Annual Immunisation Coverage Report
2014
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List of vaccine abbreviations

7vPCV – 7-valent pneumococcal conjugate vaccine
10vPCV – 10-valent pneumococcal conjugate vaccine
13vPCV – 13-valent pneumococcal conjugate vaccine
23vPPV – 23-valent pneumococcal polysaccharide vaccine
Convax – *Haemophilus influenzae* type b conjugate (meningococcal protein conjugate) and hepatitis B (recombinant) vaccine
dTpa – diphtheria-tetanus-acellular pertussis (adults, adolescents and children aged ≥10 years formulation)
DTPa – diphtheria-tetanus-acellular pertussis (children aged <10 years formulation)
DTPa-hepB-IPV-Hib – combined diphtheria-tetanus-acellular pertussis-hepatitis B-inactivated poliovirus-*Haemophilus influenzae* type b
DTPa-IPV – diphtheria-tetanus-acellular pertussis-inactivated poliovirus
Engerix-B – recombinant DNA hepatitis B vaccine (paediatric formulation)
Flu – influenza
H-B-VAX II – hepatitis B (paediatric formulation)
Hep A – hepatitis A
Hep B – hepatitis B
Hib – *Haemophilus influenzae* type b
Hib-MenCCV – *Haemophilus influenzae* type b–meningococcal C conjugate vaccine
HPV – human papillomavirus
IPV – inactivated poliovirus
MenCCV – meningococcal C conjugate vaccine
MMR – measles–mumps–rubella
MMRV – measles–mumps–rubella–varicella
PedvaxHIB – *Haemophilus influenzae* type b conjugate vaccine (meningococcal protein conjugate)
PCV – pneumococcal conjugate vaccine
PRP-OMP – *Haemophilus influenzae* type b conjugate vaccine
PRP-T – *Haemophilus influenzae* type b conjugate vaccine
VZV – varicella-zoster virus
Executive summary
This 8th annual immunisation coverage report shows data for 2014 derived from the Australian Childhood Immunisation Register and the National Human Papillomavirus (HPV) Vaccination Program Register. From July 2014, classification as ‘fully immunised’ at 24 months of age required a dose of meningococcal vaccine, a dose of varicella vaccine and a 2nd dose of measles-containing vaccine (given as either MMR or MMRV) in addition to 3 doses of diphtheria-tetanus-pertussis, hepatitis B and polio vaccines, and 4 doses of Haemophilus influenzae type b (Hib) vaccine. Requirements for ‘fully immunised’ status did not change for the 12- and 60-month milestones. This report includes coverage data for ‘fully immunised’ and by individual vaccines at standard age milestones and timeliness of receipt at earlier ages according to Indigenous status.

Immunisation coverage
In 2014, the proportion of Australian children classified as ‘fully immunised’ increased compared with 2013 at 12 months (91.5% vs 90.8%) and 60 months (92% vs 91.2%) of age but declined at 24 months of age to 87.0%, compared to 92.1% in 2013. However, the bulk (4.7%) of this reduction in coverage at 24 months was due to changes in the requirements for ‘fully immunised’ status rather than any true decline. Overall, ‘fully immunised’ coverage has been mostly stable at the 12- and 24-month age milestones since late 2003, but at 60 months of age has increased by more than 10 percentage points since 2009. Vaccines available on the National Immunisation Program but not included in assessment of ‘fully immunised’ status included rotavirus vaccines, for which coverage at 12 months of age was lower (84.3%), likely due to strict upper age limits. In 2014, 73.4% of Australian females aged 15 years had 3 documented doses of HPV vaccine (jurisdictional range 67.7–77.4%), and 82.7% had at least 1 dose, compared to 71.4% and 81.5%, respectively, in 2013. HPV vaccine coverage among women in their twenties, vaccinated largely outside of the school setting, was 66.0% for 1 dose and 52.0% for 3 doses in 2014, compared to 64% and 48%, respectively, in 2013. Reflecting the 2 years of male catch-up HPV vaccination in Australia, in 2014 61.4% of Australian males aged 15 years had 3 documented doses of HPV vaccine (jurisdictional range 55.1–67.8%), and 72.6% had at least 1 dose.

Indigenous immunisation coverage
As in previous years, coverage for ‘fully immunised’ at 12 months of age among Indigenous children was 3.7% lower than for non-Indigenous children overall, varying from 6.9 percentage points in Western Australia to 0.3 of a percentage point in the Australian Capital Territory. However, the differential in coverage improved from 2013. The coverage gap for ‘fully immunised’ at 24 months of age among Indigenous children in 2014 increased to 3.3% from 0.1% in 2013, varying from 6.4% in Victoria to 0.5% in New South Wales, suggesting a disproportionately greater impact of the changed requirements for ‘fully immunised’ status in Indigenous children, though follow-up data are required to determine whether additional doses will be received after 24 months of age. The lower coverage gap for New South Wales may reflect the NSW Aboriginal Immunisation Health Care Worker Program that began as a 3-year pilot program in 2012. In contrast, at 60 months of age ‘fully immunised’ coverage in 2014 was 1.6 percentage points higher among Indigenous children compared to non-Indigenous children overall, and in all jurisdictions except Victoria, South Australia and Tasmania. Coverage for hepatitis A vaccine and the additional pneumococcal vaccine booster dose recommended for Indigenous children only increased in 2014 to 63.0% and 66.9%, respectively, compared with 2013.

