NCIRS National Centre for Immunisation Research and Surveillance Australia

Exploratory analysis of the first 2 years of adult vaccination data recorded on AIR

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Glossary

ACIR – Australian Childhood Immunisation Register
ACT – Australian Capital Territory
AIR – Australian Immunisation Register
ARIA++ – Accessibility/Remoteness Index of Australia
CATI – computer assisted telephone interviewing
dTpa – diptheria-tetanus-acellular pertussis
DHS – Department of Human Services
GP – general practice
MMR – measles-mumps-rubella
NCIRS – National Centre for Immunisation Research and Surveillance
NIP – National Immunisation Program
NSW – New South Wales
NT – Northern Territory
PHN – Primary Health Network
QIV – quadrivalent influenza vaccine
QLD – Queensland
SA – South Australia
SEIFA – Socio-Economic Indexes for Areas
TAS – Tasmania
TIV – trivalent influenza vaccine
23vPPV – 23-valent pneumococcal polysaccharide vaccine
VIC – Victoria

Executive summary

Background

The Australian Immunisation Register (AIR) was established on 1 October 2016, incorporating demographic data from Medicare on people of all ages in Australia. This was an expansion of the Australian Childhood Immunisation Register (ACIR), which was created in 1996 and held data only for children aged <7 years. The National Centre for Immunisation Research and Surveillance (NCIRS) has published 11 national annual immunisation coverage reports using data from the ACIR. The expanded 'whole-of-life' AIR has created potential to similarly analyse and report on vaccination coverage in adults. This is particularly important given the very limited data available on vaccination coverage in adults, which suggests inadequate uptake for certain vaccines. NCIRS conducted an exploratory analysis of adult vaccination data for selected vaccines recorded on AIR for the first 2 years of its establishment (October 2016 – September 2018). This research aims to inform continuous improvement of AIR data to evaluate the National Immunisation Program (NIP) outcomes and to provide improved information and feedback to providers and patients.

Methods

Our analysis was exploratory in nature because of factors such as availability of data for only 2 years spanning three calendar years; anticipated underreporting; lack of established methods for analysis of adult data; and higher proportion of vaccinations given in non-NIP and non–general practice (GP) provider settings compared with those for children. We used a cross-sectional study design to analyse adult data recorded on AIR between 1 October 2016 and 30 September 2018, focusing on zoster vaccine, influenza vaccine and pneumococcal polysaccharide vaccine (23vPPV), by year, age group, Aboriginal and Torres Strait Islander (hereafter referred to respectfully as Indigenous) status and jurisdiction. We also compared the AIR vaccination data with vaccine dose distribution data and computer assisted telephone interviewing (CATI) survey data, where available. Results of analysis and discussion are outlined below by vaccine.

Results

Influenza

The proportion of adults aged ≥18 years recorded on AIR as having received a dose of influenza vaccine increased from 11.5% in 2017 to 18.8% in 2018. Recorded uptake was highest in the ≥65 years age group at 31.5% in 2017 and 46.3% in 2018. Recorded uptake was substantially higher in Indigenous adults than in non-Indigenous adults – three times higher in the 18–<65 years age groups in which all Indigenous people are eligible for NIP-funded vaccine, and 64.9% for those aged ≥65 years in 2018. In 2018, two brands of enhanced immunogenicity trivalent influenza vaccine (TIV) (Fluzone® High-Dose and Fluad®) were available on the NIP for adults aged ≥65 years. Of adults aged ≥65 years recorded on AIR as having received an influenza vaccine in 2018, 92.6% received a dose of enhanced TIV, with 7.0% receiving a dose of quadrivalent influenza vaccine (QIV).

These influenza vaccination uptake figures likely substantially underestimate true uptake. Uptake in adults aged ≥65 years from previous national surveys has been around 70% or greater. We found dose distribution data to be more readily interpretable for enhanced TIV, as in 2018 enhanced TIV was used predominantly in the NIP, than QIV, which is routinely used in the private market in large numbers. The number of enhanced TIV doses recorded on AIR was 44% lower than the number distributed under the NIP (1 909 959 versus 3 409 705, i.e. 1 499 746 not accounted for), representing substantial underreporting even after accounting for doses not used or disposed of. In NSW, a CATI survey estimated that influenza vaccine uptake in adults aged ≥65 years in 2017 was 72.6% compared with our calculated figure of 31.5%. Estimation of influenza uptake is likely even less accurate in younger adults because of under-reporting of influenza vaccinations administered in workplaces, pharmacies and other non-GP immunisation settings that are known to not yet transfer data to AIR.

Zoster

Approximately 2 years after the implementation of the national zoster immunisation program, 31.2% of adults aged 70–<80 years were recorded on AIR as vaccinated at some point over the 1 October 2016 – 30 September 2018 period. The proportion was higher for Indigenous adults (36.7%) than for non-Indigenous adults (31.1%). AIR data show that zoster vaccination uptake peaked in May in both 2017 and 2018, likely because of older adults presenting to providers for influenza vaccination. Recorded zoster vaccination uptake in 2017 was 25.7% in adults aged 70 years and 19.2% in the catch-up cohort (71–<80 years). In the first 9 months of 2018, recorded vaccination uptake in the 70-year-olds age group was 22.1%, suggesting likely higher uptake than in 2017 if all 2018 data were available for analysis. Recorded uptake in 2018 was substantially lower in the 71–<80-year-olds age group at 6.8%, reflecting the decreasing pool of unvaccinated individuals in the catch-up cohort over time.

True zoster vaccine uptake in Australia is likely to be considerably higher than the figures presented here, given that the number of zoster vaccine doses recorded on AIR was approximately half the number of doses distributed under the NIP over the study period. It is not possible to determine the exact level of underreporting as an unknown proportion of doses will not have been administered over the study period for a range of reasons (stock not distributed e.g. retained by manufacturers, health departments

and immunisation providers; disposal due to cold chain breaches). Given that over 90% of zoster vaccine doses recorded on AIR were in the target age group (adults aged 70–<80 years), it is likely that these represent largely NIP-funded vaccine.

Despite the substantial under-reporting of zoster vaccination on AIR, the zoster vaccine cumulative uptake of 31.2% recorded on AIR in our study is similar to that reported from the United States of America (USA), where vaccine has been recommended since 2006 and reporting is likely more accurate. In England and Wales, where a program began in 2013 and reporting is also likely more accurate, cumulative uptake reached 55–65% in 2015–16.

Pneumococcal polysaccharide vaccine

Vaccination uptake for 23vPPV was not calculated because of the complexity of recommendations by age, Indigenous status, presence of at-risk medical conditions and the short duration of data available on the register, noting 23vPPV is only recommended every 5 years, even in target populations. The number of doses given, as recorded on AIR, peaked in May in both 2017 and 2018, as with zoster vaccination, suggesting that attendance for seasonal influenza vaccination prompts concomitant zoster and pneumococcal vaccination. In all jurisdictions except the Northern Territory (NT), the highest number of doses recorded was administered to adults aged ≥65 years. A much higher percentage of doses recorded was given to younger adults in the NT, likely because of the high proportion of the Northern Territory's population that are Indigenous and the prevalence of risk factors for pneumococcal disease. The number of 23vPPV doses recorded on AIR as administered to adults between 1 January 2017 and 30 September 2018 was approximately 40% lower than the number of doses distributed under the NIP, suggesting substantial underreporting.

Conclusions

In this analysis of AIR data, higher levels of vaccination uptake were recorded in Indigenous people, for both influenza and zoster vaccines. We found considerable geographic variation in vaccine uptake at both state/territory and primary health network (PHN) levels, which may reflect true differences in uptake and/or differences in completeness of reporting. The vaccination uptake figures presented in this report substantially underestimate true uptake, with major gaps identified between doses distributed and doses recorded on AIR.

While it is difficult to definitively assess the level of underreporting, true uptake in adults could be up to double that recorded on AIR, depending on vaccine, age group and Indigenous status, and potentially even greater for vaccines not on the NIP schedule. AIR data completeness would be expected to improve over time as GP practice management software packages are updated and as registration and transfer of data from non-GP provider groups expands.

It will be important to continue to engage with providers to facilitate timely and effective reporting to AIR and to monitor and assess the completeness of adult vaccination data over time. This will help better inform vaccine projections, purchasing, delivery and program performance, and analyses of vaccine effectiveness and safety. It will be important to provide feedback on the completeness of data to all relevant stakeholders to drive ongoing improvement, particularly given the lack of specific incentives (other than professionalism and consumer-driven demand) for immunisation providers to report adult vaccinations to AIR.

Introduction

The Australian Immunisation Register (AIR) was established on 1 October 2016, incorporating demographic data from Medicare on people of all ages in Australia.[1] This was an expansion of the Australian Childhood Immunisation Register (ACIR), which was created in 1996, and held data only for children aged under 7 years.[2] The National Centre for Immunisation Research and Surveillance (NCIRS) has published 11 national annual immunisation coverage reports using data from the ACIR.[3–12] The expanded 'whole-of-life' AIR has created potential to similarly analyse and report on vaccination coverage in adults.[1] This is particularly important given the very limited data available to date on vaccination coverage in adults,[13–15] which suggests inadequate uptake for certain vaccines,[16] and the continuing addition of new vaccines for adults to the National Immunisation Program (NIP) (refer to Box 1 for vaccines funded under the NIP for adults in 2018).

The National Shingles Vaccination Program for the elderly using Zostavax® was introduced in November 2016, and an evaluation conducted by NCIRS indicated significant underreporting of doses administered to the register.[17] In July 2018, diptheria-tetanus-acellular pertussis (dTpa) was funded under the NIP for all women during the third trimester of pregnancy.[18] Pneumococcal polysaccharide vaccine has been funded since 1999 for all Indigenous adults aged ≥50 years or <50 years with specified medical conditions and since 2005 for all adults aged ≥65 years.[19] Seasonal influenza vaccine has been funded under the NIP since 1999 for all adults aged ≥65 years, Indigenous adults aged ≥50 years or <50 years with specified medical conditions, and since January 2010 for pregnant women, all adults with specified medical conditions and all Indigenous adults.[20] In 2018 two enhanced immunogenicity trivalent influenza vaccines (Fluzone® High-Dose and Fluad®) were added to the NIP specifically for adults aged ≥65 years.[20]

Box 1. Vaccines funded for adults (≥18 years of age) under NIP in 2018

Age	Vaccine			
<50 years			Flu[a]	23vPPV[b]
≥50 years			Flu[a]	23vPPV[b]
≥65 years			Flu[a]	23vPPV[b]
Pregnant women (any age)	dTpa[c]		Flu[d]	
70 years		HZ[e]		
71–79 years		HZ[e]		

[a]Annual vaccination – all Indigenous; all adults with medical risk factors; all non-Indigenous adults aged ≥65 years.
[b]All Indigenous adults with medical risk factors (2–3 doses 5 years apart, depending on whether 23vPPV received as child); Indigenous adults aged ≥50 years without medical risk factors (2 doses 5 years apart); all non-Indigenous adults aged ≥65 years (1 dose if no medical risk factors; 2–3 doses 5 years apart if risk factors, depending on whether 23vPPV received as child).
[c]During the third trimester of pregnancy.
[d]At any stage of pregnancy.
[e]A single dose of herpes zoster (HZ) vaccine is funded for adults aged 70 years (with a 5-year catch up for 71–79-year-olds until 2021) who have not previously received a dose of HZ vaccine.

Ideal vaccination registers have been defined as confidential, centralised, population-based, electronic information systems containing core individual-level information on the population, together with information on vaccination status reported by providers of vaccination,[21] noting these are usually developed for childhood vaccination programs. Worldwide, countries with centralised, 'whole of life', population-based vaccination registers which collect vaccination information for people of all ages include Finland,[22] Norway,[23] Denmark, Iceland, Malta[24] and Australia. In New Zealand, the National Immunisation Register records information on some adult vaccines given in general practices and pharmacies.[25] Previously, surveys in Australia using CATI methods have also been undertaken which either wholly or partly focused on collection of self-reported immunisation data for older age groups. In New South Wales (NSW), an ongoing CATI survey[26] has provided annual estimates of self-reported influenza (and pneumococcal polysaccharide up to 2016) vaccine uptake in adults aged ≥65 years, but no such survey has been undertaken at national level since 2014.[13]

Under its funding agreement with the Australian Government Department of Health (Health), NCIRS conducted an exploratory analysis of adult vaccination data for selected vaccines recorded on AIR covering the first 2 years of its establishment (October 2016 – September 2018). This research aims to inform continuous improvement of AIR coverage data to evaluate NIP outcomes and to provide improved information and feedback to providers and patients.

