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ATAGI Targeted Review 2023: Vaccination for prevention of influenza in Australia

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Review article

ATAGI Targeted Review 2023: Vaccination for prevention of influenza in Australia

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Abstract

Annual seasonal influenza epidemics cause substantial disease and economic burden worldwide. During the coronavirus disease 2019 (COVID-19) pandemic in 2020 and 2021, influenza activity significantly declined. However, influenza resurged in Australia following the relaxation of non-pharmaceutical interventions, with increased influenza virus circulation in early 2022 coinciding with the SARS-CoV-2 Omicron BA.2 variant wave. Together with other respiratory virus diseases, these disease impacts on the Australian population and healthcare system have re-emphasised the importance of influenza vaccination and control. We aim to provide an overview of the current seasonal influenza vaccination program in Australia and summarise evidence and considerations underpinning potential future immunisation strategies.

Influenza causes disproportionately higher morbidity and mortality in young children and older adults. Other populations at elevated risk from influenza include Aboriginal and Torres Strait Islander peoples, pregnant women, and people with certain underlying medical conditions. All Australians aged ≥ 6 months are recommended to receive influenza vaccine every year. The National Immunisation Program (NIP) provides free vaccine for eligible at-risk populations. While approximately 70% of older adults had received influenza vaccine in 2022, coverage in other age groups remains suboptimal.

There are several key unmet needs and challenges, but also potential strategies for enhancing the influenza vaccination program in Australia. Improved monitoring and evaluation, including the use of relevant linked datasets for such purposes, is imperative to better understand variations in coverage and vaccination impact in specific populations. Adoption of evidence-based strategies, such as culturally appropriate resources that consider the characteristics of diverse Australian populations, may also help to achieve higher vaccine coverage rates. Additionally, greater vaccine uptake across the population could be facilitated by expanding the NIP-eligible population where cost-effective, and adopting the use of more effective and different types of vaccines when available.

Keywords: Influenza; influenza vaccine; immunisation programs; prevention and control; Australian Technical Advisory Group on Immunisation (ATAGI); National Immunisation Technical Advisory Group (NITAG)

Introduction

Influenza is an infectious disease that typically occurs in winter, resulting in substantial disease and economic burden worldwide.[1] Strict enforcement of non-pharmaceutical interventions (NPIs) such as lockdowns, during the first two years of the coronavirus disease 2019 (COVID-19) pandemic, led to disruption of the transmission of respiratory infections like influenza, but vaccination remains the most effective ongoing strategy to prevent and control influenza. In Australia, the Australian Technical Advisory Group on Immunisation (ATAGI) publishes an annual statement containing specific advice relating to influenza vaccination ahead of the influenza season. The Australian Immunisation Handbook[2] contains the broader clinical recommendations by ATAGI on the use of influenza vaccines for immunisation providers.

Seasonal influenza epidemiology in recent years was substantially impacted by the COVID-19 pandemic. Similar to experience overseas, influenza activity in Australia was very low in 2020 and 2021, due to NPIs such as social distancing and border control implemented to restrict the spread of SARS-CoV-2.[3–5] With the relaxation of NPIs, however, influenza activity resurged concurrently with the emergence of the Omicron BA.2 wave in early 2022.[6] Together with co-circulation of other respiratory viruses such as respiratory syncytial virus (RSV), this led to significant strain on the Australian healthcare system that highlighted the importance of influenza vaccination along with COVID-19 control.

This ATAGI targeted review focuses on the national seasonal influenza vaccination program, addressing the key considerations underpinning ATAGI's recommendations for the prevention and control of influenza. The review covers:

- influenza epidemiology in Australia;
- influenza vaccines currently available and under development;
- ATAGI recommendations for seasonal influenza vaccination and the current influenza vaccination program for Australians;
- current challenges relating to influenza vaccination in various age and at-risk populations; and
- potential future vaccination strategies that may optimise prevention of influenza.

Influenza epidemiology in Australia

Causative agents

Influenza A and B are the main types of influenza viruses that cause epidemics in humans.[7] Influenza A has subtypes that are defined by the surface antigens hemagglutinin (HA) and neuraminidase. Currently A(H1N1) and A(H3N2) are the two influenza A subtypes circulating in humans, with A(H3N2) strains being more antigenically diverse.[8] Influenza B is classified into two lineages, B/Yamagata, which was last reported in 2020, and B/Victoria.[9] (Appendix A, Table A.1)

Mutation of the influenza virus genes occurs constantly during viral replication, often altering the antigenic characteristics. This antigenic change (referred to as antigenic *drift*) causes immune responses from prior infection and immunisation to be less effective, necessitating annual review and reformulation of the influenza vaccine to aim for the best match with the predicted dominant circulating strains in the upcoming season. Influenza A viruses can also evolve rapidly through the reassortment of viral gene segments (referred to as antigenic *shift*). This major change in the virus can potentially instigate a global pandemic.[9,10]