Timeliness
Disparity in on-time vaccination between Indigenous and non-Indigenous children in 2014 was similar to previous years, declining progressively from 20.2% for vaccines due by 12 months to 11.5% for those due by 24 months and 3.0% at 60 months of age. By late 2014, the percentage of all children who received the 1st dose of diphtheria-tetanus-pertussis (DTPa)-containing vaccine at less than 8 weeks of age was greater than 50% in all but one jurisdiction and greater than 70% in six jurisdictions.

Vaccination objection
In 2014, the proportion of children whose parents had registered an objection to vaccination was 1.8% at the national level, with large regional variations, a decrease from 2013 of 0.1 of a percentage point.

Keywords: immunisation coverage, immunisation delay, Indigenous immunisation coverage, vaccine objection, human papillomavirus vaccine coverage

Introduction
This is the 8th Annual Immunisation Coverage Report, with the first report having focused on 2007 data.1–6 This report complements other reports providing data on immunisation coverage in Australia7 and highlights important trends and significant issues. It follows the format of previous reports, providing a detailed summary for 2014 that includes vaccination coverage at standard milestone ages, coverage for vaccines not included in standard coverage assessments, timeliness of vaccination, coverage for Indigenous children, analysis of ‘partially immunised’ children, and data for small geographic areas on the prevalence of vaccine objection. This report also includes data on adolescents outside the Australian Childhood Immunisation Register (ACIR).
age group from previously published sources. Readers are referred to the first report for a more detailed explanation of the background to this series of annual reports and the range of analyses presented. This report uses the longstanding international practice of reporting at key milestone ages to measure coverage against national targets and to track trends over time. Table 1 shows the Australian National Immunisation Program Schedule for 2014.

<table>
<thead>
<tr>
<th>Age</th>
<th>Vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Childhood vaccines</td>
<td></td>
</tr>
<tr>
<td>Birth</td>
<td>Hep B</td>
</tr>
<tr>
<td>2 months</td>
<td>Hep B DTPa Hib Polio 13vPCV Rotavirus</td>
</tr>
<tr>
<td>4 months</td>
<td>Hep B DTPa Hib Polio 13vPCV Rotavirus</td>
</tr>
<tr>
<td>6 months</td>
<td>Hep B DTPa Hib Polio 13vPCV Rotavirus</td>
</tr>
<tr>
<td>12 months</td>
<td>Hib-Men C&lt;sup&gt;a&lt;/sup&gt; MMR MMRV&lt;sup&gt;d&lt;/sup&gt; Hep A&lt;sup&gt;c&lt;/sup&gt; 13vPCV&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>18 months</td>
<td>DTPa Polio MMRV&lt;sup&gt;d&lt;/sup&gt; 23vPPV&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>24 months</td>
<td></td>
</tr>
<tr>
<td>48 months</td>
<td></td>
</tr>
<tr>
<td>12–15 years</td>
<td>dTpa VZV Flu&lt;sup&gt;f&lt;/sup&gt; 23vPPV&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>15–49 years</td>
<td></td>
</tr>
<tr>
<td>Adult vaccines</td>
<td></td>
</tr>
<tr>
<td>≥50 years</td>
<td>Flu&lt;sup&gt;f&lt;/sup&gt; 23vPPV&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>65 years</td>
<td>Flu&lt;sup&gt;f&lt;/sup&gt; 23vPPV&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pregnant women (any age)</td>
<td></td>
</tr>
<tr>
<td>Flu&lt;sup&gt;f&lt;/sup&gt; 23vPPV&lt;sup&gt;h&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>3rd dose of rotavirus vaccine at 6 months of age is dependent on vaccine brand used in each state or territory.

<sup>b</sup>In July 2013, the combined Haemophilus influenzae type b (Hib) and meningococcal serogroup C (Men C) vaccine, Menitorix<sup>®</sup>, was added to the NIP Schedule at 12 months of age. This combination vaccine replaces the single dose of monovalent meningococcal C Conjugate vaccine (Men C) and booster dose of monovalent Hib vaccine previously scheduled at 12 months of age.

<sup>c</sup>Aboriginal and Torres Strait Islander children – doses at 12 months and 18 months of age in the Northern Territory and Western Australia and 18 and 24 months of age in Queensland and South Australia (schedule changed in July 2013 so doses administered at 12 months and 18 months of age in all four jurisdictions).

<sup>d</sup>Measles–mumps–rubella–varicella vaccine introduced onto NIP Schedule on 1 July 2013.

<sup>e</sup>Booster dose for medically at risk children at 12 months of age and Aboriginal and Torres Strait Islander children in the Northern Territory, Western Australia, Queensland and South Australia at 12–18 months of age.

<sup>f</sup>To be given only if MMRV vaccine was not given at 18 months of age. The dose of measles–mumps–rubella vaccine at 4 years of age ceased on 1 January 2016.