Methods

Our analysis was exploratory in nature because of factors such as availability of only 2 years of data spanning three calendar years; anticipated underreporting; lack of established methods for analysis of adult data; higher proportion of vaccinations given in non-NIP and non-traditional provider settings compared with that for children; and lack of availability of data such as pregnancy and presence of medical conditions on AIR.

Vaccines examined

We used a cross-sectional study design to examine selected vaccine doses recorded on AIR for adults (approximately 20 600 000 in total) by vaccine type and age group as follows:

- zoster vaccine: 18–<50, 50–<60, 60–<70, 70–<71, 71–<80 and 80+ years
- influenza vaccine: 18–<50, 50–<65 and ≥65 years
- pneumococcal polysaccharide vaccine (23vPPV): 18–<50, 50–<65 and ≥65 years.

More limited exploratory analysis of data for non-NIP adult vaccines (including measles, mumps and rubella [MMR] and diphtheria, tetanus, and acellular pertussis [dTpa] vaccines) was also undertaken for comparison purposes.

AIR data analysis

NCIRS downloads de-identified AIR data from the Australian Government Department of Human Services (DHS) secure server for analyses under our funding agreement with Health. All people registered with Medicare are automatically added to AIR, and those not registered with Medicare can be added to AIR via a supplementary number when they have received one or more vaccines.

Using AIR data as at 31 December 2018, we calculated the number of vaccine doses recorded by month and calendar year over the 2-year period from the establishment of AIR on 1 October 2016 to 30 September 2018. This allows for a 3-month lag period for vaccinations given at the end

of the 2-year study period to be lodged and processed on AIR. Using these dose data, annual vaccination uptake (the proportion vaccinated in the relevant calendar year or part thereof) was calculated at national/jurisdictional/PHN level for influenza and zoster vaccines in relevant age groups, as the number of doses recorded in the age group on AIR divided by the number of adults in the age group registered on the AIR, multiplied by 100. We also calculated annual age-specific zoster and influenza vaccination uptake by Indigenous status, gender, provider type, remoteness (using the Accessibility/Remoteness Index of Australia [ARIA++] system)[27] and socio-economic status of area of residence[28] at the national level. For the enhanced immunogenicity trivalent influenza vaccines (TIV) only, we also examined vaccination uptake by vaccine brand. Summary aggregate data are presented by frequency and/or proportions. For zoster vaccine only, we also calculated cumulative uptake (i.e. the proportion vaccinated at some point over the 2-year period) in adults aged 70–<80 years at national level using the 'cohort method'.[29]

Data analysis was conducted using Version 9.4 of SAS Institute Inc. statistical software.[30]

Indigenous status

Indigenous status on AIR is recorded as 'Indigenous', 'non-Indigenous' or 'unknown' on the basis of self-identification to Medicare. The 1.8% of adults whose Indigenous status was not specified were classified as non-Indigenous for the purposes of our analysis.

Remoteness of area of residence

Area of residence was defined as 'Major cities', 'Inner regional', 'Outer regional', 'Remote' and 'Very remote' using ARIA++.[27] For analysis in this report, we combined the two 'Regional' categories ('Inner Regional' and 'Outer Regional') into one category and the two 'Remote' categories ('Remote' and 'Very Remote') into one category. ARIA Accessibility/Remoteness category was assigned using AIR-recorded residential postcode.

Socioeconomic status

To assess vaccination activity by socioeconomic status we used the Australian Bureau of Statistics Socio-Economic Indexes for Areas (SEIFA) Index of Education and Occupation,[28] also assigned using recorded postcode of residence on AIR.

Ethics approval

Ethics approval was not required, as de-identified, population-based, administrative data were used for routine public health surveillance purposes, under contract and with approval of Health.

Comparison of AIR vaccination data with other data, including vaccine dose distribution data and CATI survey data

To assess the level of under-reporting of doses administered to AIR, including by jurisdiction, vaccine type and provider type, we sought information on zoster, influenza and pneumococcal polysaccharide vaccine doses from:

- Health, on doses distributed under the NIP, by jurisdiction and vaccine type/brand
- states and territories, on doses distributed by provider type and vaccine type/brand.

Where possible, we also compared influenza and pneumococcal vaccine uptake in adults as recorded on AIR, with published data from CATI surveys assessing self-reported vaccination coverage in similar age groups over a similar time period.

Results

Influenza

Overall

The total number of adults aged 18–<65 years and ≥65 years recorded on AIR as having received a dose of influenza vaccine during the period 1 January 2017 to 30 September 2018 is shown by month of vaccine administration in Figure 1. In 2017, 11.5% of adults aged ≥18 years were recorded on AIR as having received a dose of influenza vaccine, with numbers highest in April (n = 369 383 for adults aged 18–<65 years and n = 663 294 for adults aged ≥65 years). In 2018, recorded doses increased substantially, with 18.8% of adults aged ≥18 years receiving a dose of influenza vaccine, with numbers highest in May (n = 960 534 for adults aged 18–<65 years and n = 1 115 239 for adults aged ≥65 years) (refer to Figure 1).

National vaccination uptake of at least one dose of influenza vaccine recorded on AIR increased progressively with age. In 2017, recorded uptake was 4.8% for people aged 18–<50 years, 10.5% for those aged 50–<65 years and 31.5% for those aged ≥65 years (refer to Table 1), increasing in each of these age groups in 2018 to 8.9%, 17.2% and 46.3%, respectively (refer to Table 2).

In 2018, two enhanced immunogenicity TIVs (Fluzone® High-Dose and Fluad®) were registered for use in adults aged ≥65 years and were available on the NIP for this age group. Of the 2 014 301 adults aged ≥65 years recorded on AIR as having received an influenza vaccine in 2018, 92.6% received an enhanced immunogenicity TIV compared with 7.0% recorded as having received the standard quadrivalent influenza vaccine (QIV), and only 0.4% as having received both (data not shown). Of the 1 909 959 doses of enhanced TIV recorded on AIR in 2018 as administered to adults aged ≥18 years, 1 874 350 (98.1%) doses were given to those aged ≥65 years, around half of which were Fluzone® High-Dose (n = 900 209, 48%) and half Fluad® (n = 974 141, 52%) (refer to Table 3). A small proportion of the doses of enhanced

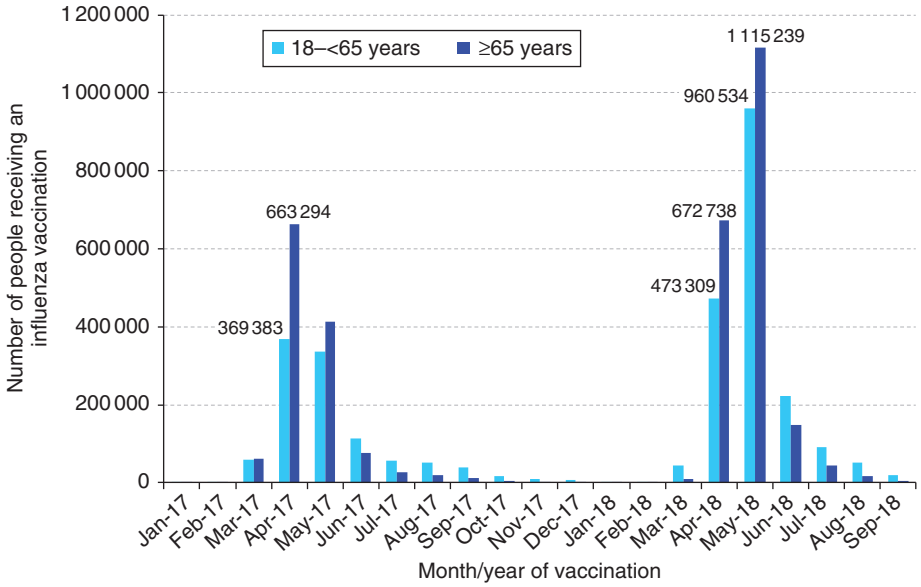

Figure 1. Adult influenza vaccine doses recorded by age at dose and month administered, Australia, 1 January 2017 to 30 September 2018.

Source: Australian Immunisation Register, data as at 31 December 2018.

Table 1. Influenza vaccination uptake[a] recorded by age at dose, Indigenous status and jurisdiction, Australia, 1 January 2017 to 31 December 2017

Jurisdiction	Age at dose								
	18–<50 years (%)			50–<65 years (%)			≥65 years (%)		
	Indigenous	All adults	Indigenous: Non-Indigenous uptake ratio	Indigenous	All adults	Indigenous: Non-Indigenous uptake ratio	Indigenous	All adults	Indigenous: Non-Indigenous uptake ratio
ACT	5.3	4.1	1.3	17.1	8.6	2.0	30.3	33.0	0.9
NSW	9.5	3.7	2.7	25.1	8.5	3.0	37.9	26.8	1.4
VIC	11.6	5.3	2.2	26.9	10.9	2.5	38.2	29.1	1.3
QLD	13.9	5.6	2.6	32.1	13.5	2.4	46.8	40.5	1.2
SA	9.9	5.1	2.0	24.4	10.8	2.3	35.1	31.8	1.1
WA	12.3	4.2	3.1	25.0	8.6	3.0	37.6	33.5	1.1
TAS	13.9	5.7	2.6	33.2	13.1	2.6	50.4	38.4	1.3
NT	41.6	14.8	6.7	48.2	16.0	4.7	49.2	28.7	1.9
AUSTRALIA	15.3	4.8	3.4	29.9	10.5	2.9	40.7	31.5	1.3

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2017).
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

immunogenicity TIV recorded on AIR as administered to adults in 2018 was recorded as given to adults aged 18–<65 years (1.9%, $n = 35\,589$), representing 0.6% ($n = 5737$) of all influenza-vaccinated adults aged 18–<50 years and 3.5% ($n = 29\,852$) of vaccinated adults aged 50–<65 years (data not shown). In 2018, 725 doses of enhanced immunogenicity TIV were recorded on AIR as given to children aged 6 months–<18 years (data not shown), which may represent either administration error (i.e. vaccine given to an inappropriate age recipient) or data recording error.

Indigenous status

Recorded influenza vaccination uptake in 2017 for Indigenous adults aged 18–<50 years, 50–<65 years and ≥65 years was 15.3%, 29.9% and 40.7%, respectively, substantially higher than that for non-Indigenous adults for each age group (refer to Table 1). In 2018, recorded uptake increased substantially for both Indigenous and non-Indigenous adults in each age group (refer to Table 2), remaining higher for Indigenous adults. The ratio of Indigenous to

Table 2. Influenza vaccination uptake[a] recorded by age at dose, Indigenous status and jurisdiction, Australia, 1 January 2018 to 30 September 2018

Jurisdiction	Age at dose								
	18–<50 years (%)			50–<65 years (%)			≥65 years (%)		
	Indigenous	All adults	Indigenous: Non-Indigenous uptake ratio	Indigenous	All adults	Indigenous: Non-Indigenous uptake ratio	Indigenous	All adults	Indigenous: Non-Indigenous uptake ratio
ACT	10.1	7.9	1.3	27.3	14.1	1.9	52.2	50.3	1.0
NSW	17.6	8.1	2.2	42.0	15.4	2.8	57.8	42.7	1.4
VIC	23.5	10.0	2.4	54.1	18.9	2.9	79.1	45.7	1.7
QLD	20.8	9.2	2.4	43.3	18.7	2.4	58.8	51.9	1.1
SA	15.1	8.2	1.9	34.8	16.4	2.1	49.7	45.9	1.1
WA	16.0	7.5	2.2	33.7	16.1	2.1	48.4	47.1	1.0
TAS	20.8	10.9	2.0	47.9	23.2	2.1	67.4	57.1	1.2
NT	45.3	16.2	6.7	57.7	18.7	5.0	61.6	30.6	2.3
AUSTRALIA	22.0	8.9	2.6	44.7	17.2	2.7	64.9	46.3	1.4

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2018).
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table 3. Number and proportion of enhanced immunogenicity trivalent influenza vaccine doses recorded in adults aged ≥65 years, by Indigenous status, brand and jurisdiction, Australia, 1 January 2018 to 30 September 2018

Jurisdiction	Indigenous			Non-Indigenous			All Adults		
	Enhanced trivalent vaccine doses (n)	Fluzone® High Dose (%)	Fluad® (%)	Enhanced trivalent vaccine doses (n)	Fluzone® High Dose (%)	Fluad® (%)	Enhanced trivalent vaccine doses (n)	Fluzone® High Dose (%)	Fluad® (%)
ACT	103	52.4	47.6	29 880	51.6	48.4	29 983	51.6	48.4
NSW	5477	44.9	55.1	572 456	49.1	50.9	577 933	49.0	51.0
VIC	10 118	55.3	44.7	448 079	49.0	51.0	458 197	49.1	50.9
QLD	4721	35.4	64.6	410 497	46.0	54.0	415 218	45.9	54.1
SA	660	43.5	56.5	145 702	48.2	51.8	146 362	48.2	51.8
WA	1367	51.3	48.7	177 495	48.3	51.7	178 862	48.3	51.7
TAS	819	40.2	59.8	60 012	46.9	53.1	60 831	46.8	53.2
NT	1304	0.6	99.4	5660	3.1	96.9	6964	2.7	97.3
AUSTRALIA	24 569	45.2	54.8	1 849 781	48.1	51.9	1 874 350	48.0	52.0

ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

non-Indigenous recorded uptake varied substantially by jurisdiction of residence, from around two-fold to more than five-fold higher in people aged <65 years, but less so in those aged ≥65 years, in both 2017 (refer to Table 1) and 2018 (refer to Table 2).