Characteristics of seasonal epidemics and at-risk populations

The timing of the influenza season varies by year in Australia, but typically occurs from May to October, with additional peaks frequently observed in February and March in the tropical areas.[11,12] There has also been increasing recognition of travel-related inter-seasonal influenza cases in recent years.[13]

In most instances, influenza is self-limiting, with the most common symptoms being cough, fever, runny nose, sore throat, and headache. However, severe influenza and complications of influenza can result in hospitalisation or death. The highest rates of influenza morbidity and mortality typically occur among children aged < 5 years, adults aged ≥ 65 years, those with underlying medical conditions, and pregnant women. Aboriginal and Torres Strait Islander peoples experience a higher influenza morbidity rate than other Australians.[2,7,14]

Influenza surveillance system in Australia

In Australia, the National Notifiable Diseases Surveillance System (NNDSS) is the primary system for the national surveillance of communicable diseases including influenza. Data for influenza activity and severity in the community are complemented by national sentinel surveillance programs, such as the Australian Sentinel Practices Research Network (ASPREN) and the Influenza Complications Alert Network (FluCAN), and by the FluTracking program, which uses an online community survey method. Data from these various sources are also used to evaluate vaccine effectiveness (VE).[15,16]

Influenza disease burden in Australia

Overall trends

Influenza disease burden can fluctuate by year due to the varying intensity of annual epidemics. In 2016 to 2018, influenza caused an average of 73.9 hospitalisations and 3.2 deaths per 100,000 population each year as per the International Statistical Classification of Diseases and Related Health Problems (ICD)-coded national hospitalisation and death registry data.[17] However, during the first two years of the COVID-19 pandemic (2020 and 2021), the circulation of influenza virus in Australia was substantially lower.[3]

In NNDSS data, nationally, there were 21,266 and 598 notifications of laboratory confirmed influenza in 2020 and 2021 respectively, which were substantially less than the five-year average.[4,5] In FluCAN sentinel hospitals, only 20 patients with laboratory-confirmed influenza were admitted during the 2020 season, in contrast to > 700 admissions per year in the preceding years.[18–20] However, following the relaxation of NPIs from late 2021, influenza activity rose with an unusually early season start in April 2022 and a rapid increase that peaked in June 2022.[21]

Importantly, the use of surveillance data will likely result in underestimation of the true disease burden, due to under-ascertainment of cases (i.e., cases not seeking healthcare or not having a diagnostic test performed at the appropriate time in their illness).[22,23] Hence, modelling studies have been undertaken to estimate the true influenza burden in Australia. In 2022, a study using time-series regression with 2007–2015 data estimated average annual influenza-attributed respiratory hospitalisation rates to be 54.8 (95%CI: 20.1–88.8) per 100,000 population.[24] Another modelling study, which utilised a similar statistical approach with 2010–2018 data, estimated the average annual influenza-attributed respiratory mortality to be 4.03 (95% CI: 3.42–4.64) per 100,000 population per year in Australia.[25]

Trends by age

Older adults and pre-school-age children have disproportionally high influenza-associated morbidity and mortality rates.[17,26,27]

Based on the 2016–2018 NNDSS and national hospitalisation data, the highest rate of notification for influenza was among children aged 1–4 years (924.2 per 100,000 population per year). The influenza-associated hospitalisation rates (based on ICD-10 codes J09–J11 in the principal or any other diagnosis fields) were highest in adults aged ≥ 65 years (243.3 per 100,000 population per year), followed by infants aged < 1 year (215.4 per 100,000 population per year). Adults aged ≥ 65 years accounted for 91% of influenza deaths.[17]

Trends in Aboriginal and Torres Strait Islander peoples

Aboriginal and Torres Strait Islander peoples are at increased risk of serious influenza, due to the high prevalence of health-related risk conditions and related longstanding social and health inequities.[28,29] During the 2016–2019 period, influenza-associated hospitalisation rates in the Aboriginal and Torres Strait Islander populations (ascertained using relevant ICD codes in the principal or any other diagnosis fields) were highest in infants aged < 6 months (744.7 per 100,000 population per year) and adults aged ≥ 50 years (500.4 per 100,000 population per year).[30] A surveillance report and modelling study reported higher hospitalisation rates in the Aboriginal and Torres Strait Islander populations, compared to the overall Australian population, across all age groups (2.0–2.4 times higher).[24,30]

However, there have been continuing issues with the accuracy of reporting of Aboriginal and Torres Strait Islander status in population (e.g. census, mortality data) and administrative (e.g. hospitalisation, vaccination, disease notification) data.[31,32] This limits the comparability and interpretation of measures of disease burden in Aboriginal and Torres Strait Islander peoples.

