compared with females), Māori (RR = 3.6, 95% CI: 3.6, 3.7 compared with European/Others aged 65–79 years), Pacific (RR = 2.4, 95% CI: 2.4, 2.4 compared with European/Others aged 65–79 years) and those living in the most deprived areas (RR = 1.8, 95% CI: 1.3, 2.4) for New Zealand Deprivation (NZDep) 9&10 (the most deprived) compared with NZDep 1&2 (the least deprived).

Conclusions: These results support targeting influenza vaccination and other interventions to the most vulnerable groups, in particular Māori and Pacific people and men aged 65–79 years and those living in the most deprived areas.

Supplementary table 3. Poisson regression model estimates for average annual number and rate (per 100,000 people) of influenza-attributable deaths by age group and disease categories, New Zealand 1994-2008

Categories	Age group (95%CI)									
	<20		20- 64		65-79		≥80		All ages		Age standardised	
P&I												
Number	0.0	(-0.1, 0.1)	0.1	(0, 0.2)	9.0	(8.7, 9.3)	51.0	(50.0, 52.0)	63.6	(61.8, 65.4)		
Rate	0.0	(0.0,0.0)	0.0	(0.0,0.0)	2.5	(2.4, 2.6)	42.9	(42.1, 43.7)	1.7	(1.6, 1.8)	1.8	(1.7, 1.9)
Respiratory illness												
Number	-0.3	(-0.4, -0.2)	16.1	(13.1,19.1)	58.9	(57.8, 60.0)	98.6	(97.3, 99.9)	173.6	(171.7, 175.5)		
Rate	0.0	(0.0,0.0)	0.7	(0.6, 0.8)	16.3	(16.0, 16.6)	82.9	(81.8, 84.0)	4.7	(4.6, 4.8)	5.2	(5.0, 5.4)
Circulatory illness												
Number	0.5	(0.5, 0.5)	15.6	(14.6, 16.6)	72.1	(70.4, 73.8)	96.8	(94.4, 99.2)	186.2	(184.7, 187.7)		
Rate	0.0	(0.0,0.0)	0.7	(0.6, 0.7)	19.9	(19.5, 20.4)	81.5	(79.4, 84.4)	5.0	(5.0, 5.1)	5.5	(5.3, 5.7)
All medical illness												
Number	5.6	(5.2, 6.0)	55.3	(53.4, 57.2)	179.7	(176.8, 182.6)	247.5	(243.8, 251.2)	491.0	(488.9, 493.1)		
Rate	0.5	(0.5, 0.5)	2.4	(2.3, 2.5)	49.7	(48.8, 50.5)	208.2	(205.1, 211.3)	13.3	(13.2, 13.4)	14.4	(14.1, 14.7)
All causes												
Number	6.0	(5.3, 6.7)	55.8	(53.7, 57.9)	182.0	(179.0, 185.0)	254.4	(250.7, 258.1)	498.8	(496.6, 501.0)		
Rate	0.5	(0.5, 0.6)	2.5	(2.4, 2.6)	49.7	(49.4, 51.1)	214.0	(211.0, 217)	13.5	(13.4, 13.6)	14.7	(14.4, 15.0)

Supplementary table 5. Poisson regression model estimates for average annual number and rate (per 100,000 people) of influenza-attributable deaths by ethnic group, age group and disease category, New Zealand 1994-2008

	Categories	Rate per 100,000 (95% CI)										Age standardised rate	
		<20		20- 64		65-79		≥80		All ages (crude)			
Māori (M)	P&I	-0.3	(-0.3, -0.3)	0.2	(0.2, 0.2)	0.0	(-0.4, 0.4)	37.8	(34.1, 41.5)	0.2	(0.2, 0.2)	0.3	(0.3, 0.3)
	Respiratory illness	-0.3	(-0.3, -0.3)	2.1	(2.0, 2.2)	11.3	(9.7, 12.9)	138.6	(131.2, 146.0)	1.8	(1.7, 1.9)	2.6	(2.4, 2.8)
	Circulatory illness	0.0	(0.0, 0.0)	1.2	(1.0, 1.4)	69.2	(66.2, 72.2)	24.7	(11.5, 37.9)	3.0	(2.9, 3.1)	4.2	(3.9, 4.5)
	All medical illness	1.0	(0.9, 1.1)	4.9	(4.6, 5.2)	139.0	(134.2, 143.8)	210.2	(190.1, 230.2)	7.6	(7.4, 7.8)	11.4	(10.8, 12.0)
	All causes	1.6	(1.4, 1.8)	5.4	(5.1, 5.7)	141.8	(137.0, 146.6)	214.9	(194.8,235.0)	8.3	(8.0, 8.6)	12.1	(11.5, 12.7)
Pacific (P)	P&I	0.0	(0.0, 0.0)	0.3	(0.3, 0.3)	5.2	(4.5, 5.9)	105.5	(99.6, 111.4)	0.9	(0.9, 0.9)	1.3	(1.2, 1.4)
	Respiratory illness	0.1	(0.0, 0.2)	0.3	(0.2, 0.4)	45.4	(43.3, 47.5)	223.2	(210.9, 235.5)	2.5	(2.4, 2.6)	4.2	(3.9, 4.5)
	Circulatory illness	0.6	(0.6, 0.6)	2.0	(1.7, 2.3)	15.1	(10.5, 19.7)	-257.9	(-279.1, -236.7)	0.8	(0.6, 1.0)	-0.1	(-0.6, 0.4)
	All medical illness	-0.1	(-0.2, 0.0)	4.3	(3.8, 4.8)	89.5	(82.0, 97.0)	44.1	(12.5, 75.7)	4.8	(4.5, 5.1)	6.8	(5.8, 7.8)
	All causes	0.0	(-0.2, 0.2)	3.7	(3.2, 4.2)	92.4	(84.8, 100.0)	68.8	(36.9, 100.7)	4.7	(4.3, 5.1)	6.9	(5.9, 7.9)
European and Others (E)	P&I	0.0	(0.0, 0.0)	0.1	(0.1, 0.1)	2.2	(2.1, 2.3)	39.5	(38.9, 40.1)	1.9	(1.9, 1.9)	0.5	(0.5, 0.5)
	Respiratory illness	0.0	(0.0, 0.0)	0.6	(0.6, 0.6)	13.9	(13.7, 14.1)	75.2	(74.2, 76.2)	5.1	(5.0, 5.2)	1.6	(1.6, 1.6)
	Circulatory illness	0.0	(0.0, 0.0)	0.5	(0.5, 0.5)	15.2	(14.8, 15.6)	78.7	(76.8, 80.6)	5.4	(5.3, 5.5)	1.6	(1.5, 1.7)
	All medical illness	0.1	(0.1, 0.1)	2.1	(2.0, 2.2)	39.1	(38.4, 39.8)	194.7	(191.8, 197.7)	14.1	(13.9, 14.3)	4.5	(4.4, 4.6)
	All causes	-0.2	(-0.3, -0.1)	2.0	(1.9, 2.1)	38.9	(38.2, 39.6)	199.9	(196.9, 202.9)	14.2	(14.0, 14.4)	4.6	(4.5, 4.7)

Excess respiratory mortality and hospitalizations associated with influenza in Australia, 2007–2015

Vivian KY Leung [1,†] Jessica Y Wong,[2,†] Roseanne Barnes,[3] Joel Kelso,[4] George J Milne,[4] Christopher C Blyth,[3,5,6,7] Benjamin J Cowling,[2] Hannah C Moore[3,‡] and Sheena G Sullivan [1,8,9,*,‡]

Abstract

Background: Influenza is the most common vaccine-preventable disease in Australia, causing significant morbidity and mortality. We assessed the burden of influenza across all ages in terms of influenza-associated mortality and hospitalizations using national mortality, hospital-discharge and influenza surveillance data.

Methods: Influenza-associated excess respiratory mortality and hospitalization rates from 2007 to 2015 were estimated using generalized additive models with a proxy of influenza activity based on syndromic and laboratory surveillance data. Estimates were made for each age group and year.

Results: The estimated mean annual influenza-associated excess respiratory mortality was 2.6 per 100 000 population [95% confidence interval (CI): 1.8, 3.4 per 100 000 population]. The excess annual respiratory hospitalization rate was 57.4 per 100 000 population (95% CI: 32.5, 82.2 per 100 000 population). The highest mortality rates were observed among those aged ≥75 years (35.11 per 100 000 population; 95% CI: 19.93, 50.29 per 100 000 population) and hospitalization rates were also highest among older adults aged ≥75 years (302.95 per 100 000 population; 95% CI: 144.71, 461.19 per 100 000 population), as well as children aged <6 months (164.02 per 100 000 population; 95% CI: −34.84, 362.88 per 100 000 population). Annual variation was apparent, ranging from 1.0 to 3.9 per 100 000 population for mortality and 24.2 to 94.28 per 100 000 population for hospitalizations. Influenza A contributed to almost 80% of the average excess respiratory hospitalizations and 60% of the average excess respiratory deaths.