In 2018, uptake of influenza vaccine recorded on AIR was greatest from late April to late May across all age groups for both Indigenous adults (refer to Figure 2) and non-Indigenous adults (refer to Figure 3), with about two-thirds of adults vaccinated by the end of May.

In 2018, enhanced immunogenicity TIV was recorded as given to 84.5% of influenza-vaccinated Indigenous adults aged ≥65 years compared with 92.8% of their non-Indigenous counterparts (refer to Figure 4), with standard QIV given to 15.1% and 6.9%, respectively; less than 0.5% were recorded as having received both vaccines (data not

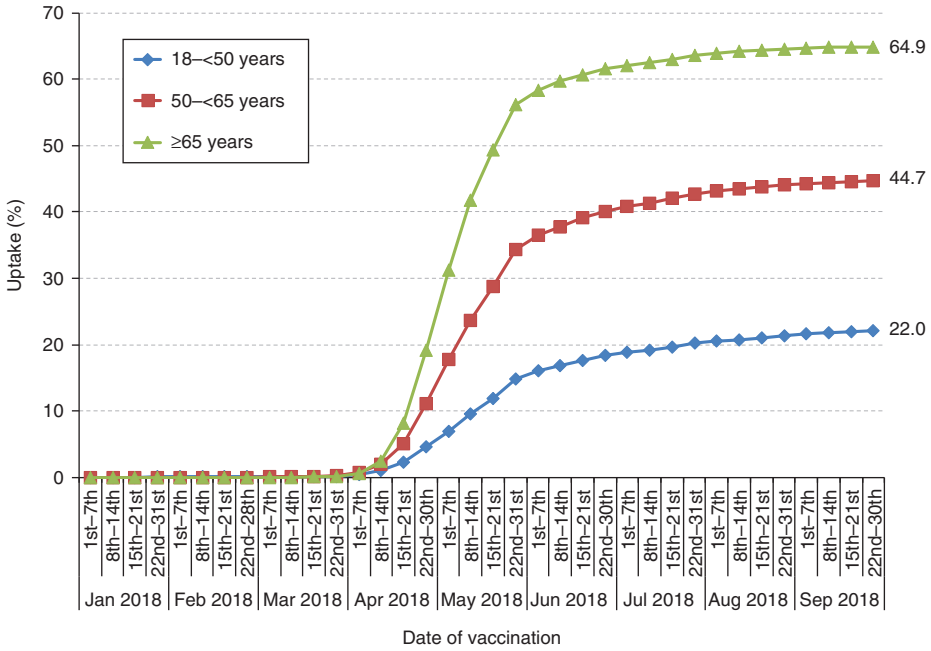

Figure 2. Recorded cumulative uptake[a] of at least one dose of influenza vaccine for Indigenous adults by age at dose, Australia, 1 January 2018 to 30 September 2018.

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2018).

Source: Australian Immunisation Register, data as at 31 December 2018.

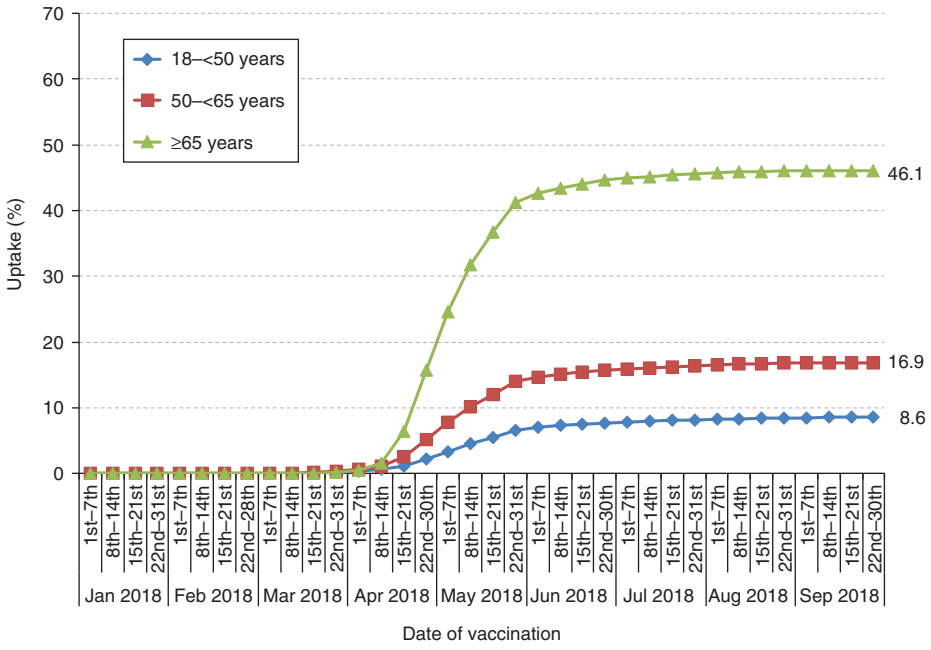

Figure 3. Recorded cumulative uptake[a] of at least one dose of influenza vaccine for non-Indigenous adults by age at dose, Australia, 1 January 2018 to 30 September 2018.

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2018).

Source: Australian Immunisation Register, data as at 31 December 2018.

shown). At the jurisdictional level, the proportion of influenza-vaccinated Indigenous and non-Indigenous adults aged ≥65 years who received an enhanced immunogenicity TIV in 2018 ranged from 67.8% in the NT (where they only received supplies of Fluad® and then ran out of these, necessitating use of QIV – personal

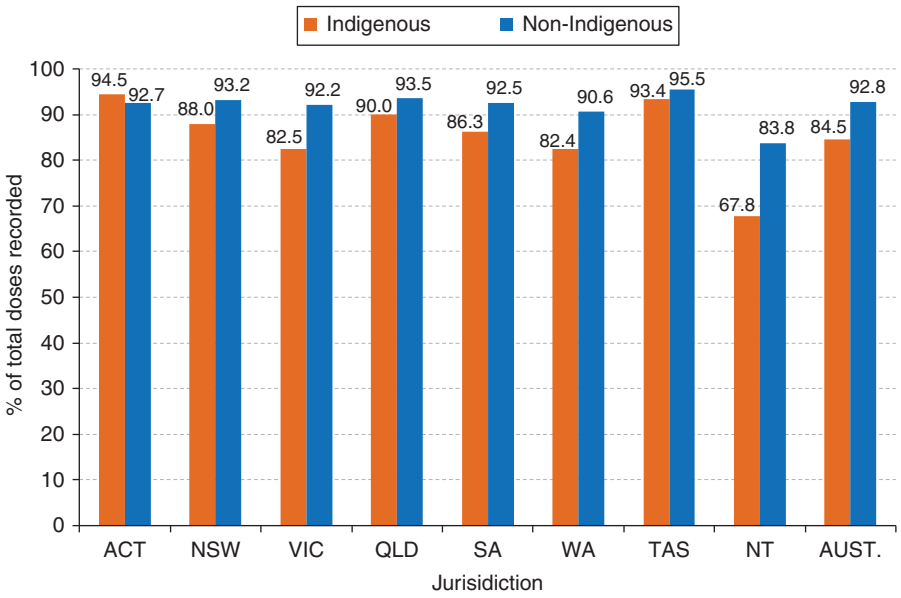

Figure 4. Proportion[a] of influenza-vaccinated adults aged ≥65 years recorded as having received a dose of enhanced immunogenicity trivalent influenza vaccine, by Indigenous status and jurisdiction, Australia, 1 January 2018 to 30 September 2018.

[a]Calculated as number of adults aged ≥65 years with an enhanced immunogenicity trivalent influenza vaccine dose recorded in 2018 ÷ total number of adults aged ≥65 years with at least one influenza vaccine dose recorded in 2018 x 100 (age calculated as at 31 December 2018). ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.

Source: Australian Immunisation Register, data as at 31 December 2018.

communication Rosalind Webby, May 2019) to 94.5% in the Australian Capital Territory (ACT) for Indigenous adults, and from 83.8% in the NT to 95.5% in Tasmania for non-Indigenous adults (refer to Figure 4).

The proportion of adults recorded as vaccinated with an enhanced immunogenicity TIV brand is shown in Table 3. The most notable difference was in the NT, where 97.3% of vaccinated adults aged ≥65 years received Fluad® (refer to Table 3) – the NT only received Fluad in 2018, but some NT residents may have been vaccinated in other jurisdictions.

Gender

Recorded influenza vaccination uptake was higher in females than in males across each age group in both 2017 and 2018 (refer to Figure 5), with greater differences between female and male uptake in 2018 compared with 2017 (18–<50 years: 3.0 versus 5.3 percentage points; 50–<65 years: 2.9 versus 4.9 percentage points; ≥65 years: 2.8 versus 3.6 percentage points).

Remoteness

Recorded influenza vaccination uptake varied by remoteness in both 2017 and 2018 for all age groups (refer to Figure 6). For adults aged 18–<50 years, recorded uptake was highest in remote areas (11.0% in 2017 and 15.0% in 2018) and was substantially lower in major cities (4.3% in 2017 and 8.5% in 2018). For adults aged 50–<65 years, recorded influenza vaccination uptake was lowest in major cities (9.2% in 2017 and 15.9% in 2018) but similar in regional and remote areas (13.5–13.9% in 2017 and 20.3–20.6% in 2018). For adults aged ≥65 years, recorded uptake was lowest in remote areas (28.3% in 2017 and 36.9% in 2018) and highest in regional areas (36.4% in 2017 and 50.8% in 2018). Recorded uptake was substantially higher in Indigenous adults than in non-Indigenous adults in all age groups and remoteness categories (refer to Table 4). Notably, the higher recorded uptake in remote areas in younger age groups is driven by Indigenous status, as Indigenous adults in these age groups are eligible for funded vaccine (refer to Table 4). In contrast, lower recorded uptake in remote areas in adults aged ≥65 years is due to low uptake among non-Indigenous adults (refer to Table 4).

Socio-economic status

In both 2017 and 2018, recorded influenza vaccination uptake for each adult age group was slightly lower in areas of highest socio-economic status versus areas of lowest socio-economic status (refer to Table 5).