Trends in pregnant women and people with underlying medical conditions

Compared with the general population, pregnant women and their infants are at increased risk of complications from influenza, including influenza-related hospitalisation[33,34] and adverse birth outcomes such as low birth weight, stillbirth, and preterm delivery.[35–37] In a 2019 review of published studies, pregnancy was associated with a 6.8-fold increase in risk (95% CI: 6.02–7.68) of influenza-related hospitalisation.[33] However, due to a lack of nationally representative data, influenza disease burden in pregnant women in Australia largely remains unclear.

Similarly, the accurate estimate of influenza disease burden among Australians with underlying medical conditions is uncertain. However, a wealth of evidence suggests elevated risk of hospitalisation in at-risk populations.[38–41] A 2013 review of published studies estimated odds ratios for developing severe influenza in those with cardiovascular disease or neuromuscular disease, compared to those without, to be 1.97 (95% CI: 1.06–3.67) and 3.21 (95% CI: 1.84–5.58) respectively.[41]

Influenza vaccines

Overview of existing influenza vaccines

Vaccines currently in use in Australia

Inactivated influenza vaccines (IIV) are the most widely used influenza vaccine globally, with virus from either embryonated chicken eggs (egg-based) or cell culture (cell-based). The standard-dose vaccines contain 15 µg of HA per strain per dose with no adjuvant. There is currently a lack of high-certainty evidence showing difference in effectiveness between egg- and cell-based vaccines, while concerns exist that egg-based vaccines may acquire mutations during manufacture which could cause circulating strain mismatch.[42–45]

The introduction of a cell-based vaccine has helped diversify supply lines to overcome the potential impact of egg shortages, particularly when rapid upscaling of vaccine production is needed (e.g., during an influenza pandemic). Egg-based IIVs are also produced either using high-dose HA content (60 µg of HA per strain with no adjuvant) or as an adjuvanted formulation (15 µg of HA per strain with the MF59 adjuvant), which elicit a greater immune response than the standard vaccines. While most standard IIVs can be given from 6 months of age, enhanced vaccines are targeted to older adults (e.g., ≥ 65 years of age) to mitigate the effect of immuno-senescence.

Vaccines currently not available for use in Australia

Live attenuated influenza vaccine (LAIV), for intranasal administration, mimics natural infection without causing disease.[46] Advantages of LAIV include a good safety profile and ease and acceptability of needleless administration among children and their parents/carers.[47]

Studies have reported mixed results on the effectiveness of LAIV used in the northern hemisphere. Early studies, prior to 2013, showed higher effectiveness of LAIV than of IIV in children aged 6 months to 17 years.[48,49] However, a lower VE of LAIV against A(H1N1)pdm09 was reported in the United States of America (USA) during the 2013–2016 seasons,[50,51] while other countries did not identify a significant reduction in VE during the same period.[52]

The A(H1N1)pdm09 component in LAIV was replaced with a new strain in 2018, but there is limited data on the effectiveness of the new LAIV.[50,53] The LAIV has been licensed in other countries, with some, such as the United Kingdom (UK), preferentially recommending its use in children.[48] In Australia, FluMist, the first LAIV, was registered by the Therapeutic Goods Administration (TGA) in 2016, though the vaccine has not yet been supplied and is currently not produced nor available for use in the southern hemisphere.

Recombinant influenza vaccine (RIV), another vaccine type that is not yet available for use in Australia, was developed by using recombinant DNA technologies to produce influenza HA in cell culture, with 45 µg of HA per strain per dose. RIV has been used in the USA for individuals aged ≥ 18 years since the 2013–2014 season[54] and is now preferentially recommended for adults aged ≥ 65 years.[55] While studies examining comparative VE of RIV versus IIV are currently limited, some data suggest potentially higher VE for RIV.[56] Other potential benefits of RIV include a faster manufacturing time and avoidance of vaccine strain mutations during manufacture.[57] In Australia, the first RIV, Flublok, was registered in May 2021 for individuals aged ≥ 18 years.

There are also new types of influenza vaccines currently in development. These include new adjuvanted vaccines, combination vaccines for influenza and other respiratory diseases (e.g. COVID-19, RSV), and vaccines utilising new platform technologies like mRNA.

Duration of immunity, general VEs, and safety

The duration of immunity following influenza vaccination is generally less than a year, with waning levels of vaccine-induced antibodies commencing from 3 to 4 months after vaccination.[58,59] In addition, circulating strains can vary from year to year, potentially resulting in the inclusion of new vaccine virus strains in each respective northern and/or southern hemisphere formulation annually.[58–63] Influenza VE is affected by factors such as the recipient's age, the level of strain match between the vaccine and circulating virus, as well as the type of vaccine and the timing of vaccination. Additionally, there are limitations with each of the different methods and surveillance systems from which VE estimates are derived, and direct comparison between them may not be appropriate. Overall, influenza vaccines are moderately effective at preventing various clinical outcomes. During the period 2016–2019, VE estimates ranged from 13% to 42% from FluCAN data on hospitalisations, and 33% to 68% from ASPREN data on GP visits (Appendix A, Table A.1).