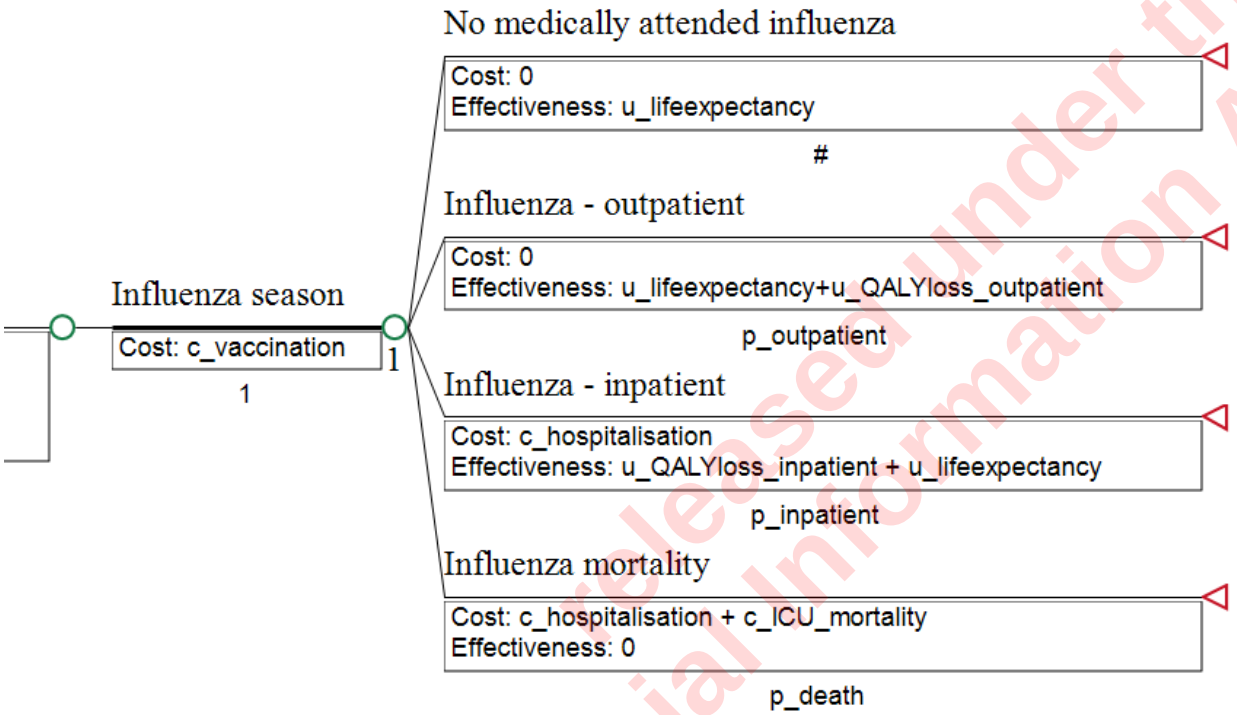
Conclusions: Influenza causes considerable burden to all Australians. Expected variation was observed among age groups, years and influenza type, with the greatest burden falling to older adults and young children. Understanding the current burden is useful for understanding the potential impact of mitigation strategies, such as vaccination.

De-identified line-listed mortality and hospitalization data were provided for selected ICD-10-AM codes, including pneumonia and influenza (J09–J18), respiratory diseases (J00–J99) and cardiovascular diseases (I00–I99) (Supplementary Table S3, available as Supplementary data at *IJE* online). Data were aggregated by ISO week and the analyses restricted to records in which these ICD codes appeared as the underlying cause of death or the principal cause of hospitalization. We estimated influenza-associated respiratory mortality [illegible] main analysis, and

	Rate per 100 000 (95% CI)
Deaths	
0–5 months	2.31 (–2.8, 7.43)
6 months–4 years	0.3 (–1.42, 2.02)
5–14 years	0.11 (–1.07, 1.29)
15–49 years	0.23 (–0.36, 0.83)
50–64 years	1.27 (0.29, 2.26)
65–74 years	5.31 (3.8, 6.82)
75 years and abo	35.11 (19.93, 50.29)
Under 65 years	0.41 (–0.04, 0.86)
65 years and abo	16.43 (10.98, 21.89)
All ages	2.61 (1.78, 3.44)

New Zealand estimates from Khieu et al 2017		
Influenza mortality per 100,000 persons (General population)		
5 to 19		0.50
20 to 64 years of age		2.50
Influenza mortality per 100,000 persons (Māori)		
20 to 64 years of age		5.40
Influenza mortality per 100,000 persons (Pacific)		
20 to 64 years of age		3.70

Decision tree



Captures key influenza outcomes over 1 year

Discounted QALY loss from Premature mortality from influenza

Vaccine efficacy – Turner et al, 2014

TABLE 1

Characteristics of study participants with influenza-like illness and severe acute respiratory infection, New Zealand, 2013 influenza season*

Characteristic	Hospitalised with severe acute respiratory infection		General practice visit for influenza-like illness	
	Cases n (%)[a]	Controls n (%)[a]	Cases n (%)[a]	Controls n (%)[a]
Vaccinated	82 (36.6)	372 (45.4)	44 (9.1)	177 (17.4)
Median age in years	49 (21.9)	41 (5.0)	25 (5.2)	21 (2.1)
Male	105 (46.9)	410 (50.1)	224 (46.5)	415 (41.0)
Age group				
6 months–5 years	40 (17.9)	271 (33.1)	74 (15.4)	255 (25.2)
6–17 years	11 (4.9)	35 (4.3)	141 (29.3)	221 (21.8)
18–45 years	51 (22.8)	129 (15.8)	173 (35.9)	330 (32.6)
46–64 years	51 (22.8)	156 (19.1)	75 (15.6)	159 (15.7)
65–79 years	47 (21.0)	134 (16.4)	16 (3.3)	41 (4.0)
≥80 years	24 (10.7)	93 (11.4)	3 (0.6)	7 (0.7)
Ethnicity				
Māori	29 (12.9)	169 (20.7)	18 (3.7)	57 (5.6)
Pacific	77 (34.4)	238 (29.1)	97 (20.1)	203 (20.0)
Other characteristics				
Mean New Zealand deprivation score [b]	5.3	5.9	4.95	4.9
Pregnant	5 (2.2)	5 (0.6)	Not collected	Not collected
Current smoker	24 (10.7)	86 (10.5)	30 (6.2)	56 (5.5)
Chronic disease	138 (61.6)	528 (64.5)	Not collected	Not collected
Obese[c]	44 (19.6)	134 (16.4)	17 (3.5)	42 (4.2)
Self-defined well-being health status of poor or fair[d]	28 (12.5)	120 (14.7)	Not collected	Not collected
Frailty[e]	5 (2.2)	24 (2.9)	Not collected	Not collected
Dependence[f]	10 (4.5)	50 (6.1)	Not collected	Not collected
Total	**224 (100)**	**818 (100)**	**482 (100)**	**1,013 (100)**

Vaccine efficacy vs inpatient and outpatient – Turner et al 2014

TABLE 4

Estimated influenza vaccine effectiveness, by participant age group and by influenza virus type and subtype: crude and propensity adjusted models, New Zealand, 2013 influenza season

Influenza virus and age group	Hospitalised with severe acute respiratory infection		General practice visit for influenza-like illness	
	Crude model[a]	Propensity adjusted model[a]	Crude model[a]	Propensity adjusted model[a]
	VE (95% CI)	VE (95% CI)	VE (95% CI)	VE (95% CI)
Age group				
6 months–17 years	72 (–22 to 93)	78 (2 to 95)	56 (6 to 79)	56 (6 to 79)
18–64 years	66 (43 to –79)	61 (34 to 77)	59 (32 to 75)	55 (24 to 73)
≥65 years	35 (–25 to 66)	34 (–28 to 66)	74 (12 to 92)	76 (15 to 93)

VE: vaccine effectiveness, as a percentage.