<sup>g</sup>Measles–mumps–rubella–varicella vaccine introduced into NIP Schedule on 1 July 2013.

<sup>h</sup>Medically at-risk children

<sup>i</sup>From February 2013, males and females aged 12–13 years received the HPV vaccine at school. Males aged 14–15 years also received the vaccine as part of a catch-up program until the end of the 2014 school year.

<sup>j</sup>Annual vaccination, all aged ≥6 months with medical risk factors, Aboriginal and Torres Strait Islander people aged ≥15 years, non-Indigenous adults aged ≥65 years.

<sup>k</sup>Aboriginal and Torres Strait Islander people: aged ≥15 years with medical risk factors; all aged ≥50 years.

<sup>l</sup>At any stage of pregnancy.

High levels of reporting to the ACIR are maintained by a system of incentive payments for immunisation providers and carers. These have been discussed in detail elsewhere. Some recent changes to immunisation policy, the incentive payment system and changes to the “fully immunised” coverage algorithms are highlighted in Box 1 and also referred to in this report.

**Methods**

*The Australian Childhood Immunisation Register*

The ACIR was established on 1 January 1996 by incorporating demographic data from Medicare on all enrolled children under the age of 7 years. Participation in the ACIR is ‘opt-out’ so it constitutes a nearly complete population register, as approximately 99% of children are registered with Medicare by 12 months of age. Children not enrolled in Medicare can also be added to the ACIR via a supplementary number. Since 2001, vaccinations given overseas may be recorded if a provider endorses their validity. Data are transferred to the ACIR when a recognised immunisation provider supplies details of an eligible vaccination either automatically from medical practice software or through the internet using the Medicare Australia website or by submitting paper encounter forms. The existence of medical contraindications and...
The conscientious objection to immunisation is also recorded on the ACIR. From 2016, conscientious objection is no longer a valid exemption to immunisation linked to family payments and therefore will no longer be recorded on the ACIR.

All vaccination records for a child remain on the register indefinitely, but no new vaccination records are added after the 7th birthday. However, from 2016 this will change to allow the recording of vaccinations given up to 19 years of age.

Vaccinations recorded on the ACIR must be rendered in accordance with the guidelines issued by the Australian Technical Advisory Group on Immunisation (ATAGI). Notifications falling outside these guidelines, or duplicate notifications, prompt an enquiry with the provider and, if their validity cannot be established, they are rejected.

Box 1. Significant changes in immunisation policy, immunisation incentives and coverage calculation algorithms, Australia, 2011 to 2014

<table>
<thead>
<tr>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2014</td>
<td>Immunisation coverage assessment algorithm for the 24-month milestone amended to require a dose of meningococcal vaccine, a dose of varicella vaccine and a 2nd dose of measles–mumps–rubella (MMR) vaccine to be classified as fully immunised.</td>
</tr>
<tr>
<td>July 2013</td>
<td>Immunisation coverage assessment algorithm for the 12-month milestone amended to include a 3rd dose of pneumococcal conjugate vaccine (PCV) in the assessment of fully immunised.</td>
</tr>
<tr>
<td>Combined Haemophilus influenzae type b (Hib) and meningococcal serogroup C (Men C) conjugate vaccine, Menitorix®, added to the National Immunisation Program (NIP) Schedule at 12 months of age, replacing the single dose of monovalent Men C vaccine and booster dose of monovalent Hib vaccine previously scheduled at 12 months of age.</td>
<td></td>
</tr>
<tr>
<td>Combination measles–mumps–rubella–varicella (MMRV) vaccine added to the NIP at 18 months of age, replacing MMR dose previously scheduled at 4 years of age and varicella vaccine dose previously scheduled at 18 months of age. MMR vaccination at 4 years of age continued in parallel until first cohort eligible for MMRV vaccine reached 4 years of age.</td>
<td></td>
</tr>
<tr>
<td>Hepatitis A vaccination schedule for Indigenous children changed so that dose 1 administered at 12 months of age and dose 2 at 18 months of age in all four relevant jurisdictions (the Northern Territory, Western Australia, Queensland and South Australia).</td>
<td></td>
</tr>
<tr>
<td>February 2013</td>
<td>Human papillomavirus (HPV) vaccine funded under the NIP for males aged 12–13 years, delivered in school-based programs.</td>
</tr>
<tr>
<td>July 2012</td>
<td>Eligibility for Family Tax Benefit Part A supplement required that children are assessed as fully immunised during the financial years that they turn 1, 2 and 5 years old or have an approved exemption, replacing the Maternity Immunisation Allowance.</td>
</tr>
<tr>
<td>October 2011</td>
<td>13-valent PCV (13vPCV) replaced 23-valent pneumococcal polysaccharide vaccine as booster dose in Indigenous children living in the Northern Territory, Western Australia, Queensland and South Australia.</td>
</tr>
<tr>
<td>July 2011</td>
<td>13vPCV replaced 7-valent PCV on the NIP for children at 2, 4 and 6 months of age in all states and territories except the Northern Territory (adopts 13vPCV from 1 October 2011).</td>
</tr>
</tbody>
</table>

‘Conscientious’ objection to immunisation is also recorded on the ACIR. From 2016, conscientious objection is no longer a valid exemption to immunisation linked to family payments and therefore will no longer be recorded on the ACIR. All vaccination records for a child remain on the register indefinitely, but no new vaccination records are added after the 7th birthday. However, from 2016 this will change to allow the recording of vaccinations given up to 19 years of age.