Frequencies of local adverse events (AEs) following standard intramuscular influenza vaccination vary greatly by vaccine type and age of the recipient, but overall, 20–80% of people experience induration, swelling, redness, and pain at the injection site.[64–67] One to ten percent of people who received standard IIVs can also experience systemic AEs such as fever, malaise, and myalgia which may last one to two days.[27,64–66,68] The risk of anaphylaxis, a severe vaccine-associated allergic reaction, to influenza vaccine is very rare, with the estimation of 1.35 per million vaccine doses for trivalent IIVs.[69,70] An association with Guillain–Barré syndrome (GBS) was noted after a small increase in risk of GBS was reported following IIV administration in 1976. Since then, close surveillance has shown that vaccine-attributable GBS occurs, at most, at a very low rate of up to 1 in 1 million doses of influenza vaccine.[71] However, the risk of GBS has been shown to be 15 times higher following influenza infection than the risk following influenza vaccination.[72]

Selection of seasonal influenza vaccine compositions (WHO and AIVC recommendations)

Every September, the World Health Organization (WHO) provides recommendations on the composition of seasonal influenza vaccines for the countries in the southern hemisphere.[73] Based on the WHO recommendation and laboratory data review, the Australian Influenza Vaccine Committee (AIVC) provides advice to the TGA on the strain composition for Australian influenza vaccines, which are then adopted by all vaccine manufacturers. Implications for vaccine composition, of the disappearance since 2020 of the B/Yamagata-lineage, are not yet known.

Vaccination program for seasonal influenza in Australia

Overview of ATAGI recommendations in 2023

ATAGI routinely publishes an annual statement covering clinical advice for immunisation providers on the administration of seasonal influenza vaccines; this includes updates and key changes to available vaccines, timing of vaccination, and eligibility for the National Immunisation Program (NIP)-funded vaccination. This statement is generally published around February–March ahead of the influenza season.

For the 2023 season, several brands of egg- and cell-based IIVs are registered for use in children and adults. Two higher-immunogenicity vaccines, the adjuvanted vaccine and the high-dose vaccine respectively, are available and preferentially recommended over the standard vaccine for people aged ≥ 65 years.[74] Currently, all Australians ≥ 6 months of age are recommended to receive annual influenza vaccine before the influenza season begins. Details on registered influenza vaccines by age are provided in the annual ATAGI statement on influenza vaccine.[74]

Eligibility for the funded influenza vaccination programs

Individuals who are most at risk of serious influenza are eligible for free annual influenza vaccines through the NIP. These eligible people include children aged 6 months to < 5 years, adults aged ≥ 65 years, Aboriginal and Torres Strait Islander peoples aged ≥ 6 months, pregnant women, and people aged ≥ 6 months with specified medical conditions (Appendix A, Table A.2). Jurisdictional based immunisation schemes may also provide funded influenza vaccination to people who are deemed at higher risk or for whom vaccination is recommended to protect at-risk populations in occupational or other settings (e.g. healthcare workers).[75]

Vaccine coverage and priority populations

In 2022, among the Australian population aged ≥ 6 months, influenza vaccine coverage recorded in the Australian Immunisation Register (AIR) was 38.7%. While reported influenza vaccine coverage in the whole population has increased from 26.2% in 2019,[76] coverage in some age groups such as children aged 6 months – 4 years declined in 2021, despite the introduction of mandatory reporting of vaccine administration to the AIR in that year (Figure 1).