Influenza Vaccine Effectiveness Against Influenza–Related Mortality in Australian Hospitalized Patients: A Propensity Score Analysis FREE

Monica L Nation, Robert Moss, Matthew J Spittal, Tom Kotsimbos, Paul M Kelly, Allen C Cheng ✉ for the Influenza Complications Alert Network (FluCAN) Investigators

Clinical Infectious Diseases, Volume 72, Issue 1, 1 January 2021, Pages 99–107,

	Survivors (n = 9104)	Deaths (n = 194)	Survivors (n = 6315)	Deaths (n = 136)	
Age group, y					< .001
0.5–15 y	1745 (19.2)	1 (0.5)	740 (11.7)	0 (0)	
16–49 y	1964 (21.6)	19 (9.8)	1506 (23.8)	5 (3.7)	
50–64 y	1479 (16.2)	25 (12.9)	1236 (19.6)	21 (15.4)	
65–79 y	2086 (22.9)	61 (31.4)	1602 (25.4)	43 (31.6)	
≥ 80 y	1830 (20.1)	88 (45.4)	1231 (19.5)	67 (49.3)	

Analysis and Outcome	No.	Adjusted Odds Ratio (95% CI)	Estimated IVE (95% CI)	*P* Value
Primary analysis model				
Influenza-related mortality[a]	6495	0.69 (.49–.97)	31% (3%–51%)	.033

No. of comorbidities					< .001
0	2487 (27.3)	5 (2.6)	1240 (19.6)	4 (2.9)	
1	2720 (29.9)	59 (30.4)	1878 (29.7)	23 (16.9)	
≥ 2	3897 (42.8)	130 (67.0)	3197 (50.6)	109 (80.1)	
Diabetes	1961 (21.5)	55 (28.4)	1392 (22.0)	43 (31.6)	.005
Chronic cardiac disease	2828 (31.1)	103 (53.1)	2114 (33.5)	82 (60.3)	< .001
Chronic respiratory disease	3216 (35.3)	90 (46.4)	2978 (47.2)	83 (61.0)	< .001
Chronic neurological disease	1517 (16.7)	53 (27.3)	1045 (16.5)	38 (27.9)	< .001
Chronic renal disease	316 (3.5)	7 (3.6)	364 (5.8)	8 (5.9)	< .001
Liver disease	391 (4.3)	13 (6.7)	326 (5.2)	11 (8.1)	.009
Malignancy	743 (8.2)	30 (15.5)	495 (7.8)	25 (18.4)	< .001
Immunosuppression	1640 (18.0)	54 (27.8)	1436 (22.7)	47 (34.6)	< .001

Costs

Item	Value	
GP visit	$80	Cost spreadsheet
Vaccine admin	$27.84	MOH capitation
Influenza vaccine	s 9(2)(b)(ii), s 9(2)	Current price s 9(2)(j)
Hospitalisation cost	• $2,403 (up to 18 years) • $2,607 – Open listing • $3,307 – 50 to 64 years • $3,485 – M & P 50 to 64 years	• Age dependant cost of hospitalisation. • 2017 to 2022 primary diagnosis with ICD J09, J10 and J11 • Most prevalent DRG – E62A-C (respiratory infections/inflammations) and D63A-C Otis Media and Upper Respiratory infections
ICU/mortality cost	• $115,500	Tested in sensitivity analysis

SA – people 50 to 64 years

Parameter	high value	low value	high value	low value
Vaccine efficacy (mortality)	42%	18%		
Vaccine efficacy (outpatient)	70%	46%		
Vaccine efficacy (inpatient)	71%	45%		
QALY loss from inpatient	200%	50%		
QALY loss from outpatient	200%	50%		
QALY loss from prem mort	1	0.9		
Vaccine admin cost	125%	75%		
Vaccine cost	100%	150%		
Hospitalisation cost	200%	50%		
ICU and mortality cost	115000	0%		
Mortality rate	200%	50%		
Inpatient rate	200%	50%		
Outpatient rate	200%	50%		

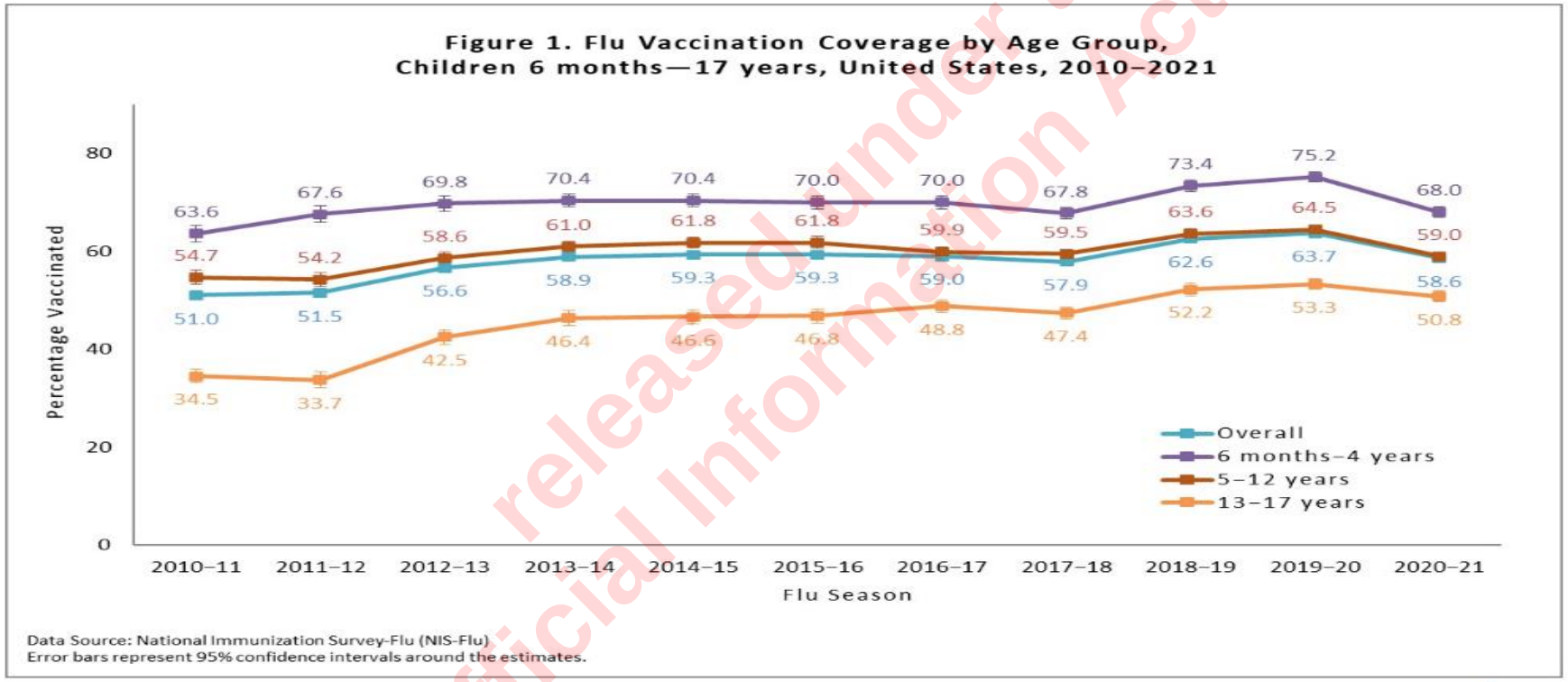
s 9(2)(b)(ii), s 9(2)(j)