Primary health networks

There was considerable variation in recorded influenza vaccination uptake for adults aged 18–<50, 50–<65 and

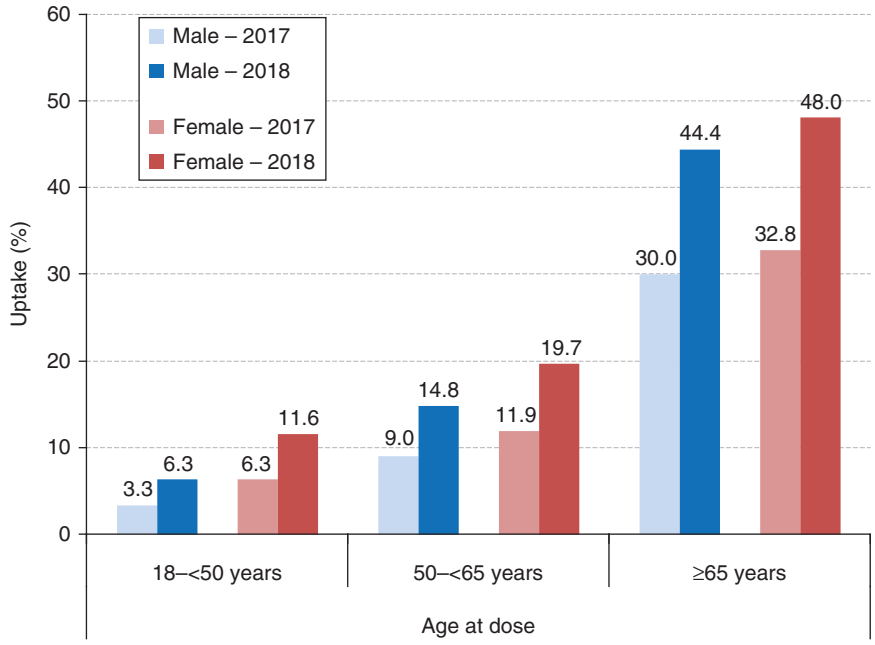

Figure 5. Recorded influenza vaccine uptake[a] by age at dose and gender, Australia, 2017 and 2018[b].

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of relevant year).
[b]1 January 2018 to 30 September 2018 only.

Source: Australian Immunisation Register, data as at 31 December 2018.

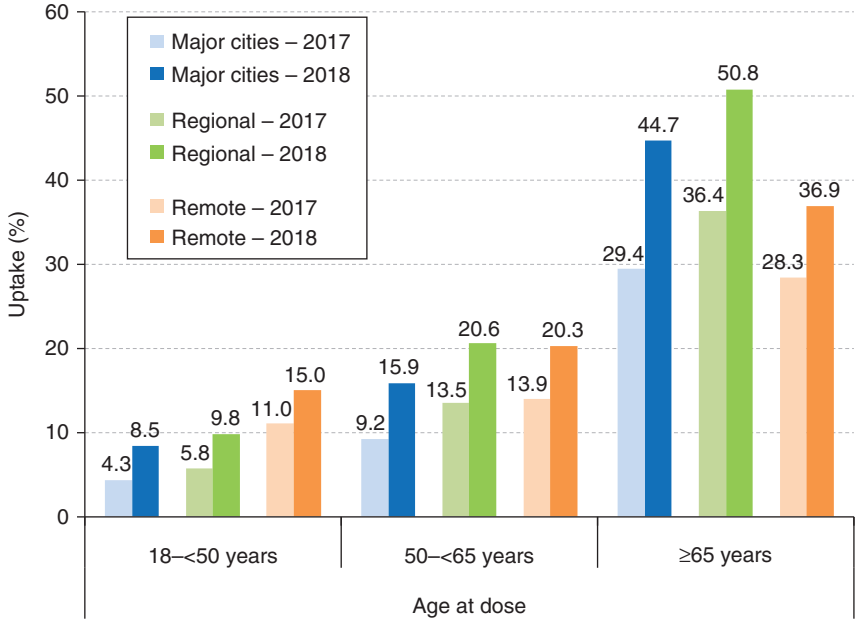

Figure 6. Recorded adult influenza vaccination uptake[a] by age at dose and remoteness category, Australia, 2017 and 2018[b].

[a]Calculated as number of adults with at least one influenza vaccine dose given ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of relevant year).
[b]1 January 2018 to 30 September 2018 only.

Source: Australian Immunisation Register, data as at 31 December 2018.

Table 4. Recorded influenza vaccination uptake[a] by age at dose, Indigenous status and remoteness category, Australia, 1 January to 30 September 2018

Remoteness Status	Age at dose					
	18–<50 years (%)		50–<65 years (%)		≥65 years (%)	
	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous
Major Cities	16.6	8.4	40.3	15.7	63.1	44.6
Regional	20.3	9.3	46.5	19.9	69.1	50.4
Remote	33.8	8.1	47.7	15.4	53.3	35.2

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2018).
Source: Australian Immunisation Register, data as at 31 December 2018.

Table 5. Influenza vaccination uptake[a] recorded on AIR by age and socio-economic status, Australia, 2017 and 2018[b]

Index of Education/Occupation decile	Age at dose					
	18–<50 years (%)		50–<65 years (%)		≥65 years (%)	
	2017	2018	2017	2018	2017	2018
1 – Lowest	5.3	9.1	12.3	19.6	32.8	46.4
2	5.3	9.3	13.0	20.0	35.8	49.2
3	5.0	9.1	11.7	19.1	33.0	47.6
4	4.8	9.1	11.1	18.5	30.8	46.7
5	5.1	9.2	11.6	18.6	33.9	49.6
6	4.9	9.0	11.1	18.2	33.6	49.1
7	4.8	9.1	10.3	17.2	31.2	46.1
8	4.8	8.6	9.9	16.2	32.5	46.1
9	4.3	8.8	8.3	14.9	27.3	43.5
10 – Highest	4.2	8.2	8.0	13.7	27.8	42.7

[a]Calculated as number of adults with at least one influenza vaccine dose given ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of relevant year).
[b]1 January 2018 to 30 September 2018 only.
Source: Australian Immunisation Register, data as at 31 December 2018.

≥65 years by PHNs in both 2017 and 2018 – refer to Appendix Table A1 for further detail. In the ≥65 year age group, the highest recorded influenza vaccination uptake was in the Gippsland and Darling Downs and West Moreton PHNs.

Distribution of influenza vaccine doses

QIV

Health distributed 4 488 685 and 2 457 187 doses of QIV to jurisdictions for the NIP in 2017 and 2018, respectively. The number of doses reported as distributed to jurisdictions (which includes doses for use in children), and the number of doses recorded on AIR as administered to adults aged ≥18 years in 2017 and 2018 are shown in Tables 6 and 7, respectively.

Enhanced TIV

In 2018, Health distributed 3,409,705 doses of enhanced immunogenicity TIV to jurisdictions for the NIP. A total of 1 909 959 doses of enhanced immunogenicity TIV were recorded on AIR in 2018 (with 98.1% of these administered to adults aged ≥65 years) (refer to Table 8), equivalent to 56.0% of the distributed doses. The percentage of distributed doses recorded on AIR varied by jurisdiction – from 48.5% in the NT to 66.5% in Tasmania.

For the five jurisdictions that provided data on doses distributed by provider type, the percentage of enhanced immunogenicity TIV doses distributed that were recorded on AIR by provider type in 2018 varied from 54.8–67.0% for GPs and 6.7–32.1% for other providers (refer to Table A2 in the Appendix for further detail).

Zoster

Overall

The number of zoster vaccine doses recorded as given to those aged 70–<71 years and 71–<80 years during the period 1 October 2016 to 30 September 2018 is shown by month of administration in Figure 7. For both age groups, the highest number of doses was given in November 2016,

Table 6. QIV doses distributed under NIP and recorded on AIR in adults aged ≥18 years, 2017

Jurisdiction	Total doses[a] distributed by Health	Total doses recorded in AIR in adults
ACT	57 750	32 898
NSW	1 500 470	615 803
VIC	1 135 445	554 183
QLD	824 840	552 110
SA	380 280	172 367
WA	420 080	222 000
TAS	116 410	63 235
NT	53 410	20 565
AUSTRALIA	4 488 685	2 233 161

[a]Includes FluQuadri® and Fluarix® Tetra (both registered and available for use in anyone aged ≥3 years) and Afluria® Quad (registered for use in adults aged ≥18 years only).
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Health = Australian Government Department of Health.

Table 7. QIV doses[a] distributed under the NIP and doses recorded on AIR in adults aged ≥18 years, 1 January to 30 September 2018

Jurisdiction	Total doses[a] distributed by Health	Total doses recorded on AIR in adults
ACT	36 085	26 511
NSW	599 588	528 314
VIC	640 565	486 079
QLD	481 035	379 720
SA	192 215	115 009
WA	259 611	147 672
TAS	56 530	46 326
NT	50 781	31 209
AUSTRALIA	2 457 187	1 760 840

[a]Includes FluQuadri® and Fluarix® Tetra (both registered and available for use in anyone aged ≥3 years, i.e. dose distribution data will includes some vaccines ultimately given to children, rather than adults) and Afluria® Quad (registered for use in adults aged ≥18 years only).
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Health = Australian Government Department of Health.

when the national program commenced. Peaks also occurred in May in both 2017 and 2018, coinciding with the rollout of seasonal influenza vaccination programs.

Overall national recorded cumulative zoster vaccination uptake for the age group eligible for vaccine (70–<80 years) through the NIP during the period 1 October 2016 – 30 September 2018 was 31.2%. Cumulative uptake ranged from a high of 37.8% in Queensland to a low of 19.9% in the NT (data not shown). Cumulative zoster vaccination uptake was higher for Indigenous adults aged 70–<80 years than for non-Indigenous adults, 36.7% versus 31.1%, respectively.

Annual vaccination uptake for the target (70 years) and catch-up (71–<80 years) age groups was also calculated for the 3 years (or part thereof) for which data were available: 1 October 2016 – 31 December 2016; 1 January 2017 – 31 December 2017; and 1 January 2018 – 30 September 2018. Recorded vaccination uptake for one dose of zoster vaccine for eligible adults aged 70 years was 3.8% in the period 1 October 2016 to 31 December 2016 (refer to Table 9), varying from a high of 7.1% in Western Australia to a low of 0.9% in Tasmania. Recorded catch-up vaccination uptake for eligible adults aged 71–<80 years was 6.6% (refer to Table 9) and also varied by jurisdiction. In other age groups (not eligible for NIP vaccine) recorded vaccination uptake was 0% (data not shown).

In the first full calendar year of the AIR's operation (1 January 2017 to 31 December 2017), recorded zoster vaccination uptake in adults aged 70 years increased to 25.7% (refer to Table 10), nationally, ranging from 31.7% in Tasmania to 14.9% in the NT. For eligible adults aged

Table 8. Enhanced TIV doses[a] distributed under the NIP and doses recorded on AIR, Australia, 1 January to 30 September 2018

Jurisdiction	Total doses distributed by Health	Total doses distributed by jurisdiction	Total doses recorded on AIR	% of doses distributed that are recorded on AIR[b]
ACT	45 680	No data provided	30 306	66.3[c]
NSW	1 126 530	1 126 829	589 775	52.3[d]
VIC	871 360	877 940	469 774	53.9[c]
QLD	695 650	697 040	420 306	60.3[d]
SA	276 770	276 450	148 871	53.9[d]
WA	284 655	288 505	181 840	63.0[d]
TAS	94 460	93 215	62 010	66.5[d]
NT	14 600	No data provided	7077	48.5[c]
AUSTRALIA	3 409 705	na	1 909 959	56.0[c]

[a]Fluad® and Fluzone® High-Dose, both registered for use in adults aged ≥65 years only.
[b]98.1% recorded as given to adults aged ≥65 years.
[c]% of doses distributed by Health that are recorded on AIR.
[d]% of doses distributed by jurisdictions that are recorded on AIR.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Health = Australian Government Department of Health.