Vaccinations recorded on the ACIR must be rendered in accordance with the guidelines issued by the Australian Technical Advisory Group on Immunisation (ATAGI). Notifications falling outside these guidelines, or duplicate notifications, prompt an enquiry with the provider and, if their validity cannot be established, they are rejected.

Measuring immunisation coverage using the ACIR

The cohort method has been used for calculating coverage at the population level (national and state/territory) since the ACIR’s inception. Cohort immunisation status is assessed at 12 months of age (for vaccines due at 6 months), 24 months of age (for vaccines due at 12 and 18 months), and 60 months of age (for vaccines due at 48 months). A minimum 3-month lag period is allowed for late notification of vaccinations to the ACIR, but only vaccinations given on or before a child’s 1st, 2nd or 5th respective birthdays are considered. If a child’s records indicate receipt of the last dose of a vaccine that requires more than 1 dose to complete the series, it is assumed that earlier vaccinations in the sequence have been given. This assumption has been shown to be valid.

Three-month birth cohorts are used for time trend analyses, while both 3-month wide and 12-month wide cohorts are used for all other analyses in this report. The 12-month wide cohorts used in this report are children born between 1 January 2013 and 31 December 2013 for the 12-month milestone age; children born between 1 January 2012 and 31 December 2012 for the 24-month milestone age; and children born between 1 January 2009 and 31 December 2009 for the 5-year (60-month) milestone age.

The proportion of children designated as ‘fully immunised’ is calculated using the number of children completely immunised with the vaccines of interest by the designated age as the numerator, and the total number of Medicare-registered children in the age cohort as the denominator. ‘Fully immunised’ at 12 months of age is defined as a child having a record on the ACIR of three doses of a diphtheria (D), tetanus (T) and pertussis-containing (P) vaccine, 3 doses
of polio vaccine, 2 or 3 doses of PRP-OMP containing *Haemophilus influenzae* type b (Hib) vaccine or 3 doses of any other Hib vaccine, 3 doses of hepatitis B vaccine, and 3 doses of 13-valent pneumococcal conjugate vaccine. ‘Fully immunised’ at 24 months of age is defined as a child having a record on the ACIR of 3 doses of a DTP-containing vaccine, 3 doses of polio vaccine, 3 or 4 doses of PRP-OMP Hib, Infanrix Hexa or Hiberix vaccine (3 doses only of Infanrix Hexa or Hiberix if given after 11.5 months of age), or 4 doses of any other Hib vaccine, 3 doses of hepatitis B vaccine, 2 doses of a measles, mumps and rubella-containing (MMR) vaccine, 1 dose of meningococcal C vaccine, and 1 dose of varicella vaccine. ‘Fully immunised’ at 60 months of age is defined as a child having a record on the ACIR of 4 doses of a DTP-containing vaccine, 4 doses of polio vaccine, and 2 doses of an MMR-containing vaccine.

Immunisation coverage estimates were also calculated for individual National Immunisation Program (NIP) vaccines, including the three NIP vaccines given in early childhood but not routinely reported in the quarterly coverage reports published in *Communicable Diseases Intelligence* and not part of ‘fully immunised’ calculations at 12, 24 and 60 months of age. These are: a 2nd or 3rd dose of rotavirus vaccine by 12 months of age; a 2nd dose of hepatitis A vaccine in Indigenous children by 30 months of age; and a booster dose of pneumococcal vaccine in Indigenous children by 30 months of age.

Changes to immunisation policy and changes to the ‘fully immunised’ coverage algorithms have had an impact on vaccination coverage presented in this report. From July 2012, eligibility for the Family Tax Benefit Part A supplement required that children needed to be assessed as fully immunised, replacing the Maternity Immunisation Allowance. To meet the immunisation requirements for the Family Tax Benefit Part A supplement, parents needed to have their children immunised during the financial years that each child turned 1, 2 and 5 years old. Children needed to be up to date with immunisation or have an approved exemption.

The Australian Government has extended the immunisation requirements which were already in place for Child Care Benefit (CCB), Child Care Rebate (CCR) and the Family Tax Benefit (FTB) Part A end-of-year supplement. From 1 January 2016, children of all ages must meet immunisation requirements to be eligible to receive the FTB Part A end-of-year supplement and child care payments. Conscientious objection is no longer a valid exemption category for these requirements. Children need to be up to date with immunisation or have a medical exemption (approved by their general practitioner).

From the December 2013 quarterly coverage report, the 3rd dose of pneumococcal conjugate vaccine was included in coverage requirements for ‘fully immunised’ at the 12-month milestone. From the December 2014 quarterly coverage report, a dose of meningococcal vaccine and a dose of varicella vaccine were included in the coverage requirements for ‘fully immunised’ at the 24-month milestone, along with the 2nd dose of MMR instead of the 1st dose as previously. The 2nd dose of MMR remained in the coverage assessment algorithm for the 60-month milestone age.