New Zealand influenza uptake in 65+

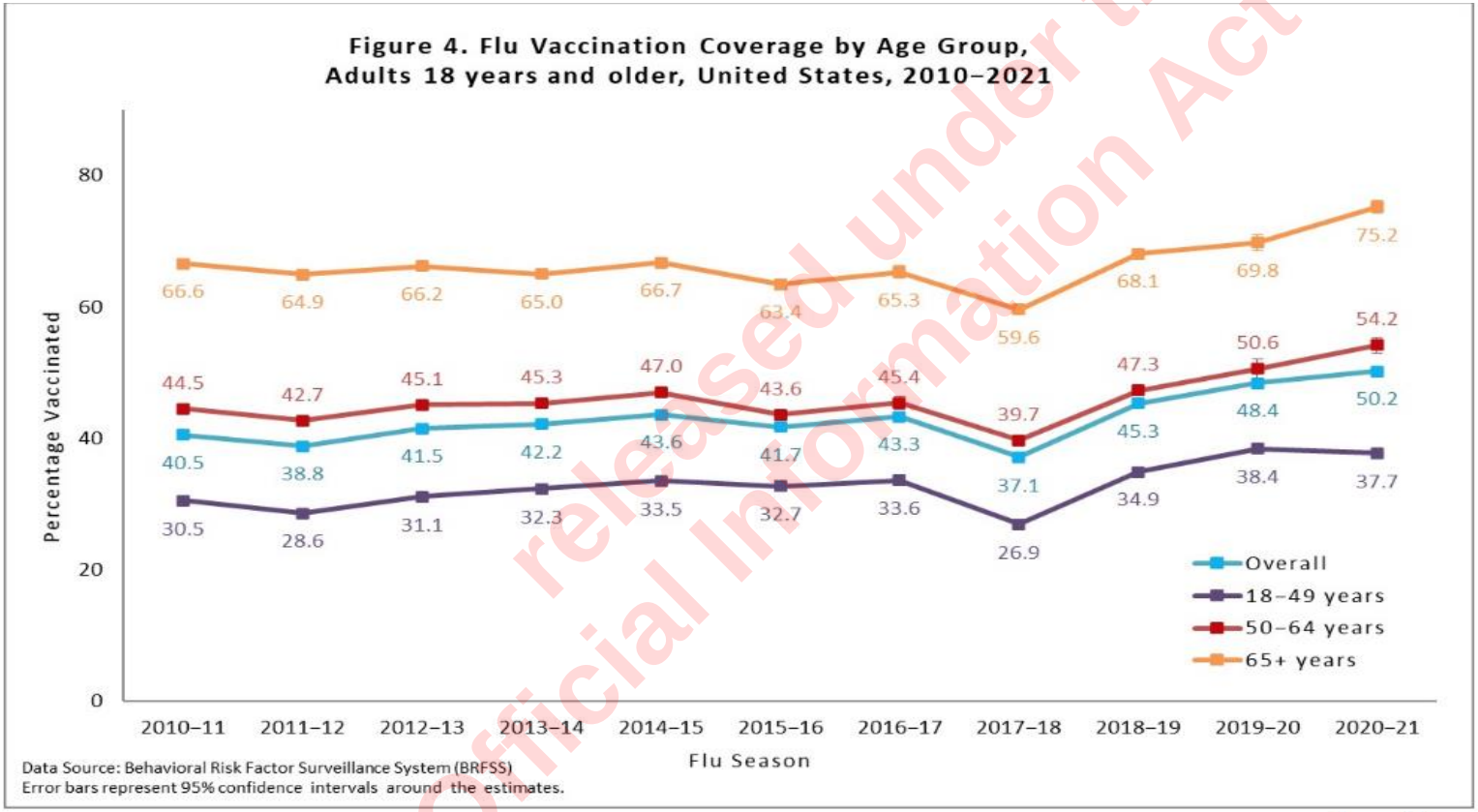
Influenza uptake rates all people 65+					
Ethnic group	2018	2019	2020	2021	2022
Māori	43.7%	45.6%	60.1%	54.2%	39.9%
Pacific Peoples	62.6%	61.8%	75.3%	67.4%	53.4%
Asian	44.8%	43.4%	52.3%	47.9%	33.4%
Other	54.4%	57.6%	68.8%	66.1%	46.6%
Total	53.2%	55.8%	66.9%	63.6%	45.1%

Influenza uptake in people aged 65 to 69 years of age					
Ethnic group	2018	2019	2020	2021	2022
Māori	40.70%	42%	57.60%	48.70%	36.20%
Pacific Peoples	58.50%	56.60%	72.10%	61.80%	48.80%
Asian	40.60%	39.30%	51.40%	45.40%	30.60%
Other	49.20%	50.60%	64.60%	57.90%	40.30%
Total	47.90%	48.80%	62.70%	55.60%	39.00%

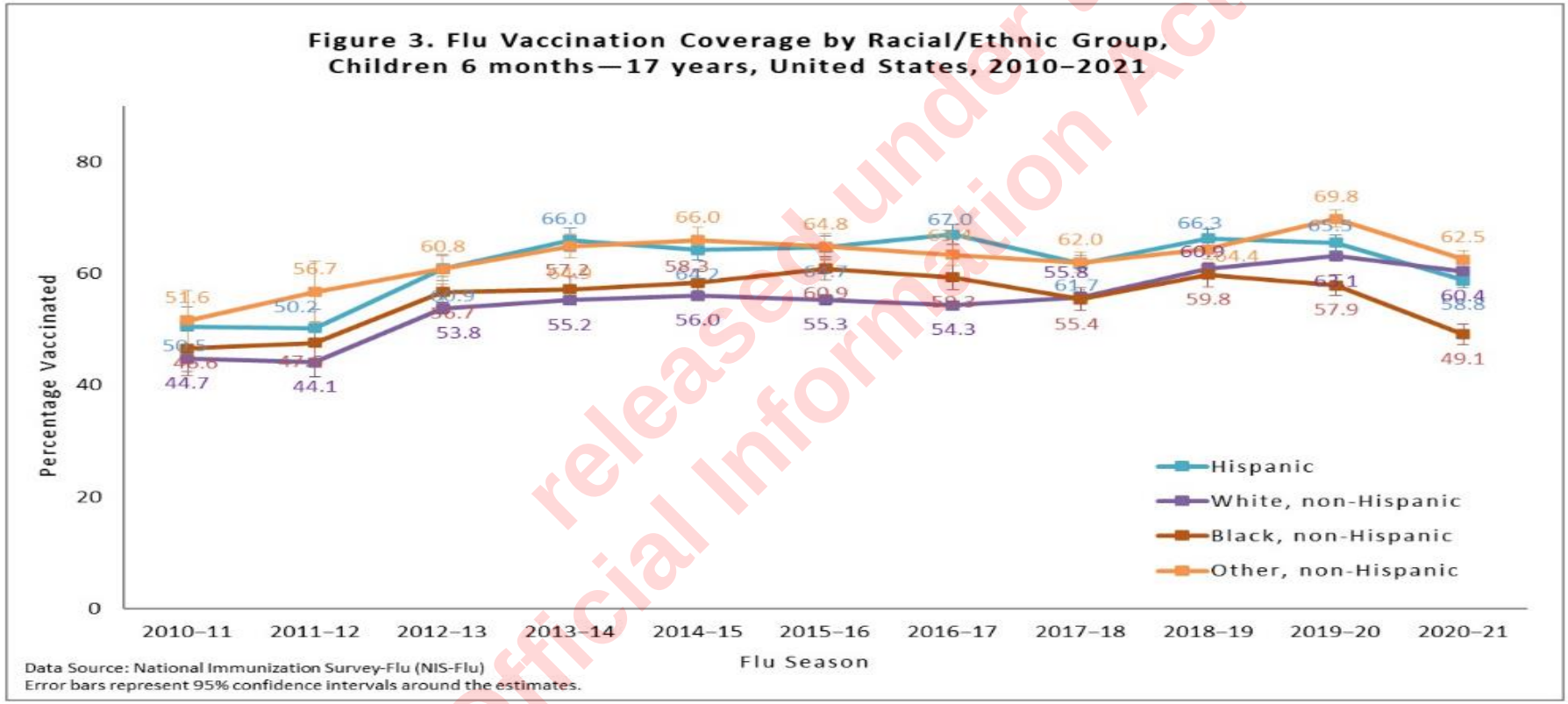
Flu Vaccination Coverage, United States, 2020–21 Influenza Season



Flu Vaccination Coverage, United States, 2020–21 Influenza Season



Flu Vaccination Coverage, United States, 2020–21 Influenza Season



UK accine coverage in high risk groups

- 45% to 50% reasonable?

Influenza vaccine uptake rates in at-risk adults aged 16–64 years over time

PHARMAC
Pharmaceutical Management Agency

Hot Topic minutes
10 November 2022

Expanding access to influenza vaccinations (multiple groups)

Attendees

Presenting Health Economist: Eric Mathews (EM)
Therapeutic Group Manager: Andrew Oliver (AO)

Other attendees:

Augusta Connor (AC)
Ben Campbell-Macdonald (BMC)
Ned Spencer (NS)
Joshua Cronin-Lampe (JCL)
Scott Metcalfe (SM)

Proposal background

Presenting HE noted multiple widening of access proposals and that each proposal had received a high recommendation at the most recent Immunisation Special Advisory Committee meeting.

EM explained that the four proposals under assessment are:

1. Open listing (influenza vaccine funded for all)
2. Access widening to those aged 0-18
3. Access widening to those aged 50-64
4. Access widening to Māori and Pacific people aged 50-64

EM noted key outcomes were the number of inpatient events, outpatient events and the risk of mortality.

Hospitalisations

The meeting was made aware of the Khieu 2015 paper that captured the burden of hospitalisations from influenza-like illness from the 1990s to 2008. It was noted that this paper found that the burden of influenza was significantly underestimated by discharge data.

The Khieu paper estimates of hospitalisation rates per 100,000 by age group is key evidence to modelling – rates much higher than ESR data would suggest.Khieu 2015 also reports hospitalisations by ethnicity – note that the ethnicity rate ratios were not age-standardised

EM noted that mortality is the key driver of model results rather than hospitalisations

The meeting considered that it may be acceptable to apply ethnicity specific rate ratios from Khieu papers to the crude age rates reported in Khieu et al

Action: HEs to apply rate ratios from Khieu papers to crude age rates reported in Khieu et al for the Māori and Pacific specific proposal

The meeting was made aware of Australian data (Leung et al) that may be helpful to inform hospitalisation data and test in sensitivity analysis since it includes more recent data than the Khieu paper does.