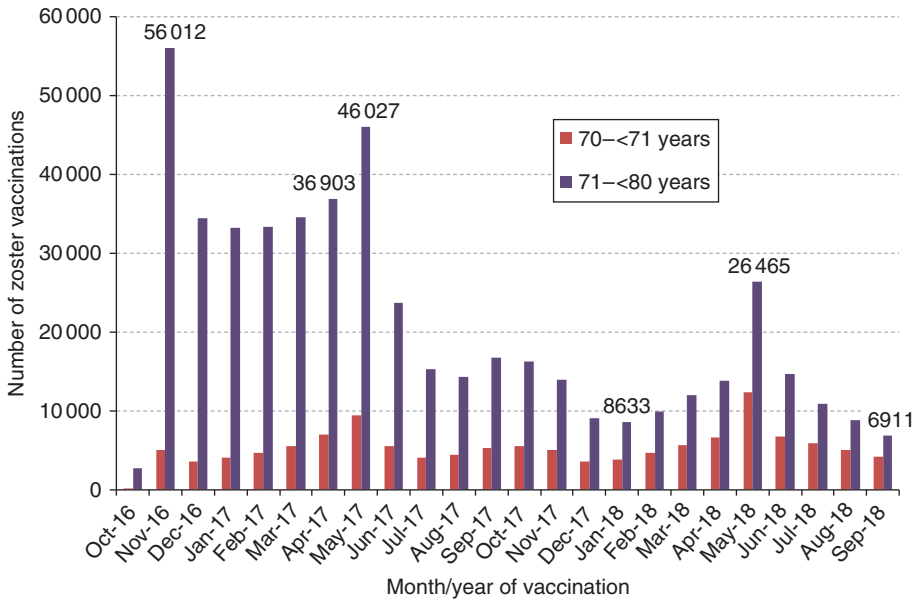

Figure 7. Number of zoster vaccine doses recorded by month for adults aged 70–<71 years and 71–<80 years, Australia, 1 October 2016 to 30 September 2018.

Source: Australian Immunisation Register, data as at 31 December 2018.

71–<80 years, recorded uptake was 19.2% (refer to Table 10) in 2017. In other adult age groups, recorded vaccination uptake ranged from 0% (18–<50 years) to 0.5% (60–<70 years) (data not shown).

In the most recent 9-month period (1 January 2018 to 30 September 2018), recorded zoster vaccination uptake in adults aged 70 years was 22.1% (refer to Table 11), ranging from a high of 31.7% in Queensland to a low of 11.9% in the NT. Recorded catch-up vaccination uptake for adults aged 71–<80 years decreased markedly to 6.8% nationally (refer to Table 11), and was highest in Queensland (8.6%). In age groups not NIP-eligible, recorded vaccination activity ranged from 0% (18–<50 years) to 0.5% (60–<70 years) (data not shown).

Indigenous status

In the first 3 months of the zoster program (1 October 2016 to 31 December 2016), recorded vaccination uptake was slightly higher in Indigenous adults than in non-Indigenous

Table 9. Recorded zoster vaccination uptake[a] in adults aged 70–<80 years by age at dose, Indigenous status and jurisdiction, Australia, 1 October 2016 to 31 December 2016

Jurisdiction	Age at dose					
	70 years (%)			71–<80 years (%)		
	Indigenous	Non-Indigenous	All	Indigenous	Non-Indigenous	All
ACT	0.0[b]	6.1	6.1	11.5	9.1	9.1
NSW	3.1	2.2	2.2	3.5	4.0	4.0
VIC	3.0	3.5	3.5	7.6	6.1	6.2
QLD	7.3	4.1	4.1	9.9	7.9	7.9
SA	5.0	6.6	6.6	11.1	10.9	10.9
WA	4.1	7.2	7.1	6.9	11.7	11.7
TAS	4.7	0.8	0.9	3.8	1.9	1.9
NT	6.3	4.1	4.3	6.2	6.1	6.1
AUSTRALIA	4.2	3.8	3.8	7.0	6.6	6.6

[a]Calculated as number of adults with a zoster vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2016).
[b]n < 26 persons.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table 10. Recorded zoster vaccination uptake[a] in adults aged 70–<80 years by age at dose, Indigenous status and jurisdiction, Australia, 1 January 2017 to 31 December 2017

Jurisdiction	Age at dose					
	70 years (%)			71–<80 years (%)		
	Indigenous	Non-Indigenous	All	Indigenous	Non-Indigenous	All
ACT	71.4[b]	30.8	30.9	14.5	21.4	21.4
NSW	20.1	20.2	20.2	19.0	16.9	16.9
VIC	38.1	26.5	26.7	28.0	19.1	19.2
QLD	26.3	30.1	30.1	22.6	22.4	22.4
SA	25.3	31.3	31.3	17.4	21.4	21.4
WA	18.4	26.4	26.4	14.0	17.3	17.2
TAS	40.9	31.6	31.7	32.2	27.2	27.2
NT	18.9	14.3	14.9	16.6	10.3	11.0
AUSTRALIA	28.1	25.6	25.7	23.0	19.2	19.2

[a]Calculated as number of adults with a zoster vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2017).
[b]n < 26 persons.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

adults, both for those aged 70 years and the catch-up cohort (71–<80 years) (refer to Table 9). Vaccination uptake among Indigenous adults remained higher in 2017 and 2018 (refer to Tables 10 and 11) by a margin of 2–3 percentage points nationally. In adults aged 70 years, vaccination uptake was substantially higher among Indigenous adults than among non-Indigenous adults in Tasmania, Victoria and the NT in both 2017 and 2018 (refer to Tables 10 and 11). Among the catch-up cohort (71–<80 years), Indigenous adults had higher recorded vaccination uptake than non-Indigenous adults in five jurisdictions (NSW, Victoria, Queensland, Tasmania and the NT) in 2017 (refer to Table 10), and higher in all jurisdictions except Western Australia in 2018 (refer to Table 11).

Gender

Zoster vaccination uptake was recorded as 6.7 percentage points higher in females aged 70 years than in males in 2017 (29.0% versus 22.3%) and 6.0 percentage points higher in 2018 (24.1% versus 30.1%) (refer to Figure 8). In adults aged

Table 11. Recorded zoster vaccination uptake[a] in adults aged 70–<80 years by age at dose, Indigenous status and jurisdiction, Australia, 1 January 2018 to 30 September 2018

Jurisdiction	Age at dose					
	70 years (%)[a]			71–<80 years (%)[ab]		
	Indigenous	Non-Indigenous	All	Indigenous	Non-Indigenous	All
ACT	12.5[b]	26.1	26.0	15.4	7.4	7.4
NSW	18.8	17.2	17.2	7.8	6.5	6.5
VIC	32.2	20.8	21.0	8.9	6.1	6.2
QLD	29.7	31.7	31.7	9.3	8.6	8.6
SA	18.1	22.7	22.7	8.9	6.3	6.3
WA	13.6	20.1	20.0	5.4	5.7	5.7
TAS	36.9	27.5	27.7	11.8	8.4	8.5
NT	18.8	11.1	11.9	6.6	3.4	3.8
AUSTRALIA	25.5	22.1	22.1	8.5	6.8	6.8

[a]Calculated as number of adults with a zoster vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December 2018).
[b]n < 26 persons.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

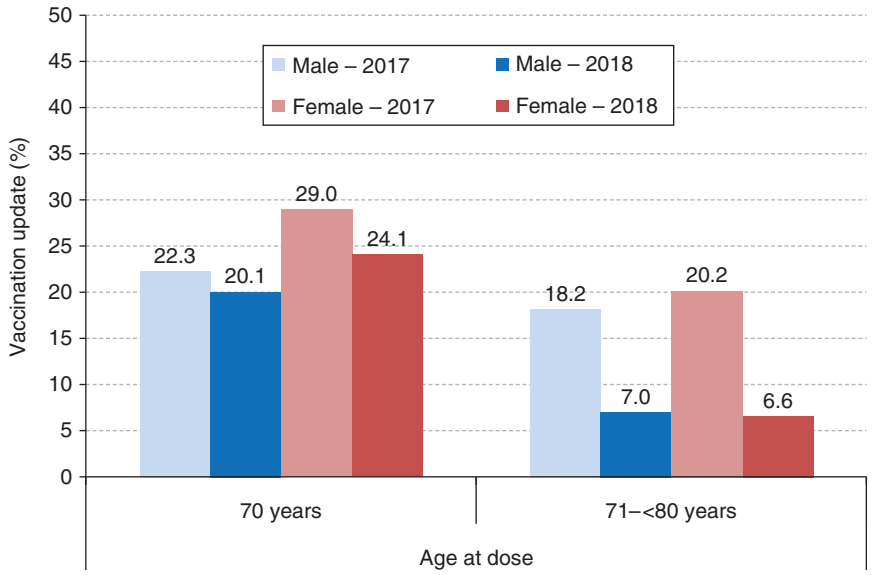

Figure 8. Recorded zoster vaccination uptake[a] by age at dose and gender, Australia, 2017 and 2018[b].

[a]Calculated as number of adults with a zoster vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of the relevant year).
[b]1 January to 30 September only.

Source: Australian Immunisation Register, data as at 31 December 2018.

71–<80 years recorded vaccination uptake was higher in females in 2017 (20.2% versus 18.2%) but slightly lower in 2018 (6.6% versus 7.0%) (refer to Figure 8).

Remoteness

In 2017, the first full calendar year of AIR operation, recorded zoster vaccination uptake was highest in regional areas for both the 70 years and 71–<80 years age groups (27.4% and 22%, respectively) and lowest in remote areas (20.1% and 15%, respectively) (refer to Figure 9). A similar pattern was seen in 2018.

Socio-economic status

For adults aged 70 years and 71–<80 years at the time of vaccination, recorded zoster vaccination uptake did not vary substantially by socio-economic status in 2017 or 2018 (data not shown).

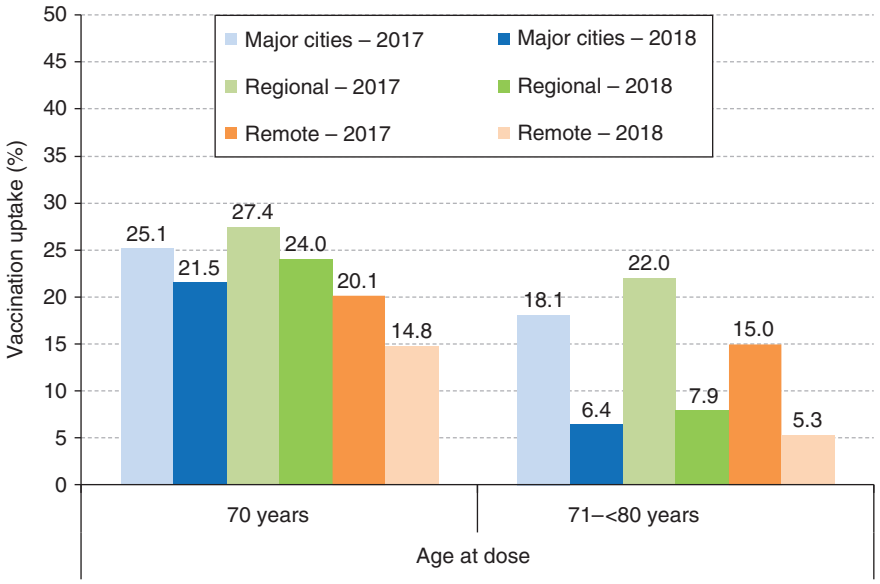

Figure 9. Recorded zoster vaccination uptake[a] by age at dose and remoteness, Australia, 2017 and 2018[b].

[a]Calculated as number of adults with a zoster vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of the relevant year).
[b]1 January to 30 September only.

Source: Australian Immunisation Register, data as at 31 December 2018.

Table 12. Total zoster vaccine doses distributed by Health and jurisdictions, and doses recorded on AIR in adults, Australia, 1 October 2016 – 30 September 2018

Jurisdiction	Total doses distributed for use in NIP by Health	Total doses distributed by jurisdiction	Total doses recorded on AIR in adults[a]	Doses on AIR as % of those distributed
ACT	19 055	No data provided	12 140	63.7[b]
NSW	525 150	373 424	193 344	51.8[c]
VIC	358 368	No data provided	168 467	47.0[b]
QLD	258 311	262 950	163 426	62.2[c]
SA	107 429	90 304	63 322	70.1[c]
WA	119 000	128 711	68 821	53.5[c]
TAS	34 917	55 111	21 200	38.5[c]
NT	5004	No data provided	2734	54.6[b]
AUSTRALIA	1 427 234	na	693 454	48.6[b]

[a]90.5% of doses overall were recorded as given to adults aged 70–<80 years.
[b]% of doses distributed by Health.
[c]% of doses distributed by jurisdictions.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Health = Australian Government Department of Health.