**Timeliness**

Age-appropriate timely vaccination was defined as receipt of a scheduled vaccine dose within 30 days of the recommended age. For example, a child who received the 1st dose of DTPa (due at 60 days of age) when he or she was more than 90 days of age was classified as late for that dose. For descriptive purposes, we categorised the delay outcome measure for each dose as either ‘delay of 1–<6 months’ or ‘delay ≥6 months’. Timeliness is measured in 12-month birth cohorts. Children included in the timeliness analysis were assessed at 1–3 years after doses were due, to allow time for late vaccinations to be recorded. Therefore, cohorts assessed for timeliness are not the same as those assessed for coverage milestones. The interval between doses was not evaluated. Timeliness of different vaccines and doses was also compared by plotting the cumulative percentage receiving each vaccine dose by age.

**Remoteness status**

The area of residence of children was defined as ‘Major cities’, ‘Inner regional’, ‘Outer regional’, ‘Remote’, and ‘Very remote’ using the Accessibility/Remoteness Index of Australia (ARIA+). ARIA+ is a continuous varying index with values ranging from 0 (high accessibility) to 15 (high remoteness), and is based on road distance measurements from over 12,000 populated localities to the nearest Service Centres in five categories based on population size. For analysis, 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.

**Indigenous status**

Indigenous status on the ACIR is recorded as ‘Indigenous’, ‘non-Indigenous’ or ‘unknown’, as reported by the child’s carer to Medicare or by the immunisation provider to the ACIR. For this report we considered two categories of children: ‘Indigenous’ and ‘non-Indigenous’; children with unknown Indigenous status were presumed to be ‘non-Indigenous’. Coverage estimate time trends are presented from 2002 only, due to poor rates of reporting Indigenous status prior to then.

**Small area analysis**

Analysis for small areas was done by ABS-defined Statistical Area 3 (SA3), chosen because each is small enough
to show differences within jurisdictions but not too small to render maps unreadable. Maps were created using version 12 of the MapInfo mapping software and the ABS Census Boundary Information. As postcode is the only geographical indicator available from the ACIR, the ABS Postal Area to SA3 Concordance 2011 was used to match ACIR postcodes to SA3s.

Objection to vaccination and incomplete immunisation

Until 2016, parents who registered vaccination objection were eligible for parental incentive payments even if their children were unvaccinated. However some parents who objected to vaccination did not register an objection. We calculated the proportions of children with registered vaccination objection status and no vaccines recorded on the ACIR, registered vaccination objection status and at least one vaccine recorded on the ACIR, no registered vaccination objection status and no vaccines recorded on the ACIR, and no registered vaccination objection status and not ‘fully immunised’ by 24 months of age, from the cohort of children registered with Medicare and born between 1 October 2012 and 31 December 2012. Some of the children in the latter two groups may be incompletely immunised due to unregistered vaccination objection. We chose this cohort for calculation of proportions of these groups in 2014 so that children under the age of 12 months were excluded, to allow sufficient time for registration of objection.

Human papillomavirus vaccine coverage

Human papillomavirus (HPV) vaccine is included on the NIP, with the vaccine delivered to females and, since 2013, males through an ongoing school-based program usually in the first year of secondary school. From 2007 to 2009, there was a time-limited catch-up program delivered through schools, general practices and community immunisation services for females up to age 26. Males were offered a time-limited catch-up program in 2013–2014, at the age of 14–15 years. A full course of HPV immunisation was defined as 3 doses of quadrivalent HPV vaccine. Data on HPV vaccination are provided by the National HPV Vaccination Program Register, which is operated by the Victorian Cytology Service. Data for males represent the vaccination coverage achieved during the catch-up program for 14–15-year-old males during 2013–2014. The purpose of this legislated register is to support the implementation of the vaccination program and to provide data for monitoring and evaluation. States and territories provide data to the HPV Register from their school-based programs. Doses administered in general practice or by community providers outside of the school program are notified on a voluntary basis, with a notification payment provided only to GPs during the 2007–2009 catch-up program. The World Health Organization (WHO) recommends using 15 years as the reference age for HPV vaccination coverage for the purposes of international comparison.

Coverage in the elderly

While an Adult Vaccination Survey (AVS) has not been undertaken in Australia since 2009, data from a Newspoll Omnibus Survey in 2014 are presented. From September 2016 the ACIR will expand to become the Australian Immunisation Register. This Register will capture all vaccines administered throughout a person’s life (birth to death) from that point forward, given through general practice and community clinics.

Indigenous adolescent and adult coverage

Indigenous adolescent and adult coverage estimates are obtained from the 2012/13 Aboriginal and Torres Strait Islander Health Survey.