Coverage by age group

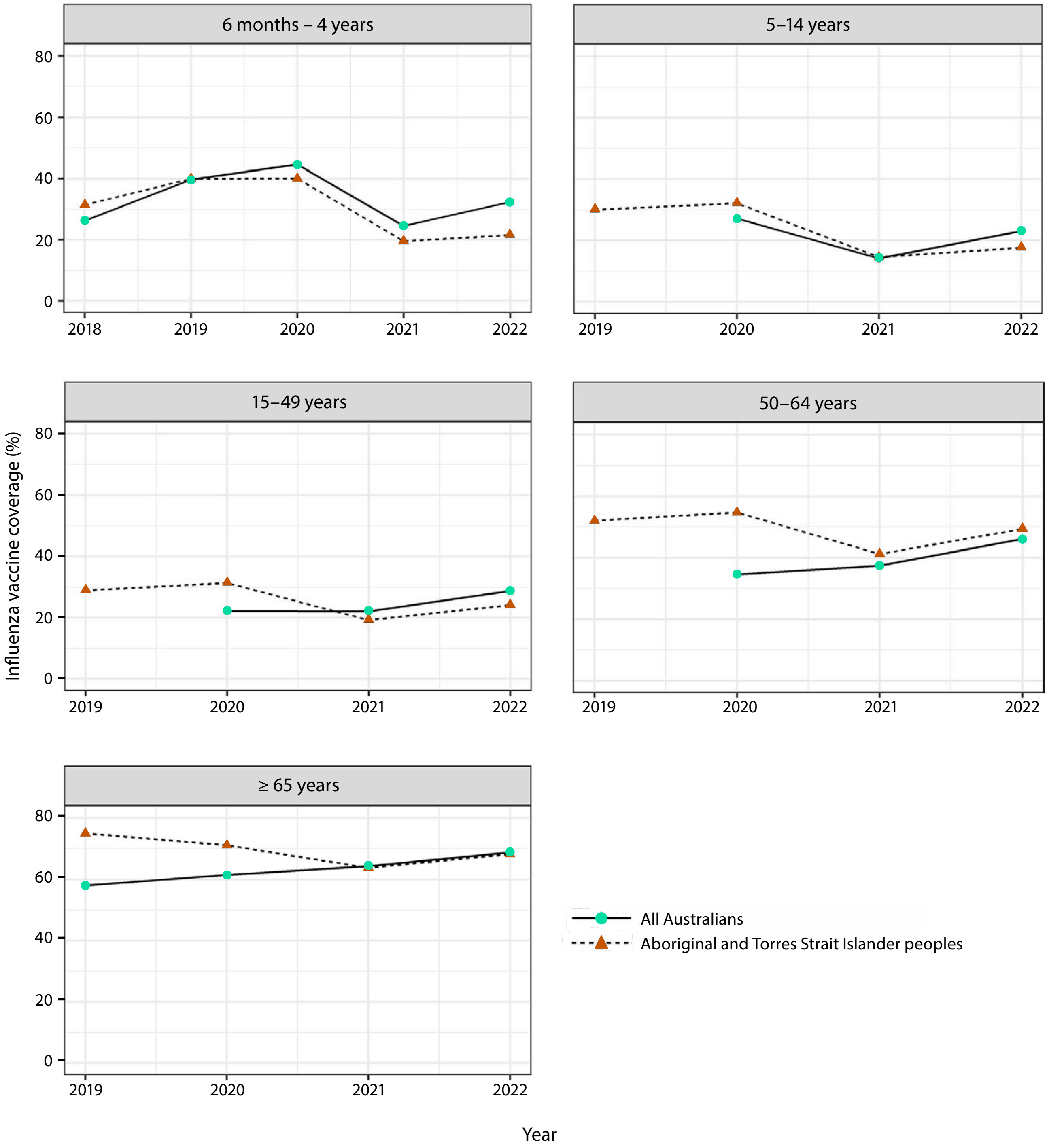
Influenza vaccine coverage in children aged 6 months – 4 years had incremental improvements from below 10% in 2017 to approximately 45% in 2020, with the rollouts of the jurisdictionally based programs in 2018 and NIP in 2019 for all children in the age group.[76,81,82] However, since the coverage drop to 24.5% in 2021, vaccine uptake in young children has not recovered to the pre-pandemic levels.[77]

Conversely, influenza vaccine coverage has been generally high in older adults, particularly among Aboriginal and Torres Strait Islander peoples.[76,81] In 2022, nearly 70% of Australians aged ≥ 65 years had received influenza vaccine.[77]

Coverage in pregnant women

Owing to transplacental transfer of influenza-specific antibodies,[83,84] vaccinating pregnant women also protects their infants (up to age 6 months) from influenza. Young infants are at high risk of influenza-associated hospitalisation, but are too young to be vaccinated themselves.[27,85,86] A recent review of published cohort studies has shown that influenza vaccine coverage in Australian pregnant women did not reach 60% in most contexts, although it was higher (up to 75%) in Western Australia and Victoria in recent years.[87]

Figure 1: Influenza vaccine coverage among various age groups, Australia, 2018–2022[a]



a Sources: references 76–80.

Coverage in people with underlying medical conditions

Influenza vaccination is recommended for people with underlying medical conditions associated with an increased risk of influenza infection and related complications,[38] and the influenza vaccine is available under the NIP for individuals with many of these conditions (Appendix A, Table A.2). In 2013, the list of underlying medical conditions for which seasonal influenza vaccination is recommended was further expanded to include trisomy 21, obesity (defined as a body mass index [BMI] ≥ 30 kg/m^2), and alcoholism. However, these conditions are not currently eligible for NIP-funded influenza vaccines.

Influenza vaccine coverage among people with a medical comorbidity is currently quite poorly reported. However, in FluCAN sentinel hospitals during 2017–2020, influenza vaccine coverage was estimated at 45–50% among adults aged < 65 years with medical comorbidities who were hospitalised during the influenza season.[18–20,88]

Unmet needs and challenges in influenza vaccination in Australia

Remaining challenges in influenza vaccination in Australia

Coverage data

The AIR was only expanded to include adults in late 2016 and has had underreporting issues, particularly among young adults who are more likely to receive non-NIP-funded influenza vaccines in the workplace and non-GP settings.[89] However, with the introduction of the mandatory reporting policy for influenza vaccines that commenced in 2021, and with related initiatives to improve reporting systems,[90] it is anticipated that data completeness of the AIR should improve.