Primary health networks

Recorded zoster vaccination uptake varied considerably across PHNs in 2016, 2017 and 2018 for adults aged 70 years and 71–<80 years (refer to Appendix Table A3). In the 70-year age group, the highest recorded zoster vaccination uptake was in the Gippsland, Brisbane North and Country South Australia PHNs. In the 71–<80 years age group, the highest recorded zoster vaccination uptake was in the Gippsland, Murray, Tasmania, and Darling Downs and West Moreton PHNs.

Distribution of zoster vaccine doses

Between 1 October 2016 and 30 September 2018, Health distributed 1 427 234 doses of NIP-funded zoster vaccine to jurisdictions (refer to Table 12).

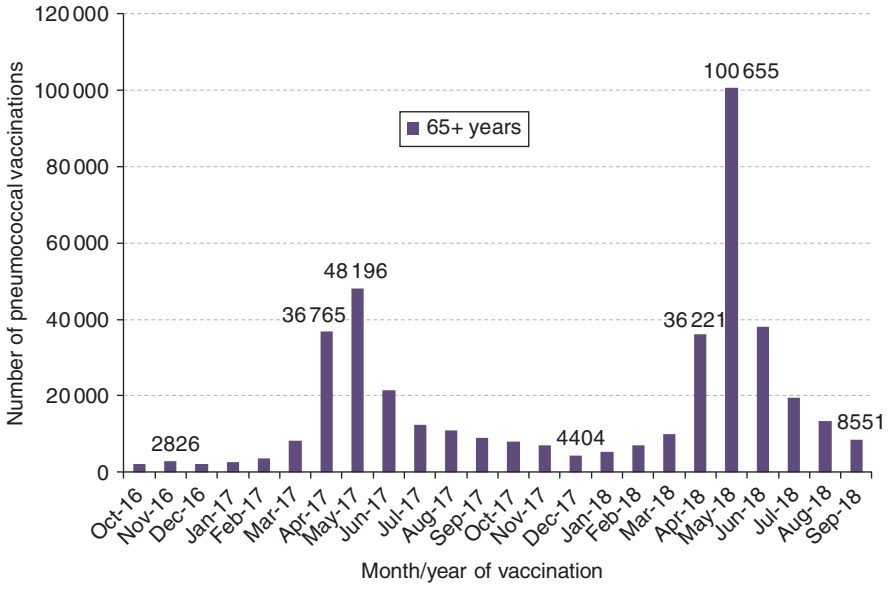

Figure 10. Recorded number of pneumococcal polysaccharide vaccine doses given to adults aged ≥65 years by month, Australia, 1 October 2016 to 30 September 2018.

Source: Australian Immunisation Register, data as at 31 December 2018.

Over this 2-year period, a total of 693 454 doses of zoster vaccine were recorded on AIR as administered to adults aged ≥18 years, with 90.5% (n = 627 298) of these administered to individuals in the target age group of 70–<80 years, 4.1% to individuals aged ≥80 years, 4.2% to individuals aged 60–<70 years, 0.9% to individuals aged 50–<60 years and 0.2% to individuals aged 18–<50 years. This equates to 48.6% of the doses distributed by Health (refer to Table 12). While the vast majority of doses given in the NIP-target age groups likely represents NIP-funded vaccine, doses given to individuals in other age groups could represent a combination of private market vaccine and 'leakage' of NIP-funded vaccine.

In the period 1 October 2016 to 30 September 2018, zoster vaccine doses recorded on AIR as administered to adults aged ≥18 years, calculated as a percentage of doses distributed by Health/jurisdictions, varied from a high of 70.1% in South Australia to a low of 38.5% in Tasmania (refer to Table 4).

For the five jurisdictions that provided data on doses distributed by provider type, zoster vaccine doses recorded on AIR calculated as a percentage of doses distributed varied from 52.9–70.3% for GPs to 19.0–97.9% for other providers in 2017, and from 59.9–84.5% to 25.9-99.7%, respectively, in 2018 (refer to Tables A4–A6 in the Appendix for further detail).

Pneumococcal polysaccharide vaccine

Overall

The number of 23vPPV vaccine doses recorded between 1 October 2016 and 30 September 2018 for adults aged ≥65 years is shown by month of administration in Figure 10. The highest number of doses recorded as given in both 2017 and 2018 were in April and May, at the time of rollout of seasonal influenza vaccination programs.

A total of 206 023 23-valent pneumococcal polysaccharide vaccine (23vPPV) doses were recorded on AIR as given to adults aged ≥18 years between 1 January 2017 and 31 December 2017 (refer to Table 13), and 276 217 doses between 1 January and 30 September 2018 (refer to Table 13). In all jurisdictions except the NT, and across both years, most 23vPPV doses were administered to adults aged ≥65 years. In the NT, the highest number and proportion of 23vPPV doses was administered to adults aged 18–<50 years, equating to 47.5% of doses administered in 2018.

Gender

Marginally more number of doses were administered to females than males in all three age groups in both 2017 and 2018 (refer to Table 14).

Indigenous status

In Indigenous adults in 2017, the highest number of recorded 23vPPV doses was administered to those aged 18–<50 years (3519 versus 3342 for those aged 50–<65 years and 2318 for those aged ≥65 years) (refer to Table 14). In 2018, the highest number of recorded doses was in those aged 50–<65 years (3706 versus 3354 in those aged 18–<50 years and 3423 in those aged ≥65 years) (refer to Table 14). In non-Indigenous adults, recorded doses in adults aged ≥65 years predominated by a large margin (refer to Table 14).

Of 23vPPV doses recorded as given to adults aged 18–<50 years, around one-third were given to Indigenous adults,

Table 13. Recorded pneumococcal polysaccharide vaccine doses by age at dose and jurisdiction, 2017 and 2018[a]

Jurisdiction	Age at dose					
	18–<50 years		50–<65 years		≥65 years	
	2017	2018	2017	2018	2017	2018
ACT	97	130	258	307	2888	4165
NSW	2127	2690	6448	8422	48 693	74 607
VIC	1822	1934	5387	6145	39 363	56 711
QLD	2210	2411	5018	5695	42 184	52 716
SA	536	569	1638	1768	12 993	16 705
WA	1126	1227	2541	2725	19 559	24 503
TAS	301	278	908	1053	5980	8259
NT	2010	1518	921	786	1015	893
AUSTRALIA	**10 229**	**10 757**	**23 119**	**26 901**	**172 675**	**238 559**

[a]1 January 2018 to 30 September 2018 only.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table 14. Number and proportion of pneumococcal polysaccharide vaccine doses recorded by age at dose, gender, Indigenous status and remoteness category, Australia, 2017 and 2018[a]

	Age at dose					
	18–<50 years		50–<65 years		≥65 years	
Year	2017	2018	2017	2018	2017	2018
Male	4878	5042	10 666	12 299	84 019	114 922
(% of total)	(47.7)	(46.9)	(46.1)	(45.7)	(48.7)	(48.2)
Female	5351	5715	12 453	14 602	88 656	123 637
(% of total)	(52.3)	(53.1)	(53.9)	(54.3)	(51.3)	(51.8)
Indigenous	3519	3354	3342	3706	2318	3423
(% of total)	(34)	(31)	(15)	(14)	(1)	(1)
Non Indigenous	6710	7403	19 777	23 195	170 357	235 136
(% of total)	(66)	(69)	(85)	(86)	(99)	(99)
Major cities	4718	5514	12 730	15 082	110 557	154 301
(% of total)	(48)	(53)	(56)	(57)	(65)	(65)
Regional	3213	3260	8776	10 134	58 167	78 982
(% of total)	(33)	(31)	(39)	(38)	(34)	(33)
Remote	1841	1581	1142	1210	1996	2748
(% of total)	(19)	(15)	(5)	(5)	(1)	(1)

[a]1 January 2018 to 30 September 2018 only.
Source: Australian Immunisation Register, data as at 31 December 2018.

who constitute only 2.4% of this age group as recorded on AIR (data not shown). Similarly, Indigenous adults aged 50–<65 years accounted for around 15% of doses but 1.4% of adults in this age group as recorded on AIR (refer to Table 14).

Remoteness

In both 2017 and 2018, the highest numbers of recorded 23vPPV doses were administered to adults residing in 'Major cities' (refer to Table 14). On AIR 25% of adults aged 18–<50 years and 29% of adults aged 50–<65 years, respectively, are recorded as residing in 'Regional' or 'Remote' areas (data not shown). For both years, a disproportionately higher number of 23vPPV doses were recorded in adults aged 18–<50 years and 50–<65 years residing in 'Regional' or 'Remote' areas compared with adults in the same age groups residing in 'Major cities'. Higher numbers of recorded doses administered in remote areas in younger adult age groups is likely driven by Indigenous status, as Indigenous adults in both the 18–<50 and 50–<65 years age groups are eligible for NIP-funded vaccine.

Table 15. Pneumococcal polysaccharide vaccine doses distributed and doses recorded in adults, Australia, 1 January 2017 – 30 September 2018

Jurisdiction	Total doses distributed by Health for NIP[a]	Total doses distributed by jurisdiction	Total doses recorded on AIR in adults	Doses recorded on AIR as % of those distributed
ACT	11 000	No data provided	7840	71.3[b]
NSW	328 000	300 186	142 920	47.6[c]
VIC	157 000	No data provided	111 292	70.9[b]
QLD	144 460	158 161	110 157	69.6[c]
SA	60 500	55 747	34 195	61.3[c]
WA	67 880	84 188	51 637	61.3[c]
TAS	17 167	22 848	16 769	73.4[c]
NT	10 534	No data provided	7085	67.3[b]
AUSTRALIA	796 541	na	481 895	60.5[b]

[a]Includes doses distributed for use in children, although this represents a small proportion of total (1.4% of total doses recorded on AIR).
[b]% of doses distributed by Health.
[c]% of doses distributed by jurisdiction.
ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Health = Australian Government Department of Health.
Source: Australian Immunisation Register, data as at 31 December 2018.

Primary health networks

The number of recorded 23vPPV vaccine doses given to adults aged 50–<65 years and ≥65 years in 2016, 2017 and 2018 by PHN is presented in Appendix Table A7.

Distribution of 23vPPV vaccine doses

Between 1 January 2017 and 30 September 2018, Health distributed 796 541 doses of 23vPPV to jurisdictions (refer to Table 15). Over this period, a total of 481 895 doses of 23vPPV vaccine were recorded on AIR as administered to adults aged ≥18 years. This equates to 60.5% of the doses distributed by Health (refer to Table 15). While some 23vPPV doses are given to children, this represents a small number – only 6691 (1.4% of all doses recorded on AIR over the 1 January 2017 to 30 September 2018 period) were recorded as administered to children.

In the period 1 January 2017 to 30 September 2018, the proportion of 23vPPV vaccine doses recorded on AIR, calculated as a percentage of those distributed, varied by jurisdiction (refer to Table 15).

The proportion of 23vPPV vaccine doses recorded on AIR, calculated as a percentage of those distributed, by provider type (GP versus other providers) for the five jurisdictions that provided data is presented in Appendix Tables A8 and A9.

MMR and dTpa vaccine

A total of 52 597 measles, mumps, and rubella (MMR) vaccine doses were recorded on AIR as given to adults aged 18–<65 years between 1 January 2017 and 31 December 2017 (refer to Table 16), with the majority given to adults aged 18–<40 years in all jurisdictions. A similar picture was seen in the first 9 months of 2018 (refer to Table 17).

A total of 510 849 adult diphtheria–tetanus–acellular pertussis (dTpa) vaccine doses were recorded on AIR as given to adults aged ≥18 years between 1 January 2017 and 31 December 2017 (refer to Table 16), with the majority given to those aged 18–<40 years in most jurisdictions. A higher proportion of doses was recorded as given to females aged 18–<40 years than those aged ≥65 years (62% versus 55%, respectively, data not shown), possibly reflecting dTpa vaccination programs for pregnant women. A similar picture was seen in the first 9 months of 2018 (refer to Table 17).

Discussion

This report is the first to examine adult vaccination data recorded on AIR, using the first 2 years of data from the expanded register. Key findings are discussed by vaccine – these should be interpreted carefully in the context of the substantial data limitations relating to under-reporting and completeness of data, as outlined below.