Mortality

EM noted that elevated mortality rates by ethnicity and age group were available in the supplementary appendix of Khieu 2017

EM explained that the key model parameters that impact results were the vaccine efficacy in terms of preventing mortality, the administration cost of vaccination and the mortality risk for people 50-64.

EM explained that mortality rates specific to those aged 50-64 were not provided in the appendix, and that there was a very large difference in rates between the 20-64 age group and the 65+ age group. SM noted that these rates could be plotted graphically to aid in the analysis.

Action: EM to send Khieu and AU papers to SM then discuss approach to mortality estimates.

The meeting considered that it may be appropriate to adjust Australian data with the relative risk of mortality for Maori and Pacific, but that the Au paper may not be representative due to the lower proportion of indigenous people relative to NZ

The meeting noted that old hospitalisation and mortality results from the Khieu paper may reflect lower rates of vaccination

Vaccine efficacy

EM noted the Turner 2014 paper on vaccine efficacy and proposed to use this in the CUA – meeting noted the variability in vaccine efficacy and that observational studies are required to capture mortality differences as RCTs are not as informative in th9is context. Meeting considered that this paper may be reasonable, but that the paper should be examined in more detail.

Action: EM to double-check Up-to-date to confirm the likely vaccine efficacy to corroborate the efficacy observed in Turner 2014.
Action: EM to check the weighting of the two groups in Turner to see if the study is appropriate to use
Action: SM to review Turner paper and decide if it is appropriate to use

EM noted that vaccine efficacy is a key assumption since it has a material impact on CUA results

Patient numbers and uptake

The meeting noted that in recent years, the incidence of influenza has been unexpectedly low, so using an average of the recent years may underestimate likely future incidence.

EM noted CDC data from the US broken down by relevant age groups that may inform uptake assumptions for the BIA. The meeting considered that the US data aligned well with NZ uptake rates but that it was difficult to assess this data without knowing how the immunisation system in the US is run. EM noted that this was an important assumption since uptake has a large impact on BIA results.

Action: EM to use aged 65+ NZ uptake rates and proportionately adjusted by US CDC age-specific data to estimate the NZ rates in the relevant age groups less then 50 years of age.

Meeting noted uptake rates from MoH website had uptake rates for the 55-64 age group, and that this could also be used to inform the BIA for people aged 50 to 64.

Access Criteria

BCM noted that this would be the first ethnicity-specific item on the Options for Investment (OFI) list and that the precedent-setting nature of this would need to be considered.

Influenza vaccine – Widening access to age groups

- All age groups (<65 years of age)
- People aged up to 18 years of age
- People aged 50 to 64 years of age
- Māori and Pacific people aged 50 to 64 years of age

GENERAL

Latest Clinical Recommendation: Immunisation Advisory Committee (May 2022)

- High priority - All age groups (<65 years of age)
- High priority - People aged up to 18 years of age
- High priority - People aged 50 to 64 years of age
- No formal recommendation – Māori and Pacific people aged 50 to 64 years of age

Condition: Influenza infection
Comparator: No vaccination
Availability of existing alternatives: None identified

NEED

Health need of the person: <1 (Low)
Influenza infection in people under the age of 65 can result in hospitalisation for serious acute respiratory infection (SARI). The highest disease burden in people under 65 years of age from influenza hospitalisation is in the <1 year (244.5 per 100,000), 1 to 4 years (161.1 per 100,000), 20 to 34 years (52.3 per 100,000), and 50 to 64 years (53.2 per 100,000) age groups (Khieu et al. Vaccine 2015;33:4087-92). Mortality from influenza in people under the age of 65 is low, reported as 2.5 per 100,000 people aged (20 to 64 years) and 0.5 per 100,000 people aged 0 to 19 years of age (Khieu et al. Vaccine 2017;33:4087-92 – Supplementary Appendix).
Health Need of Family, Whānau and Others: Family and Whānau can be impacted by influenza from potential infection transmission, supporting family members in receiving medical care such as supporting an outpatient or inpatient visit.
Māori Health Areas of Focus (hauora arotahi): Respiratory Health (Romaha Ora)
Māori health need:
The hospitalisation rate in each of these age groups noted above is likely to be amplified for Māori relative to European/Others, given the relative risk of hospitalisation for Māori (1.38) across all age groups (Khieu et al. Vaccine 2015;33:4087-92). In addition, Māori people experience elevated mortality rates from influenza, Māori people aged 20 to 64 years of age have a mortality rate of 5.4 per 100,000 people vs European/Other of 2.0 per 100,000 people, or an age standardised relative risk of 2.7 (Khieu et al. Vaccine 2017;33:4087-92 – Supplementary Appendix).

Access – relatively lower uptake of influenza vaccination in Māori 65 years and over – 59.6% (2020), 54.5% (2021) and 67.4% (2022) vs 66.3% (2020) 63.6% (2021) 71.1% (2022) for the overall population (MOH QLIK -NIR 2022 – accessed 03/11/2022) (MOH – Flu Vaccine data, 2022).

Uptake in Māori 55 to 64 years and over was higher than the overall population in 2022 – 38% vs 34.5% (MOH – Flu Vaccine data, 2022).

Impact on population groups experiencing inequities:
The hospitalisation rate for influenza is likely to be amplified for Pacific peoples relative to European/Others, given the relative risk of hospitalisation for Pacific peoples (1.43) across all age groups (Khieu et al. Vaccine 2015;33:4087-92). Similarly for Māori, Pacific peoples also

experience elevated rates of mortality (3.7 per 100,000 people aged 20 to 64 years) vs European/Others (2.0 per 100,000 people aged 20 to 64 years) or an age standardised relative risk of 1.5.

Access - Pacific peoples over the age of 65 years appear to have relatively high influenza vaccination uptake relative to the general population - 75.7% (2020), 67.4% (2021) and 71.6%% (2022) vs 66.3% (2020) 63.6% (2021) 71.1%% (2022).

Uptake in Pacific people 55 to 64 years and over was higher then the overall population in 2022 – 42.5% vs 34.5% (MOH – Flu Vaccine data, 2022).

The Immunisation Advisory Committee noted that the influenza-attributable death rate per 100,000 was higher for more materially deprived areas (NZDep 9&10) compared with least deprived areas (RR 1.8, 95% CI 1.3-2.4; Khieu et al. J infect. 2017;75:225-33).

Government condition priorities: Infectious diseases

HEALTH BENEFITS

Health benefit to the person: Influenza vaccination reduces the risk of outpatient and inpatient influenza events (Turner et al, 2014) and reduces the risk of influenza related mortality (Ferdinand et al, 2021) (Nation et al, 2020).
Health benefit to family, whānau, others: No direct benefit identified. Influenza vaccination may provide indirect protection to family and whanau however evidence available to inform reduced transmission from influenza vaccination is limited.
Consequences for health system: Fewer GP admission and hospitalisation events.
Government system priorities: Prevention | Health equity | Primary health care

COSTS AND SAVINGS

Health costs to the person: Time required for people to see their health care professional.
Health costs to family, whanau, others: Family and whanau may be required to invest their own time to assist a family member to receive a vaccine, this is likely to be the case for younger people.
Pharmaceutical costs per person: s 9(2) per dose
Costs to rest of health sector, per person: Vaccine administration cost of $27.84 (MOH Capitation,2022)

SUITABILITY

Impact on use by the person: Injection requiring appointment with healthcare professional
Impact on use by others: None identified
Impact on health workforce: Storage (refrigeration) and administration

COST-EFFECTIVENESS

People aged 0 to 18 years of age
Point estimate: s 9(2)(b) per $1m
Likely range: s 9(2)(b)(ii), s 9 per $1m

CUA notes: The CUA result is primarily driven by influenza mortality related outcomes. Due to the high number needed to treat (NNT) to prevent a mortality event in this age group (645,100) and non-negligible cost per person for vaccination (s 9(2) + $27.84) this proposed age group has

s 9(2)(b)(ii), s 9(2)(j). The NNT to prevent an outpatient event and inpatient event of 553 and 2,374 respectively is significantly lower than the NNT to prevent mortality however these outcomes have lower impact on the CUA result. The CUA range is informed by uncertainty in vaccine efficacy against influenza.

All people – Open listing

Point estimate: s 9(2)(b) per $1m

Likely range: s 9(2)(b)(ii), s 9 per $1m

CUA notes: The CUA result is primarily driven by influenza mortality related outcomes. Due to the high number needed to treat (NNT) to prevent a mortality event in this age group (169,800) and non-negligible cost per person for vaccination (+ $27.84) this proposed age group has s 9(2)(b)(ii), s 9(2)(j). The NNT to prevent an outpatient event and inpatient event of 800 and 3,300 respectively is significantly lower than the NNT to prevent mortality however these outcomes have lower impact on the CUA result. The CUA range is informed by uncertainty in vaccine efficacy against influenza.