Results

Coverage estimates

‘Fully immunised’

Coverage estimates in 2014 for full-year birth cohorts at the three milestone ages of 12 months, 24 months and 60 months are provided in Tables 2–4. The proportion of Australian children classified as ‘fully immunised’ was 91.5% at 12 months, 86.8% at 24 months and 92.0% at 60 months of age, compared to 2013 coverage at these milestones of 90.8%, 92.1% and 91.2%, respectively. Nationally and for almost all jurisdictions, ‘fully immunised’ coverage (except at the 24-month age milestone) and coverage for all individual vaccines (except rotavirus vaccine, varicella vaccine and dose 2 of MMR vaccine) at all three age milestones was above 90%, the target at that time.

Figure 1 shows time trends in ‘fully immunised’ childhood vaccination coverage in Australia, assessed at 12 months, 24 months and 60 months of age, for 3-month cohorts born from 1 January 1999 to 31 December 2013. Coverage has been largely stable at the 12- and 24-month age milestones since late 2003. However, during 2013, ‘fully immunised’ coverage at the 12-month age milestone for vaccines due at 6 months of age declined by 1.8 percentage points, partly due to the inclusion of 13-valent pneumococcal conjugate vaccine (PCV) in the coverage assessment algorithm, and then increased by 1.2% in 2014. In the latter half of 2014, ‘fully immunised’ coverage at the 24-month age milestone declined by 5.5 percentage points. The bulk of this decrease was due to the coverage assessment algorithm being amended in July 2014 to include a dose of meningococcal vaccine, a dose of varicella vaccine and a 2nd dose of MMR vaccine. This is demonstrated in Table 2 which shows ‘fully immunised’ coverage at the 24-month age milestone to have only dropped by 0.4 of a percentage point percent when calculated using the old algorithm. For vaccines due at 48 months of age, ‘fully immunised’ coverage dropped to 80.4% in January 2008, following the change in assessment age from 72 months to 60 months,
but then rose substantially in 2009 and 2010 and kept increasing throughout 2011–2014 to a level higher than that for the 12-month and 24-month age milestones in 2014.

### Individual vaccines

Coverage at 12 months of age for individual antigens in the relevant combination vaccine (DTPa-hepB-IPV-Hib) increased in 2014 (Figure 2). Coverage for 3 doses of PCV by 12 months of age rose steadily from below 90% in mid-2007 to 91.4% in late 2014, just below the level for all other vaccines assessed at this age except for rotavirus vaccine. After being added to the NIP in July 2007, rotavirus vaccine coverage for 2 or 3 doses (depending on vaccine brand) at 12 months of age rose steeply from about 75% in late 2008 to almost 84% in late 2011 and has remained largely stable since, with minor fluctuations. Rotavirus vaccine coverage was lower nationally (Figure 2) and had greater variation between jurisdictions than other vaccines given at 2, 4 and 6 months of age. Reported coverage in 2014 at 12 months of age varied from 90.4% in the Australian Capital Territory for 2 doses

### Table 2. Percentage of children assessed in 2014 as immunised by 12 months of age, by vaccine and state or territorya, Australia

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of children</td>
<td>5,560</td>
<td>98,101</td>
<td>3,641</td>
<td>61,747</td>
<td>19,593</td>
<td>5,893</td>
<td>75,544</td>
<td>33,710</td>
<td>303,789</td>
</tr>
<tr>
<td>Diphtheria, tetanus, pertussis</td>
<td>95.1</td>
<td>92.4</td>
<td>91.3</td>
<td>92.8</td>
<td>92.2</td>
<td>92.0</td>
<td>92.7</td>
<td>92.7</td>
<td>92.6</td>
</tr>
<tr>
<td>Polio</td>
<td>95.1</td>
<td>92.3</td>
<td>91.3</td>
<td>92.8</td>
<td>92.1</td>
<td>92.0</td>
<td>92.6</td>
<td>92.7</td>
<td>92.5</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em> type b</td>
<td>94.8</td>
<td>92.0</td>
<td>91.1</td>
<td>92.5</td>
<td>91.9</td>
<td>91.7</td>
<td>92.3</td>
<td>92.3</td>
<td>92.3</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>94.6</td>
<td>92.0</td>
<td>91.1</td>
<td>92.4</td>
<td>91.8</td>
<td>91.7</td>
<td>92.2</td>
<td>92.1</td>
<td>92.2</td>
</tr>
<tr>
<td>Pneumococcal conjugate</td>
<td>94.6</td>
<td>91.8</td>
<td>91.1</td>
<td>92.3</td>
<td>91.6</td>
<td>91.7</td>
<td>92.1</td>
<td>91.8</td>
<td>92.0</td>
</tr>
<tr>
<td>Fully immunisedb</td>
<td>93.9</td>
<td>91.3</td>
<td>90.6</td>
<td>92.0</td>
<td>91.2</td>
<td>91.2</td>
<td>91.6</td>
<td>91.3</td>
<td>91.5</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>90.4</td>
<td>87.4</td>
<td>86.4</td>
<td>82.2</td>
<td>83.5</td>
<td>86.1</td>
<td>83.3</td>
<td>80.0</td>
<td>84.3</td>
</tr>
</tbody>
</table>

bFully immunised – 3 doses of a diphtheria-tetanus-pertussis (DTPa)-containing vaccine, 3 doses of polio vaccine, 2 or 3 doses of PRP-OMP-containing *Haemophilus influenzae* type b (Hib) vaccine or 3 doses of any other Hib vaccine, 3 doses of any hepatitis B vaccine or 2 doses of either Engerix-B (paediatric), Comvax or H-B-VAX II (paediatric), and 3 doses of pneumococcal conjugate vaccine.