Several factors could also improve the utility of the AIR. Increasing influenza immunisation coverage in populations with increased risk of influenza is a priority to optimise the implementation and maximise the benefits of the funded program. However, some of the priority populations, such as pregnant women and people with underlying medical conditions, are not currently identifiable within the AIR. To better understand coverage and impacts of vaccination programs in these at-risk populations, building capacity to link the AIR to other databases containing information on risk populations should be harnessed to generate timely and consistent coverage estimations that can inform program actions.

Disease burden evaluations

The NNDSS routinely collects laboratory-confirmed influenza cases to guide national policy development and resource allocation, and to monitor the need and impacts of disease control programs. However, NNDSS is based on case surveillance and the absence of denominator data (i.e., the number of tests performed) limits the interpretation of epidemiologic trends. Improvements in case ascertainment over time is an additional challenge in interpreting epidemiologic trends for influenza. There has been an increase in testing frequency for influenza virus, which has likely, to an unknown extent, increased the number of lab-confirmed positive cases notified to NNDSS.[91–93] Incorporating laboratory-negative test data in epidemiological reporting is essential for a better understanding of influenza disease burden in Australian populations.

Vaccination coverage in special populations

Children aged 6 months – 4 years

In Australia, children aged < 5 years have higher rates of laboratory-confirmed influenza and influenza-associated hospitalisations than older age groups.[17] Owing to their key role in the transmission of influenza,[94,95] vaccination in young children provides both direct protection in those vaccinated and indirect protection to other age groups. Additionally, the economic impacts of influenza in young children can be extensive, involving both direct (e.g., hospitalisation) and indirect costs (e.g. productivity losses for parents /communities).[96]

Nonetheless, annual coverage in children aged 6 months – 4 years has been below 45%, with a substantial decline in 2021.[77] Furthermore, coverage data have shown vaccination in young children commencing and peaking several weeks later than in older adults.[80,97] This potentially suggests coverage at the onset of influenza season in young children is poorer, particularly those in tropical areas where influenza season frequently occurs earlier than the delivery of the vaccine program (i.e. March/April).

A better understanding of both the coverage decline since 2021, and of timeliness of vaccination, is required for effective strategies to improve coverage among young children, with the aim to optimise protection in both children and other members of the community.

Aboriginal and Torres Strait Islander peoples

All Aboriginal and Torres Strait Islander peoples aged over 15 years have been eligible to receive the influenza vaccine under the NIP since 2010. From 2015, NIP funding was extended to children aged 6 months – 4 years and from 2019, vaccination under the NIP became available to all Aboriginal and Torres Strait Islander peoples aged ≥ 6 months.[98] Despite this, coverage in the population aged < 65 years remains suboptimal.

Culturally appropriate communication and services to implement vaccination programs tailored for Aboriginal and Torres Strait Islander populations remain limited.[99] To fill the gap during the COVID-19 pandemic, Aboriginal Community Controlled Health Organisations (ACCHOs), a primary health care service operated by local Aboriginal communities, took a leadership role in delivering evidence-based and culturally appropriate translated COVID-19 prevention messages to promote COVID-19 vaccination.[100] Liaising with Aboriginal-led initiatives such as ACCHOs to build culturally appropriate information, resources, and services is essential to improve influenza vaccine uptake in Aboriginal and Torres Strait Islander peoples.

Culturally and linguistically diverse (CALD) Australians

Australia is one of the most multicultural countries in the world, with approximately half of the population having one or more parents born overseas and 30% of Australians reporting a birthplace overseas.[101] People living in Australia from CALD backgrounds are heterogenous; their health needs and outcomes vary considerably. In particular, those from non-English speaking backgrounds who have been settled through humanitarian programs may experience more difficulties in accessing and engaging with health services due to language barriers, cultural differences, and difficulties navigating an unfamiliar system.[102–104] The effect of these barriers has been highlighted in recent years, by lower COVID-19 vaccine uptake and higher COVID-19 related-mortality in CALD communities in Australia.[105–107] Though accurate vaccine coverage estimates in CALD populations are less well understood due to the absence of demographic information in the AIR,[108] surveys report lower influenza vaccination rates in CALD Australian adults, particularly from non-English speaking backgrounds.[109,110]

During the COVID-19 pandemic, extensive strategies were implemented to support the COVID-19 vaccination rollout in CALD communities. These included communication tailored to the diverse characteristics of CALD communities, services in languages other than English, and CALD community engagement to identify issues and address these with culturally appropriate solutions.[111,112] Similar efforts are needed to better understand and report back data for action related to influenza and other vaccine coverage in CALD Australians. This could assist to limit inequity in vaccine uptake and health impacts.