People aged 50 to 64 years of age

Point estimate: s 9(2)(b) per $1m

Likely range: s 9(2)(b)(ii), s 9 per $1m

CUA notes: The CUA result is primarily driven by influenza mortality related outcomes. Due to the high number needed to treat (NNT) to prevent a mortality event in this age group (129,000) and non-negligible cost per person for vaccination (+ $27.84) this proposed age group has s 9(2)(b)(ii), s 9(2)(j) The NNT to prevent an outpatient event and inpatient event of 1,200 and 3,000 respectively is significantly lower than the NNT to prevent mortality however these outcomes have lower impact on the CUA result. The CUA range is informed by uncertainty in vaccine efficacy against influenza.

Māori and Pacific people aged 50 to 64 years of age

Point estimate: s 9(2)(b) per $1m

Likely range: s 9(2)(b)(ii), s 9 per $1m

CUA notes: The CUA result is primarily driven by influenza mortality related outcomes. Māori and Pacific people have a higher risk of mortality and the number needed to treat (NNT) to prevent a mortality event in this age group (66,100) is lower compared to other groups considered however the non-negligible cost per person for vaccination (s 9(2) + $27.84) means this proposed group has s 9(2)(b)(ii), s 9(2)(j) The NNT to prevent an outpatient event and inpatient event of 1,200 and 3,290 respectively is significantly lower than the NNT to prevent mortality however these outcomes have lower impact on the CUA result. The CUA range is informed by uncertainty in vaccine efficacy against influenza.

BUDGET IMPACT

People aged 0 to 18 years of age

BIA notes: In the absence of evidence for uptake in this age group, uptake has been assumed to be approximately 60% based on uptake rates seen in people aged 6 months to 17 years in the United States (US) general population (CDC, 2021). Pharmac staff note the US healthcare system is different to New Zealand's however uptake in people aged 65 years and over appear similar between the US and New Zealand and so extrapolating US uptake rates in other age groups is likely not unreasonable (OECD – Influenza vaccination rates, 2021). The BIA captures cost savings from reduced outpatient and inpatient events.

Year	1	2	3	4	5	5-year NPV
People	734,545	733,947	733,712	732,607	730,133	
Pharmaceutical costs	s 9(2)(b)(ii), s 9(2)(j)					
Other health sector savings	-$1,917,162	-$1,915,603	-$1,914,988	-$1,912,105	-$1,905,646	-$8,251,260
Other health sector costs	$20,449,732	$20,433,096	$20,426,543	$20,395,791	$20,326,893	$88,013,444
Total health sector budget impact	s 9(2)(b)(ii), s 9(2)(j)					

All people – Open listing

BIA notes: Uptake for people aged 0 to 18 and 18 to 49 years of age in this age group has been assumed to be 60% and 36% respectively based on uptake rates seen in people aged 6 months to 17 years and 18 to 49 years in the US general population (CDC, 2021). For people aged 50 to 64 years of age, uptake rate of 34.5% has been assumed based on the uptake seen in people aged 55-to-64-years reported by the Ministry of Health (MOH – Flue Vaccine Data, 2022). The BIA captures cost savings from reduced outpatient and inpatient events.

Year	1	2	3	4	5	5-year NPV
People	1,823,543	1,823,761	1,826,967	1,832,218	1,836,318	
Pharmaceutical costs	s 9(2)(b)(ii), s 9(2)(j)					
Other health sector savings	-$3,446,496	-$3,483,377	-$3,525,793	-$3,571,563	-$3,614,568	-$15,186,681
Other health sector costs	$50,767,431	$51,310,697	$51,935,489	$52,609,685	$53,243,160	$223,702,223
Total health sector budget impact	s 9(2)(b)(ii), s 9(2)(j)					

People aged 50 to 64 years of age

BIA notes: For people aged 50 to 64 years of age, uptake rate of 34.5% has been assumed based on the uptake seen in people aged 55-to-64-years reported by the Ministry of Health (MOH – Flue Vaccine Data, 2022). Uptake is assumed to gradually increase over 5 years (10%) assuming there will be a drive by the health system to incrementally improve uptake rates in this age group. The BIA captures cost savings from reduced outpatient and inpatient events.

Year	1	2	3	4	5	5-year NPV

People	332,477	352,152	370,871	388,112	404,558	
Pharmaceutical costs	s 9(2)(b)(ii), s 9(2)(j)					
Other health sector savings	-$758,046	-$802,907	-$845,585	-$884,894	-$922,391	-$3,606,874
Other health sector costs	$9,256,146	$9,803,912	$10,325,035	$10,805,024	$11,262,881	$44,041,825
Total health sector budget impact	s 9(2)(b)(ii), s 9(2)(j)					

Māori and Pacific people aged 50 to 64 years of age

BIA notes: For Māori and Pacific people aged 50 to 64 years of age, an uptake rate of 38% (Māori people) and 42% (Pacific people) has been assumed based on the uptake seen in Māori and Pacific people aged 55-to-64-years reported by the Ministry of Health (MOH – Flue Vaccine Data, 2022). Uptake is assumed to gradually increase over 5 years (10%) assuming there will be a drive by the health system to incrementally improve uptake rates in this age group. The BIA captures cost savings from reduced outpatient and inpatient events.

Year	**1**	**2**	**3**	**4**	**5**	**5-year NPV**
People	72,786	77,614	82,294	86,698	91,028	
Pharmaceutical costs	s 9(2)(b)(ii), s 9(2)(j)					
Other health sector savings	-$221,269	-$235,948	-$250,175	-$263,561	-$276,725	-$1,066,849
Other health sector costs	$2,026,362	$2,160,785	$2,291,076	$2,413,661	$2,534,220	$9,770,087
Total health sector budget impact	s 9(2)(b)(ii), s 9(2)(j)					