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 Childhood Immunisation Register, data as at 31 March 2015.

### Table 3. Percentage of children assessed in 2014 as immunised by 24 months of age, by vaccine and state or territorya, Australia

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of children</td>
<td>5,549</td>
<td>101,937</td>
<td>3,638</td>
<td>63,676</td>
<td>20,223</td>
<td>5,893</td>
<td>77,235</td>
<td>34,735</td>
<td>312,515</td>
</tr>
<tr>
<td>Diphtheria, tetanus, pertussis</td>
<td>96.3</td>
<td>95.1</td>
<td>95.4</td>
<td>95.1</td>
<td>94.7</td>
<td>95.2</td>
<td>95.5</td>
<td>94.6</td>
<td>95.2</td>
</tr>
<tr>
<td>Polio</td>
<td>96.3</td>
<td>95.1</td>
<td>95.4</td>
<td>95.1</td>
<td>94.7</td>
<td>95.1</td>
<td>95.5</td>
<td>94.5</td>
<td>95.1</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em> type b</td>
<td>94.8</td>
<td>93.7</td>
<td>94.9</td>
<td>94.1</td>
<td>93.2</td>
<td>93.8</td>
<td>94.0</td>
<td>93.1</td>
<td>93.8</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>95.6</td>
<td>94.6</td>
<td>95.4</td>
<td>94.6</td>
<td>94.2</td>
<td>94.8</td>
<td>94.9</td>
<td>93.8</td>
<td>94.6</td>
</tr>
<tr>
<td>Measles, mumps, rubella</td>
<td>91.9</td>
<td>88.7</td>
<td>89.2</td>
<td>90.3</td>
<td>88.5</td>
<td>88.0</td>
<td>89.1</td>
<td>86.2</td>
<td>88.9</td>
</tr>
<tr>
<td>Varicella</td>
<td>92.3</td>
<td>89.6</td>
<td>90.1</td>
<td>90.4</td>
<td>88.9</td>
<td>88.6</td>
<td>89.8</td>
<td>87.7</td>
<td>89.6</td>
</tr>
<tr>
<td>Meningococcal C</td>
<td>94.6</td>
<td>93.5</td>
<td>94.7</td>
<td>94.1</td>
<td>93.2</td>
<td>94.0</td>
<td>93.7</td>
<td>92.7</td>
<td>93.6</td>
</tr>
<tr>
<td>Fully immunised – old definitionb</td>
<td>93.3</td>
<td>91.5</td>
<td>93.4</td>
<td>92.7</td>
<td>91.5</td>
<td>91.8</td>
<td>92.1</td>
<td>91.1</td>
<td>91.9</td>
</tr>
<tr>
<td>Fully immunisedc</td>
<td>90.1</td>
<td>86.4</td>
<td>86.4</td>
<td>88.7</td>
<td>86.3</td>
<td>85.3</td>
<td>87.0</td>
<td>84.3</td>
<td>86.8</td>
</tr>
</tbody>
</table>

bFully immunised – old definition – 3 doses of a DTPa-containing vaccine, 3 doses of polio vaccine, 3 or 4 doses of PRP-OMP-containing Hib vaccine or 4 doses of any other Hib vaccine, and 3 doses of hepatitis B vaccine.
cFully immunised – 3 doses of a DTPa-containing vaccine, 3 doses of polio vaccine, 3 or 4 doses of PRP-OMP-containing Hib vaccine or 4 doses of any other Hib vaccine, 3 doses of hepatitis B vaccine, 2 doses of a measles–mumps–rubella (MMR)-containing vaccine, 1 dose of varicella vaccine, and 1 dose of meningococcal C vaccine.

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 Childhood Immunisation Register, data as at 31 March 2015.
of Rotarix® vaccine, to 80.0% in Western Australia for 3 doses of RotaTeq® vaccine (Table 2).

In 2014 coverage at 24 months of age was around 93–95% for all vaccines (except varicella and the 2nd dose of MMR) (Figure 3). In the latter half of 2014, coverage for MMR declined by 5.1 percentage points. This is due to the 2nd dose of MMR, now due at 18 months of age, being assessed at 24 months of age for the first time, instead of the 1st dose as previously. Varicella coverage at 24 months of age increased sharply in mid-2013, following replacement of monovalent varicella vaccine with measles–rubella–varicella (MMRV) vaccine as the vaccine due at 18 months of age (see also separate section below comparing varicella coverage before and after introduction of MMRV vaccine). As the 18-month schedule point has historically been associated with lower coverage when assessed at the 24-month age milestone, given that there is only a 6-month time period for catch-up, we compared varicella coverage assessed at 36 months and 60 months of age to that assessed at 24 months, by jurisdiction (Figure 4). Coverage by jurisdiction was 6.0 to 10.4 percentage points higher at 60 months, with all jurisdictions reaching over 90% varicella coverage when assessed at 60 months.
For vaccines due at 48 months of age, trends in individual vaccine coverage were similar to that seen for ‘fully immunised’ coverage, that is, a marked drop in January 2008 following the change in assessment age from 72 months to 60 months, followed by a marked increase in 2009 and 2010 and ongoing increase to a level higher than when coverage was assessed at 72 months of age (Figure 5). Coverage for both vaccines due at 48 months (DTPa and MMR) was greater than 92% in 2014.