Future strategies to enhance seasonal influenza vaccination programs in Australia

Seasonal annual influenza vaccination is recommended for all Australians aged ≥ 6 months, with NIP-funded vaccines for those who are at elevated risk of severe disease and complications. While coverage in adults aged ≥ 65 years was approximately 70% in 2022, uptake in other age groups, including in those eligible for NIP-funded influenza vaccines, remains suboptimal.

While one approach to facilitate achieving better influenza vaccine uptake is to promote vaccination in the already NIP-eligible populations, other potential strategies include the expansion of NIP-eligibility to everyone aged ≥ 6 months, or to fund vaccine for certain sub-populations who are not currently eligible. In 2020, all jurisdictions introduced funded influenza vaccines for all Australians aged ≥ 6 months; it was estimated that influenza vaccine doses released to the market increased by approximately 30% compared to the previous year.[75,113] Though several factors impacted the increase, the 2020 experience illustrated potentially greater efficiency of broad programs such as those based on age compared to those targeting individuals based on specific conditions, with less confusion about the NIP eligibility criteria. To be considered for inclusion in the NIP, however, a positive recommendation from the Pharmaceutical Benefits Advisory Committee based on clinical and cost-effectiveness assessments is required.[114] Some economic evaluations on vaccination programs have demonstrated favourable results in expanding universal vaccination to specific age groups such as adults aged 50–64 years in Australia.[115,116] In the UK, vaccinating school-aged children (i.e. 2–16 years old) with a live-attenuated vaccine program was identified as the most cost-effective option evaluated, and has been in place in the national influenza vaccination program since the 2013/2014 season.[47,117]

Another important future strategy is to adopt the use of more effective and different types of influenza vaccines when available. This is to harness the advantage of each vaccine, particularly new vaccine technologies, in the national vaccination program. There is increasing evidence showing the significant benefits of new technologies such as high potency, and rapid and inexpensive production. Consideration of newer vaccines should include existing technologies such as for cell-based, RIV, and LAIV, and candidates at advanced stages of development, including mRNA influenza vaccines and combination vaccines for influenza and COVID-19 and/or other respiratory viruses.[118,119] Increasing the availability of different vaccine platforms will provide greater versatility in vaccination strategies to improve vaccine coverage. It also enables the development of manufacturing infrastructure and supply pathways to ensure scale-up is possible in response to emergency situations, such as an influenza pandemic.

Conclusions

Influenza vaccination is recommended in all Australians aged ≥ 6 months and is provided free under the NIP to those who are at risk of complications. However, influenza vaccine coverage in some Australian populations, such as children aged < 5 years, remains suboptimal and continues to be an ongoing challenge. This review highlighted key areas requiring improvement and potential strategies to enhance the influenza vaccination program in Australia. These include the need for improved monitoring and evaluation through utilising relevant linked datasets to better understand uptake in specific population groups, and integration of evidence-based strategies such as culturally appropriate resources to meet the characteristics of diverse Australian populations. Additionally, expansion of the NIP-eligible population, where cost-effective, and adopting the use of more effective and different types of vaccines, when available, could be potential strategies to help achieve higher vaccine coverage in Australia.

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Appendix A: Supplementary material

Table A.1: Vaccine compositions, circulating strains, and estimated vaccine effectiveness (VE) in Australia, by year, 2016–2022