Influenza vaccine

Following the severe influenza season in 2017,[31] influenza vaccination uptake recorded on AIR in 2018 increased substantially across all adult age groups, although some of this increase could be due to better completeness of reporting. Recorded uptake of influenza vaccine in 2018 peaked over a 6-week period from late April to late May, with two-thirds of vaccinated adults having received the vaccine by the end of

Table 16. MMR and dTpa vaccine doses recorded as given, by age at dose and jurisdiction, Australia, 1 January 2017 to 31 December 2017

Jurisdiction	MMR vaccine		dTpa vaccine		
	Age at dose				
	18–<40 years	40–<65 years	18–<40 years	40–<65 years	≥65 years
ACT	871	460	4977	3285	1383
NSW	12 121	3873	70 586	48 988	22 795
VIC	6341	2125	74 076	40 949	15 729
QLD	11 626	3808	61 843	40 444	15 123
SA	1683	783	17 888	12 392	6318
WA	4212	1833	29 323	17 264	6789
TAS	505	229	6004	4969	1958
NT	1485	642	5073	2232	461
AUSTRALIA	38 844	13 753	269 770	170 523	70 556

ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table 17. MMR and dTpa vaccine doses recorded as given, by age at dose and jurisdiction, Australia, 1 January 2018 to 30 September 2018

Jurisdiction	MMR vaccine		dTpa vaccine		
	Age at dose				
	18–<40 years	40–<65 years	18–<40 years	40–<65 years	≥65 years
ACT	847	426	3894	2996	1364
NSW	11 997	3586	75 103	53 050	23 903
VIC	7235	2521	71 737	42 920	17 036
QLD	11 103	4289	59 222	40 208	16 078
SA	1568	841	15 848	11 504	5631
WA	3704	1376	26 661	16 246	6610
TAS	580	222	5809	5269	2416
NT	931	477	3615	1521	289
AUSTRALIA	37 965	13 738	261 889	173 714	73 327

ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria; WA = Western Australia.
Source: Australian Immunisation Register, data as at 31 December 2018.

May. Recorded influenza vaccination uptake was higher among Indigenous adults than among non-Indigenous adults across all age groups in most jurisdictions, three times higher in the 18–<50 and 50–65 year age groups in which all Indigenous people are eligible for NIP-funded vaccine. Recorded influenza vaccination uptake was higher in females than in males, with the largest relative difference in uptake (in the 18–<50 years age group) likely reflecting influenza vaccination during pregnancy.

The influenza vaccination uptake figures presented in this report likely substantially underestimate true uptake. Vaccination coverage estimates for adults aged ≥65 years from previous national surveys have generally been 70% or greater[13,14,15] as opposed to the figures of 31.5% (2017) and 46.3% (2018) calculated from the AIR data in this report. Dose distribution data are more readily interpretable for enhanced immunogenicity TIV than for QIV, as in 2018 enhanced immunogenicity TIV was used predominantly in the NIP compared with QIV, which is routinely used in the private market in large numbers. The number of enhanced immunogenicity TIV doses recorded on AIR was 44% lower than the number distributed by Health, which suggests substantial underreporting even after accounting for doses not used by providers or disposed of. The percentage of enhanced immunogenicity TIV doses distributed recorded on AIR was substantially higher in relation to doses distributed to GPs compared to other providers, for the five jurisdictions providing dose distribution data, suggesting a higher level of underreporting in non-GP settings. In NSW,

a CATI survey estimate of influenza vaccine coverage in adults aged ≥65 years in 2017 was 72.6%,[26] compared to our calculated figure of 31.5%. Although less data are available for comparison purposes, it is likely that underestimation of true influenza uptake is even greater in younger adults because of under-reporting of largely non-NIP-funded influenza vaccinations administered in workplaces, pharmacies and other non-GP settings. Now that immunisation providers in other settings are able to register to report vaccination encounters to AIR, it is important to continue engaging with these provider groups to facilitate their registration and reporting.

Zoster vaccine

Approximately 2 years after implementation of the national zoster immunisation program, 31.2% of adults aged 70–<80 years were recorded on AIR as vaccinated at some point over the period 1 October 2016 to 30 September 2018. The proportion was higher for Indigenous adults (36.7%) than for non-Indigenous adults (31.1%). Recorded zoster vaccination uptake peaked in May in both 2017 and 2018, likely because of presentation of older adults to providers for influenza vaccination. Recorded zoster vaccination uptake in 2017 was 25.7% in adults aged 70 years and 19.2% in the catch-up cohort (71–<80 years). In the first 9 months of 2018, recorded vaccination uptake in the 70-year age group was 22.1%, suggesting likely higher uptake than in 2017 if all 2018 data were available for analysis. Uptake in 2018 was substantially lower in the 71–<80-year-olds age group at 6.8%, reflecting the decreasing pool of unvaccinated individuals in the catch-up cohort over time, along with the shorter 9-month period analysed. Recorded zoster vaccination uptake was consistently higher in Indigenous adults (by 2–4%) across ages and years. Uptake was also 6–7% higher in females aged 70 years, compared to males, which may reflect gendered health-seeking behaviours.

However, true zoster vaccine uptake in Australia is likely to be considerably higher than the figures presented here, given that the number of zoster vaccine doses recorded on AIR was approximately half the number of doses distributed by Health over the study period. It is not possible to determine the exact level of underreporting as an unknown proportion of doses will not have been administered over the study period for a range of reasons. These include stock not being distributed, for example, retained by manufacturers, health departments and immunisation providers, along with disposal due to cold chain breaches. Given that over 90% of zoster vaccine doses recorded on AIR were in the target age group (adults aged 70–<80 years), it is likely that these represent largely NIP-funded vaccine, suggesting that non-distribution of stock in relation to doses released to the private market may have been considerably higher than under the NIP. It would be useful to compare the findings of this report with any analyses of doses distributed and/or accounted for conducted by the manufacturer of the single zoster vaccine available in Australia.

Despite the substantial under-reporting of zoster vaccination to AIR, the overall cumulative zoster vaccination uptake calculated over our entire study period (31.2%) is similar to that reported from the USA (where zoster vaccine has been recommended since 2006 and reporting is likely more accurate) of 30.6% zoster vaccine uptake (ever received) in adults aged ≥60 years in 2015.[32,33] In England and Wales, where a program began in 2013 and reporting is also likely more accurate, cumulative uptake in 2015–2016 was reported to be 55% in adults aged 70 years. England and Wales implemented a different approach to catch-up zoster vaccination, with single-year cohorts progressively eligible, starting at 79 years and moving down towards 70 years annually. Uptake of 56% was reported for the those aged 79 years who were first targeted.[34]

Pneumococcal polysaccharide vaccine

Vaccination uptake estimates were not calculated for 23vPPV because of the complexity of recommendations by age, Indigenous status and presence of at-risk medical conditions, and the short duration of data available on the register, noting 1–3 adult doses (5 years apart) are recommended over a lifetime.

A total of 206 023 and 276 217 doses of 23vPPV were recorded on AIR as administered to adults during 2017 and 2018 (first 9 months only), respectively. In all jurisdictions except the NT, the highest number of doses administered was recorded in adults aged ≥65 years. The much higher percentage of doses given to younger adults in the NT is due to the high number given to Indigenous adults and likely reflects the high proportion of the NT's Indigenous population and the prevalence of risk factors for pneumococcal disease. Doses of 23vPPV recorded on AIR peaked in May in both 2017 and 2018, as with zoster vaccination, that is, after the rollout of the seasonal influenza vaccination program. This suggests that attendance for seasonal influenza vaccination is a prompt for providers and patients to consider concomitant zoster and pneumococcal vaccination.

The number of 23vPPV doses recorded on AIR as administered to adults between 1 January 2017 and 30 September 2018 was approximately 40% lower than the number of doses distributed by Health to jurisdictions over the same period. This suggests substantial underreporting, even after accounting for doses not used by providers or disposed of.

MMR and dTpa vaccines

The number of adult dTpa vaccine doses recorded on AIR as given to adults aged 18–<40 years in 2017 and 2018 was 7 times higher than the number of MMR vaccine doses. This

is likely contributed to by the dTpa programs for pregnant women initially funded by jurisdictions and then under the NIP from mid-2018.

Conclusions

In this analysis of AIR data, higher levels of vaccination uptake were recorded in Indigenous people, for both influenza and zoster vaccines. We found considerable geographic variation in vaccine uptake at both state/territory and PHN levels, which may reflect true differences in uptake and/or differences in completeness of reporting. The population-level vaccination uptake estimates presented in this report substantially underestimate true uptake, with major gaps identified between doses distributed and doses recorded on AIR. While it is difficult to definitively assess the level of underreporting, true uptake in adults could be up to double that recorded on AIR, depending on vaccine, age group and Indigenous status, and potentially even greater for vaccines not on the NIP schedule.

The predecessor of AIR, the ACIR, also experienced substantial underreporting issues in the first 4 years of its operation.[2] Methods of transfer of vaccination information to the ACIR/AIR have changed markedly over the past 2 decades, with an increase in electronic methods from 6% in 1998[35] to 98.1% of vaccination encounters for children aged <7 years in 2017.[36] Most vaccinations in young children are given in GP settings (80.6% in 2017[36]) and most reporting to AIR occurs in a semi-automated way via practice management software (75.5% in 2017).[36] However issues with data transfer via electronic methods have been documented for childhood vaccines,[37] and these may have more impact on completeness of adult data, given the lack of specific incentives (other than professionalism and consumer-driven demand) for immunisation providers to report adult vaccinations to AIR. Little information is available on methods of reporting by immunisation providers in some of the non-GP settings that are particularly important in relation to influenza vaccination.

AIR data completeness would be expected to improve over time as GP practice management software packages are updated and as registration and transfer of data from other provider groups expands. It will be important to continue to engage with providers to facilitate timely and effective reporting to AIR and to monitor and assess the completeness of adult vaccination data over time. It will also be important to provide feedback on the completeness of data to all relevant stakeholders to drive ongoing improvement.

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Appendix

Table A1. Recorded adult influenza vaccination uptake[a] by age at dose and primary health network, Australia recorded, 2017 and 2018[b]

Primary Health Network	Age at dose					
	18–<50 years (%)		50–<65 years (%)		≥65 years (%)	
	2017	2018	2017	2018	2017	2018
ACT						
Australian Capital Territory	4.2	8.0	8.6	14.3	32.8	50.6
NSW						
Central and Eastern Sydney	3.2	6.6	6.2	10.7	21.1	31.9
Hunter New England and Central Coast	5.0	10.2	12.3	20.5	34.5	52.8
Murrumbidgee	4.8	10.2	10.5	19.2	32.2	49.0
Nepean Blue Mountains	3.5	8.6	8.4	17.8	25.5	47.5
North Coast	4.2	7.9	11.2	17.3	33.8	47.7
Northern Sydney	3.4	8.1	6.5	12.8	24.5	42.6
South Eastern NSW	4.4	8.7	11.9	18.5	35.0	51.5
South Western Sydney	2.5	6.7	6.0	13.5	17.6	34.4
Western NSW	4.5	10.2	10.2	20.2	25.9	44.1
Western Sydney	3.4	8.1	7.3	15.0	20.3	35.1
VIC						
Eastern Melbourne	4.9	10.0	9.2	17.3	26.9	45.5
Gippsland	7.6	11.6	18.2	25.5	42.5	57.3
Murray	6.9	11.6	16.1	23.6	38.9	50.8
North Western Melbourne	4.6	8.7	8.9	16.2	24.5	41.2
South Eastern Melbourne	5.0	10.0	9.3	17.6	25.1	43.7
Western Victoria	7.5	12.8	14.9	24.1	34.0	48.5
QLD						
Brisbane North	6.0	10.2	13.6	18.9	41.6	53.4
Brisbane South	5.6	9.8	12.8	18.4	37.4	51.0
Central Queensland, Wide Bay, Sunshine Coast	5.2	7.7	14.8	18.8	44.9	54.4
Darling Downs and West Moreton	5.6	9.8	14.0	20.5	39.6	55.2
Gold Coast	4.3	7.8	10.5	15.6	35.4	46.0
Northern Queensland	6.1	9.1	15.1	19.3	43.5	50.8
Western Queensland	7.8	12.3	16.2	21.9	36.7	44.8
SA						
Adelaide	4.7	7.7	9.6	15.2	30.8	44.5
Country SA	7.6	10.8	14.1	19.8	34.4	49.4
WA						
Country WA	5.3	8.8	9.8	18.4	31.3	45.1
Perth North	3.8	7.1	7.5	15.0	32.0	46.6
Perth South	4.2	7.2	9.0	16.1	37.0	49.4
TAS						
Tasmania	5.7	10.9	13.1	23.2	38.4	57.1
NT						
Northern Territory	13.7	14.9	15.6	18.4	29.4	30.9