Minutes of the Pharmac Prioritisation Meeting

Wednesday 7 December 2022

Meeting staff

Out of scope

Out of scope

Out of scope

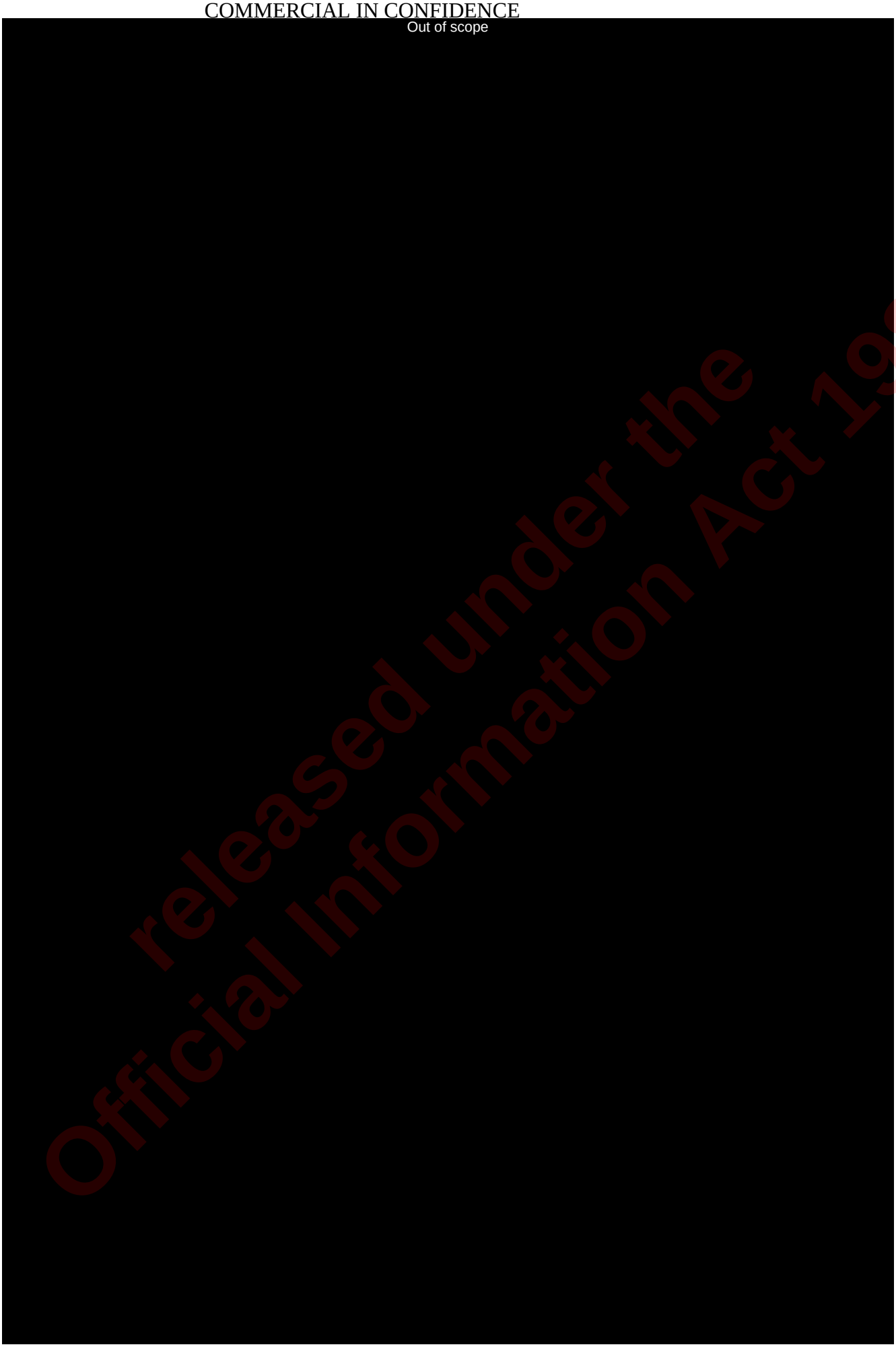
Out of scope

Prioritisation of new proposals to the *Options for investment* list

The table below summarises the new proposals that were ranked on the Options for Investment priority list at the meeting. A minute for each item prioritised is outlined below in the same order as the appear in the table.

Proposal	HE	TGM
Out of scope		
Influenza vaccine - Options for widened access – Māori and Pacific people over 50 years of age (P-001781)	EM	AO
Influenza vaccine - Options for widened access - Open listing (P-001779)	EM	AO
Influenza vaccine - Options for widened access - People over 50 years of age (P-001783)	EM	AO
Influenza vaccine - Options for widened access - Children up to 18 years of age (P-001784)	EM	AO
Out of scope		

Out of scope



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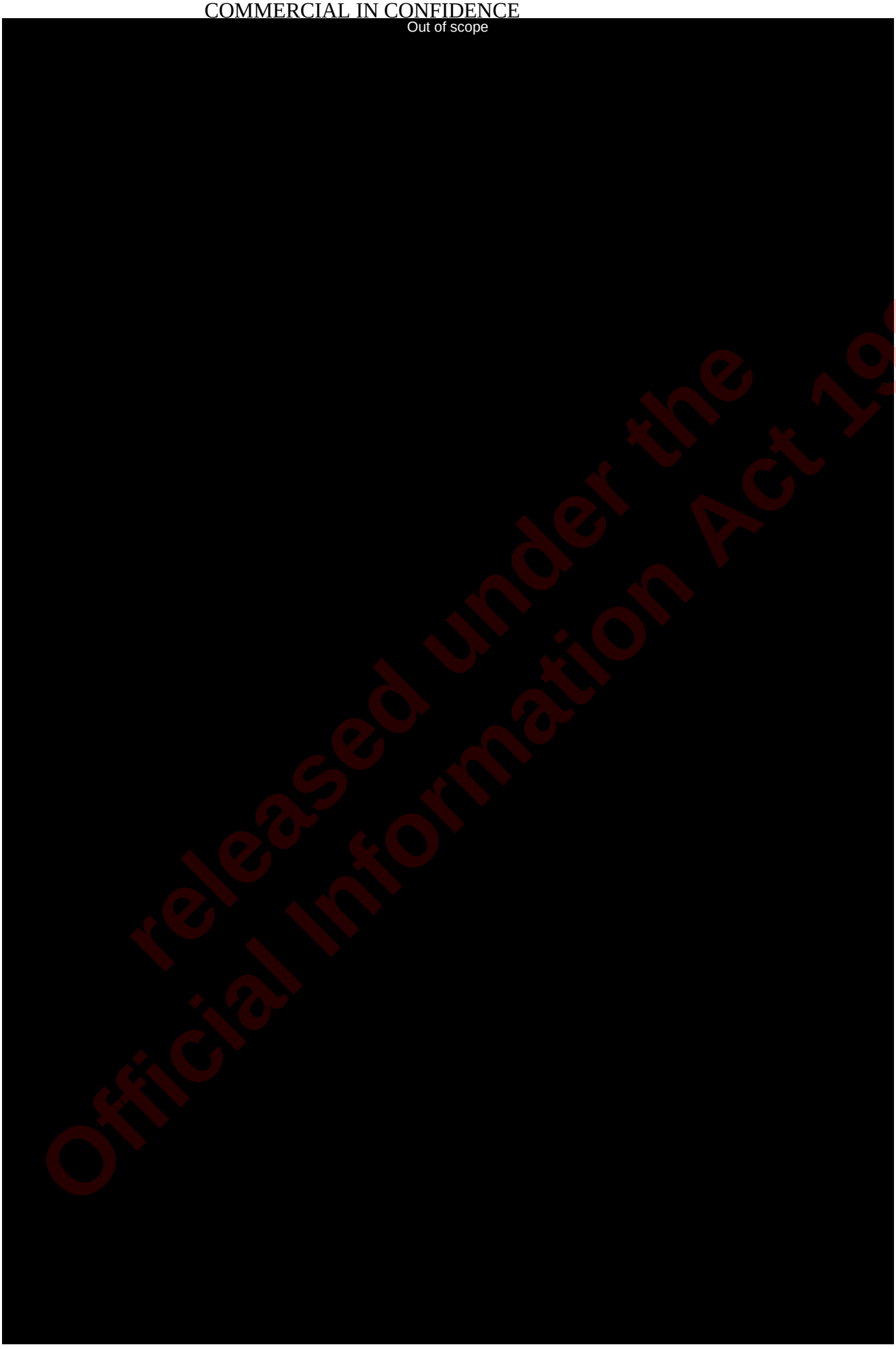

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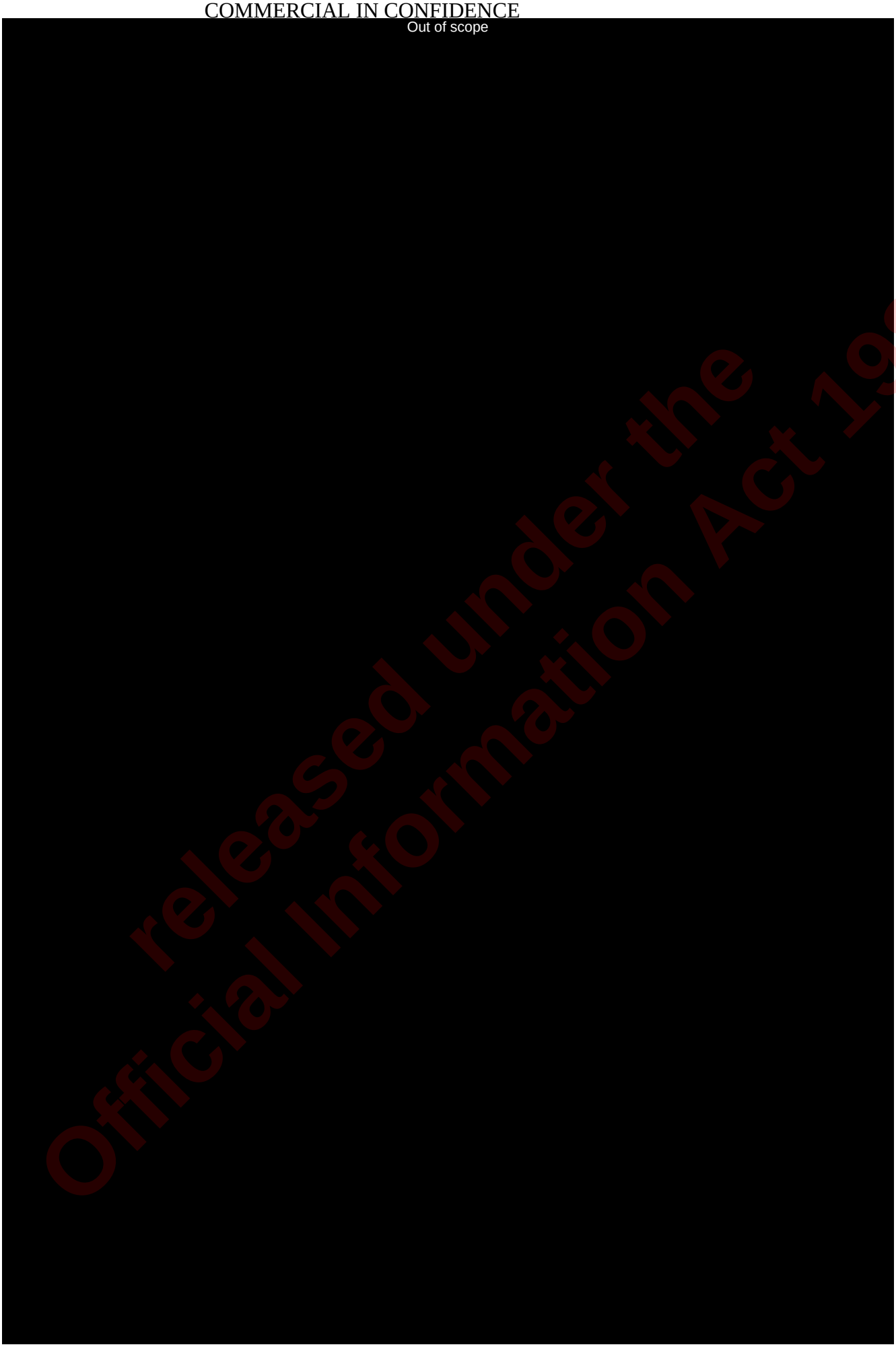


Influenza vaccine - Options for widened access – Māori and Pacific people over 50 years of age

Attendees considered the information provided and noted that this proposal to widen access to the influenza vaccine would widen access to Māori and Pacific peoples aged between 50 years and 64 years.