Year	Ref.	Vaccine composition		Circulating strains[a]	Overall estimated VE (95% CI)	
		Egg-based	Cell-based		Hospitalisation (FluCAN)	GP visits (ASPREN)
2022	21	A/Victoria/2570/2019 (H1N1)pdm09-like virus	A/Wisconsin/588/2019 (H1N1)pdm09-like virus	A(H1N1) pdm09	52% (39–62%)[b]	NA
		A/Darwin/9/2021 (H3N2)-like virus	A/Darwin/6/2021 (H3N2)-like virus	A(H3N2)		
		B/Austria/1359417/2021 (B/Victoria lineage)-like virus	B/Austria/1359417/2021-like (B/Victoria lineage) virus	B/Victoria lineage		
		B/Phuket/3073/2013-(B/Yamagata lineage) like virus	B/Phuket/3073/2013-like (B/Yamagata lineage) virus			
2021[c]	120	A/Victoria/2570/2019 (H1N1)pdm09-like virus	A/Victoria/2570/2019 (H1N1)pdm09-like virus	A(H1N1) pdm09	Not estimated[c]	Not estimated[c]
		A/Hong Kong/2671/2019 (H3N2)-like virus	A/Hong Kong/2671/2019 (H3N2)-like virus	A(H3N2)		
		B/Washington/02/2019 (B/Victoria lineage)-like virus	B/Washington/02/2019 (B/Victoria lineage)-like virus	B/Victoria lineage		
		B/Phuket/3073/2013 (B/Yamagata lineage)-like virus	B/Phuket/3073/2013 (B/Yamagata lineage)-like virus			
2020[c]	121	A/Brisbane/02/2018 (H1N1)pdm09-like virus	A/Brisbane/02/2018 (H1N1)pdm09-like virus	A(H1N1) pdm09	Not estimated[c]	Not estimated[c]
		A/South Australia/34/2019 (H3N2)-like virus	A/South Australia/34/2019 (H3N2)-like virus	A(H3N2)		
		B/Washington/02/2019-like (B/Victoria lineage) virus	B/Washington/02/2019-like (B/Victoria lineage) virus	B/Victoria lineage		
		B/Phuket/3073/2013-like (B/Yamagata lineage) virus		B/Yamagata lineage		
2019	18 122–124	A/Michigan/45/2015 (H1N1)pdm09-like virus	A/Michigan/45/2015 (H1N1)pdm09-like virus	A(H1N1) pdm09	42% (36–49%)	46% (36–55%)
		A/Switzerland/8060/2017 (H3N2)-like virus	A/Switzerland/8060/2017 (H3N2)-like virus	**A(H3N2)**		
		B/Colorado/06/2017-like virus (B/Victoria/2/87 lineage)		B/Victoria lineage		
		B/Phuket/3073/2013-like virus (B/Yamagata/16/88 lineage)	B/Phuket/3073/2013-like (B/Yamagata/16/88 lineage)	B/Yamagata lineage		
2018	19 125 126	A/Michigan/45/2015 (H1N1)pdm09-like virus	A/Michigan/45/2015 (H1N1)pdm09-like virus	**A(H1N1) pdm09**	52% (37–63%)	68% (45–82%)
		A/Singapore/INFIMH-16-0019/2016 (H3N2)-like virus	A/Singapore/INFIMH-16-0019/2016 (H3N2)-like virus	A(H3N2)		
		B/Phuket/3073/2013-like virus		B/Victoria lineage		
		B/Brisbane/60/2008-like virus	B/Phuket/3073/2013-like virus	B/Yamagata lineage		

Year	Ref.	Vaccine composition		Circulating strains[a]	Overall estimated VE (95% CI)	
		Egg-based	Cell-based		Hospitalisation (FluCAN)	GP visits (ASPREN)
2017	88 127–129	A/Michigan/45/2015 (H1N1)pdm09-like virus A/Hong Kong/4801/2014 (H3N2)-like virus B/Brisbane/60/2008-like virus (Victoria lineage) B/Phuket/3073/2013-like virus (Yamagata lineage)	NA	A(H1N1) pdm09 **A(H3N2)** B/Victoria lineage B/Yamagata lineage	23% (7–36%)	33% (17–46%)[d]
2016	130–133	A/California/7/2009 (H1N1)pdm09-like virus A/Hong Kong/4801/2014 (H3N2)-like virus B/Brisbane/60/2008-like virus (Victoria lineage) B/Phuket/3073/2013-like virus (Yamagata lineage)	NA	**A(H1N1) pdm09** **A(H3N2)** B/Victoria lineage B/Yamagata lineage	13% (-5–27%)	40% (18–56%)[d]

a Dominant strains in bold font.

b Data provided by FluCAN.

c Data for dominant strains and VE were unavailable due to limited laboratory-confirmed cases.

d VE estimated based on interim data.

Table A.2: Specified medical conditions associated with increased risk of influenza and serious complications[a,b]

Funding category	Medical category	Medical conditions
Funded under the NIP	Cardiac disease	Cyanotic congenital heart disease
		Congestive heart failure
		Coronary artery disease
	Chronic respiratory conditions	Severe asthma[c]
		Cystic fibrosis
		Bronchiectasis
		Suppurative lung disease
		Chronic obstructive pulmonary disease
		Chronic emphysema
	Chronic neurological conditions	Hereditary and degenerative CNS diseases
		Seizure disorders
		Spinal cord injuries
		Neuromuscular disorders
	Immunocompromising conditions	Haematopoietic stem cell transplant
		Malignancy
		Chronic steroid use
		Solid organ transplant
		HIV infection
	Functional or anatomical asplenia	Sickle cell disease or other haemoglobinopathies
		Congenital or acquired asplenia (for example, splenectomy) or hyposplenia
	Chronic metabolic disorders	Type 1 or 2 diabetes
		Amino acid disorders
		Carbohydrate disorders
		Cholesterol biosynthesis disorders
		Fatty acid oxidation defects, lactic acidosis
		Mitochondrial disorders
		Organic acid disorders
		Urea cycle disorders
		Vitamin/cofactor disorders
		Porphyria
	Chronic renal failure	
	Long-term aspirin therapy in children aged 5 to 10 years	
Not funded under the NIP	Chronic liver disease	
	Down syndrome	
	Obesity (body mass index ≥30 kg per m^2)	
	Children born less than 37 weeks gestation	
	Harmful use of alcohol	

a People with these conditions are recommended to receive influenza vaccination every year.

b Source: reference 2.

c Defined as requiring frequent medical consultations or the use of multiple medicines.