[a]Calculated as number of adults with at least one influenza vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of relevant year).
[b]1 January 2018 to 30 September 2018 only.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table A2. Number of enhanced immunogenicity trivalent influenza vaccine doses[a] distributed by jurisdiction[b] and recorded on AIR,[c] by provider type, Australia, 2018

		NSW	QLD	SA	WA	TAS
General Practitioner	Doses distributed by jurisdiction	1 016 875	661 365	264 405	264 450	92 080
	Doses recorded on AIR	582 361	413 790	145 004	174 337	61 681
	% of distributed doses recorded on AIR	57.3	62.6	54.8	65.9	67.0
All other Providers[d]	Doses distributed, by jurisdiction	109 935	35 675	12 045	24 055	1135
	Doses recorded on AIR	7414	6516	3867	7503	329
	% of distributed doses recorded on AIR	6.7	18.3	32.1	31.2	29.0

[a]Fluad® and Fluzone® High-Dose (both registered for use in adults aged ≥65 years only) given between 1 January 2018 to 30 September 2018.
[b]Data provided by NSW, Queensland, South Australia, Western Australia and Tasmania only.
[c]Of enhanced TIV doses recorded on AIR, 98.1% overall were given to adults aged ≥65 years.
[d]Includes councils/local government, Community Health, Aboriginal Health Services, and public and private hospitals.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table A3. Recorded zoster vaccination uptake[a] by age at dose and primary health network, adults aged 70 years and 71–<80 years, Australia, 2016–2018[b]

Primary health network	Age at dose					
	70 years			71–<80 years		
	2016	2017	2018	2016	2017	2018
ACT						
Australian Capital Territory	6.1	30.8	26.4	9.1	21.3	7.6
NSW						
Central and Eastern Sydney	2.3	16.3	12.0	3.8	12.8	4.5
Hunter New England and Central Coast	2.3	25.2	24.4	4.7	21.9	8.9
Murrumbidgee	1.7	20.7	18.2	3.6	18.1	7.8
Nepean Blue Mountains	2.0	18.3	18.9	2.6	14.3	7.9
North Coast	2.0	22.5	18.4	4.5	22.3	7.8
Northern Sydney	2.1	22.1	17.2	4.1	17.6	6.0
South Eastern NSW	2.6	26.0	21.1	4.9	21.1	7.0
South Western Sydney	2.4	15.5	13.1	3.4	11.8	5.2
Western NSW	1.4	13.6	13.7	2.3	13.9	6.9
Western Sydney	2.6	16.3	14.1	4.2	12.3	4.5
VIC						
Eastern Melbourne	3.5	27.1	21.2	5.8	18.7	5.8
Gippsland	4.1	35.8	26.0	8.2	28.7	7.7
Murray	3.5	31.8	21.0	6.8	24.5	6.8
North Western Melbourne	3.5	22.9	19.2	5.9	15.7	5.6
South Eastern Melbourne	3.1	23.3	20.9	5.6	16.6	6.4
Western Victoria	3.9	29.5	21.7	7.0	21.8	6.4
QLD						
Brisbane North	4.3	34.4	34.1	7.7	23.9	8.2
Brisbane South	4.9	29.8	29.9	8.1	21.0	7.0
Central Queensland, Wide Bay, Sunshine Coast	3.3	30.1	32.9	7.9	23.6	9.8
Darling Downs and West Moreton	4.4	30.4	34.5	8.3	24.4	10.4
Gold Coast	3.4	25.4	26.6	7.1	18.3	8.3
Northern Queensland	4.5	29.6	32.5	8.7	23.3	8.7
Western Queensland	5.1	23.6	25.7	7.9	18.1	8.4
SA						
Adelaide	6.7	30.3	22.4	11.2	20.3	6.0
Country SA	6.2	33.7	23.4	10.2	23.8	7.0
WA						
Perth North	6.6	25.7	20.2	11.1	17.1	5.4
Perth South	8.7	29.3	21.5	13.6	18.4	5.9
Country WA	5.7	23.1	17.9	9.8	15.8	6.2
TAS						
Tasmania	0.9	31.6	27.6	1.9	27.2	8.5
NT						
Northern Territory	4.9	15.0	11.5	6.4	10.5	3.8

[a]Calculated as number of adults with a zoster vaccine dose recorded ÷ total number of adults registered on AIR in relevant age group x 100 (for denominator, age calculated as at 31 December of relevant year).
[b]2016 includes vaccinations given between 1 October 2016 and 31 December 2016 only; 2018 includes vaccinations given between 1 January 2018 and 30 September 2018 only.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table A4. Total number of zoster vaccine doses distributed by jurisdiction[a] and recorded on AIR, by provider type, Australia, 2016[b]

		NSW	QLD	SA	WA	TAS
General Practitioner	Doses distributed by jurisdiction	74 477	57 592	23 204	51 737	22 906
	Doses recorded on AIR[c]	21 110	24 137	12 896	16 769	810
	Doses recorded on AIR calculated as % of distributed[c]	28.3	41.9	55.6	32.4	3.5
All other Providers[d]	Doses distributed by jurisdiction	2813	1821	422	1590	126
	Doses recorded on AIR[c]	990	1080	1034	1095	23
	Doses recorded on AIR calculated as % of distributed[c]	35.2	59.3	>100%	68.9	18.3

[a]Data provided by NSW, Queensland, South Australia, Western Australia and Tasmania only.
[b]1 October 2016 to 31 December 2016 only.
[c]Australian Immunisation Register, data as at 31 December 2018.
[d]Includes councils/local government, Community Health, Aboriginal Health Services, and public and private hospitals.

Table A5. Total number of zoster vaccine doses distributed by jurisdiction[a] and recorded on AIR, by provider type, Australia, 2017[b]

		NSW	QLD	SA	WA	TAS
General Practitioner	Doses distributed, as reported by Jurisdiction	213 610	140 113	52 422	47 017	23 769
	Doses recorded on AIR[c]	110 891	87 431	33 736	33 045	13 982
	% of distributed doses that are recorded on AIR[c]	51.9	62.4	64.4	70.3	58.8
All other Providers[d]	Doses distributed, as reported by Jurisdiction	11 953	2522	483	942	96
	Doses recorded on AIR[c]	2275	1902	1143	1621	93
	% of distributed doses that are recorded on AIR[c]	19.0	75.4	>100%	>100%	96.9

[a]Data provided by NSW, Queensland, South Australia, Western Australia and Tasmania only.
[b]1 January 2017 to 31 December 2017.
[c]Australian Immunisation Register, data as at 31 December 2018.
[d]Includes councils/local government, Community Health, Aboriginal Health Services, and public and private hospitals.

Table A6. Total number of zoster vaccine doses distributed by jurisdiction[a] and recorded on AIR, by provider type, Australia, 2018[b]

		NSW	QLD	SA	WA	TAS
General Practitioner	Doses distributed, as reported by Jurisdiction	67 962	58 838	13 473	26 270	8140
	Doses recorded on AIR[c]	57 411	48 163	14 214	15 724	6264
	% of distributed doses that are recorded on AIR[c]	84.5	81.9	>100%	59.9	77.0
All other Providers[d]	Doses distributed, as reported by Jurisdiction	2609	2064	300	1155	74
	Doses recorded on AIR[c]	675	540	299	574	28
	% of distributed doses that are recorded on AIR[c]	25.9	26.2	99.7	49.7	37.8

[a]Data provided by NSW, Queensland, South Australia, Western Australia and Tasmania only.
[b]1 January 2018 to 30 September 2018 only.
[c]Australian Immunisation Register, data as at 31 December 2018.
[d]Includes councils/local government, Community Health, Aboriginal Health Services, and public and private hospitals.

Table A7. Recorded pneumococcal polysaccharide vaccine doses, by age at dose and primary health network, adults aged 50–<65 and ≥65 years, Australia, 2017 and 2018[a]

Primary health network	Age at dose			
	50–<65 years		≥65 years	
	2017	2018[a]	2017	2018[a]
ACT				
Australian Capital Territory	231	283	2546	3775
NSW				
Central and Eastern Sydney	798	894	7156	10 738
Hunter New England and Central Coast	1766	2234	11 699	17 328
Murrumbidgee	258	373	1982	2949
Nepean Blue Mountains	337	521	2127	4417
North Coast	609	692	4357	5782
Northern Sydney	531	699	6009	9637
South Eastern NSW	778	881	5936	7639
South Western Sydney	462	783	3456	6093
Western NSW	338	513	1847	3172
Western Sydney	542	799	3995	6700
VIC				
Eastern Melbourne	979	1234	8702	13 854
Gippsland	390	384	3141	4094
Murray	845	918	5880	6622
North Western Melbourne	1269	1488	8267	12 183
South Eastern Melbourne	1074	1282	8124	12 408
Western Victoria	742	756	4991	7063
QLD				
Brisbane North	963	1060	8807	10 131
Brisbane South	965	949	8852	10 771
Central Queensland, Wide Bay, Sunshine Coast	963	1213	8951	11 071
Darling Downs and West Moreton	598	695	5101	6312
Gold Coast	415	477	4788	6424
Northern Queensland	917	1048	4985	7111
Western Queensland	175	223	484	624
SA				
Adelaide	1007	1150	8750	11 332
Country SA	690	673	4228	5337
WA				
Country WA	732	838	3480	4877
Perth North	862	944	7823	9939
Perth South	876	859	7673	8886
TAS				
Tasmania	904	1049	5931	8205
NT				
Northern Territory	626	512	648	581

[a]1 January 2018 to 30 September 2018 only.
Source: Australian Immunisation Register, data as at 31 December 2018.

Table A8. Total number of pneumococcal polysaccharide vaccine doses distributed by jurisdiction[a] and recorded on AIR,[b] by provider type, Australia, 2017

		NSW	QLD	SA	WA	TAS
General Practitioner	Doses distributed, by jurisdiction	127 431	73 742	29 950	38 236	11 187
	Doses recorded on AIR[b]	56 529	48 220	14 551	22 015	7136
	Doses recorded on AIR as % of those distributed[b]	44.4	65.4	48.6	57.6	63.8
All other Providers[c]	Doses distributed, by jurisdiction	16 444	4570	986	3093	196
	Doses recorded on AIR[b]	726	917	613	1198	50
	Doses recorded on AIR as % of those distributed[b]	4.4	20.1	62.2	38.7	25.5

[a]Data provided by NSW, Queensland, South Australia, Western Australia and Tasmania only.
[b]Australian Immunisation Register, data as at 31 December 2018.
[c]Includes councils/local government, Community Health, Aboriginal Health Services, and public and private hospitals.

Table A9. Total number of pneumococcal polysaccharide vaccine doses distributed by jurisdiction[a] and recorded on AIR,[b] by provider type, Australia, 2018[c]

		NSW	QLD	SA	WA	TAS
General Practitioner	Doses distributed, by jurisdiction	135 494	74 917	23 962	39 486	11 315
	Doses recorded on AIR[b]	84 691	59 456	18 488	27 113	9547
	Doses recorded on AIR as % of those distributed[b]	62.5	79.4	77.2	68.7	84.4
All other Providers[d]	Doses distributed, by jurisdiction	20 817	4932	849	3373	150
	Doses recorded on AIR[b]	974	1312	543	1311	36
	Doses recorded on AIR as % of those distributed[b]	4.7	26.6	64.0	38.9	24.0

[a]Data provided by NSW, Queensland, South Australia, Western Australia and Tasmania only.
Vaccinations given between 1 January 2018 to 30 September 2018.
[b]Australian Immunisation Register, data as at 31 December 2018.
[c]1 January 2018 to 30 September 2018 only.
[d]Includes councils/local government, Community Health, Aboriginal Health Services, and public and private hospitals.