The difference in funding and assessment processes between this proposal and temporary widening of access to influenza vaccines in the 2022 season were discussed. It was noted that in the 2022 season, the influenza vaccine was funded for Māori and Pacific peoples aged 55 and older and this temporary widening of access was funded through the COVID-19 Response Fund, rather than the Combined Pharmaceutical Budget (CPB). Attendees noted the other circumstances related to this funding decision, which included a loosening of New Zealand's border restrictions, population-wide immunity to influenza being relatively low and the need to ease pressure on the health system associated with the co-circulation of influenza and COVID-19.

Attendees noted that this proposal represented a permanent widening of access to influenza vaccines for future influenza seasons, funded out of the CPB. Attendees noted that the Immunisation Advisory Committee recommended funded access in future seasons be widened to people as young as 50 years of age for Māori and Pacific peoples, as this better captured people at higher risk of adverse influenza-related outcomes.

Attendees noted that currently, the influenza vaccine was funded for all people aged 65 and older. Attendees explained that, due to a lower overall life expectancy, many Māori and Pacific people would not live long enough to receive the benefit of a funded vaccination, so funding the influenza vaccine in the younger age group (50 to 64 years) for these people would be more equitable than the status quo.

Attendees noted that the CUA model for this proposal accounted for the increased baseline risk of influenza-related hospitalisation and mortality for Māori and Pacific peoples, and therefore the greater magnitude of health benefit associated with funding influenza vaccination for these population groups. Attendees also noted that the main driver of the CUA result was reduced influenza-related mortality, and that costs were driven more by administration rather than pharmaceutical costs.

Attendees noted that influenza vaccine is currently funded for people aged 65 and younger with serious mental health conditions and a number of other medical conditions. It was noted that Māori and Pacific peoples were overrepresented among these groups. Attendees considered that currently, there were barriers to receiving the appropriate diagnoses and funded vaccinations among these patient groups and this proposal could simplify access to influenza vaccine and ameliorate some of these barriers.

Attendees discussed the equity impacts of the proposal, and how this proposal was more targeted than other proposals on the OFI, in that it was the first proposal to be 100% targeted to Māori and Pacific populations. Attendees discussed how this proposal would buy more health for Māori and Pacific peoples per $1m than other proposals with otherwise similar CUA ranges. However, it was also discussed how it was also important to consider the health of other groups, and that there remained a significant trade-off with health need (given that influenza is associated with a lower health need than the majority of other proposals on the Options for Investment list).

Influenza vaccine - Options for widened access – Māori and Pacific people over 50 years of age was ranked s 9(2)(b)(ii) the Options for Investment list. The Factors which informed this ranking position

were the s 9(2)(b)(ii), s 9(2)(j) of the proposal, the disproportionate burden of influenza on Māori and Pacific peoples, and the equity-enhancing impact of this proposal.

Influenza vaccine - Options for widened access - Open listing

Influenza vaccine - Options for widened access - People over 50 years of age

Influenza vaccine - Options for widened access - Children up to 18 years of age

Attendees considered the information provided on three proposals to widen access to influenza vaccine and noted advice from the Immunisation Advisory Committee which indicated that although open listing influenza vaccines would be preferable, that in the face of budget constraints, it would be best to target people aged 50 years and older, and children up to 18 years of age.

Attendees noted that the uptake of influenza vaccines is low among some parts of the population, and it was uncertain how much uptake in the population would increase if access was widened. Attendees noted that the budget impact estimates and the CUAs for these proposals accounted for costs related to the administration of vaccines as well as any costs related to unused vaccines, and that the administration costs were significantly larger than the pharmaceutical costs.

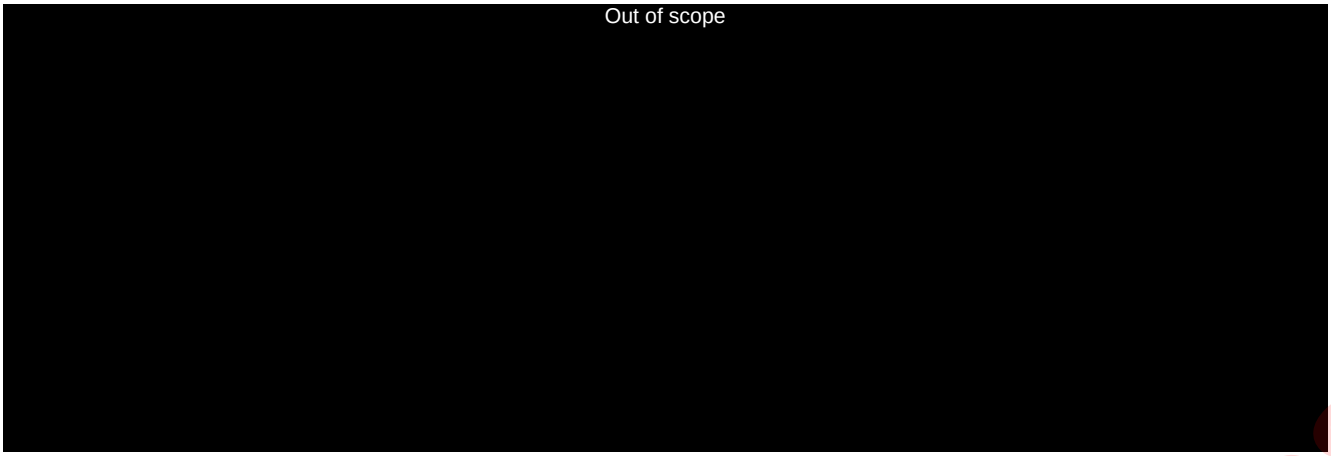
Attendees discussed the health need associated with influenza infection, and the cost-utility of these proposals in relation to each and in relation to the other proposals on the Options for Investment list.

Influenza vaccine - Options for widened access - Open listing was ranked s 9(2)(b)(ii), s the Options for Investment list. *Influenza vaccine - Options for widened access - People over 50 years of age* was ranked s 9(2)(b)(ii), s 9(2) the Options for Investment list. *Influenza vaccine - Options for widened access - Children up to 18 years of age* was ranked s 9(2)(b)(ii), s 9(2) the Options for Investment list. The Factors which informed the ranking positions of these proposals were: the very low cost-effectiveness of the proposals, the comparatively low health need associated with influenza, and the disproportionate burden of influenza on Māori and Pacific peoples.

Out of scope

Proposals re-prioritised with updated information

Out of scope



Explanation of the Pharmac Options for Investment list

The Options for Investment list records the relative ranking of proposals for investment, to be progressed when it is affordable and practical to do so. The list contains proposals that have health gains and have sufficient information to be prioritised using Pharmac's Factors for Consideration. Proposals can then be compared with each other to derive a relative ranking for investment. An explanation of the columns in the list follows:

Priority – The ranking of proposals within the Options for Investment list.

Proposal – The name of the product, or a description of the group of products.

Indication – A general description of the restrictions that the product would be funded for or widened to. The actual restrictions placed on a funded proposal may be more detailed.

Clinical Advice priority – Latest clinical recommendation, usually high, medium, low, or decline. Represents PTAC's or a Specialist Advisory Committee's overall opinion of the proposal with respect to all the Factors for Consideration. Specialist Advisory Committee's recommendations are marked as such.

Health Need – A proxy measure of the Health Need of the average patient, being estimated as the numbers of Quality Adjusted Life Years lost because of the condition, over a full lifetime under standard care.

QALYs per $1m – Cost-effectiveness results are presented as ranges to capture the uncertainty in input variables. The likely range represents Pharmac's best estimate of cost-effectiveness.

5-year NPV to the CPB – the cost to the Combined Pharmaceutical Budget over the first five years of listing (net present value, discounted at 8% p.a.)