A comparison of varicella coverage before and after introduction of MMRV vaccine

In July 2013, MMRV was introduced at the 18 months of age schedule point, replacing the single dose of varicella vaccine previously scheduled at this age point and the 2nd dose of MMR previously scheduled at 48 months of age.

Table 5 provides varicella coverage for two 3-month wide birth cohorts 2 years apart, allowing comparison of coverage before and after introduction of MMRV vaccine. For Australia as a whole, varicella coverage increased by 3.7 percentage points from pre to post introduction of MMRV. Increases occurred in all jurisdictions except the Northern Territory and Tasmania, ranging up to a 5.2 percentage point increase in South Australia and Victoria.

Indigenous coverage estimates

Immunisation coverage estimates in 2014 for the three age milestones by Indigenous status, vaccine and jurisdiction are provided in Tables 6 and 7. As in previous years, ‘fully immunised’ coverage at 12 months of age among Indigenous children was lower than for non-Indigenous children in all jurisdictions, with the differential varying from 6.9 percentage points in Western Australia to 0.3 percentage points in the Australian Capital Territory, and 3.7% overall. ‘Fully immunised’ coverage at 24 months of age among Indigenous children in 2014 was 3.3 percentage points lower, with the differential varying from 6.4 percentage points in Victoria to 0.5 of a percentage point in New South Wales. The lower coverage gap for New South Wales may reflect the NSW Aboriginal Immunisation Health Care Worker Program that began as a 3-year pilot program in 2012. ‘Fully immunised’ coverage at 60 months of age in 2014 was 1.6 percentage points higher among Indigenous children compared to non-Indigenous children, with coverage in Indigenous children at this age milestone higher in all jurisdictions except Victoria, South Australia and Tasmania.

The coverage differential between Indigenous and non-Indigenous children for individual vaccines varied in 2014,
with coverage lower for Indigenous children for all vaccines at 12 months of age, but higher at 24 months of age for DTPa, polio, hepatitis B, Hib and meningococcal C vaccines, and at 60 months of age for DTPa, polio and MMR.

The proportion of Indigenous children ‘fully immunised’ by 24 months of age was consistently higher than at 12 and 60 months of age until 2012, when coverage at 60 months rose to levels comparable to that at 24 months (Figure 6). During the latter half of 2014, the proportion of Indigenous children ‘fully immunised’ by 24 months of age decreased from 92.9% to 84.4%, due to the changes to the ‘fully immunised’ coverage algorithm, as noted above.

Adolescents and adults

For Indigenous adults and adolescents, according to the 2012/13 Aboriginal and Torres Strait Islander Health Survey, 13% of Indigenous Australians aged 15 years and over had a pneumococcal vaccination in the previous 5 years and 34% of Indigenous Australians aged 15 and over had an influenza vaccination in the previous 12 months.

Pneumococcal booster and hepatitis A vaccine for Indigenous children in some jurisdictions

Hepatitis A vaccine has been included on the NIP since November 2005 for Indigenous children in the Northern Territory, Queensland, South Australia and Western Australia, but was used earlier than this in north Queensland. Since March 2007, coverage of 2 doses of hepatitis A vaccine for Indigenous children by 30 months of age in Western Australia and the Northern Territory and 36 months of age in Queensland and South Australia had increased from 30.5% to 60.1% in December 2013 (Figure 7). By the latter half of 2014, coverage had increased to its highest recorded level of 62.9% with all four jurisdictions assessing 2 doses at 30 months of age from July 2013. An additional 17% of children had received 1 dose of hepatitis A vaccine by 18 months of age, putting national coverage in 2014 for Indigenous children (Northern Territory, Queensland, South Australia and Western Australia only) for at least 1 dose of hepatitis A vaccine at 79.8% (Table 8). There is variation in reported hepatitis A vaccine coverage by jurisdiction, from a low of 37.5% in South Australia to a high of 86.2% in the Northern Territory for 2-dose coverage (Table 8).
Figure 4. Comparison of 1-dose varicella vaccine coverage assessed in December 2014 at 24 months of age versus 36 months of age and 60 months of age, by state or territory, Australia.

ACT: Australian Capital Territory; NSW: New South Wales; NT: Northern Territory; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Australia; AUST: Australia
Source: Australian Childhood Immunisation Register, data as at 31 March 2015.

Figure 5. Trends in vaccination coverage estimates for individual vaccines\(^a\) at 60 months of age (assessed at 72 months prior to December 2007), Australia, 2003 to 2014.

By 3-month birth cohorts born between 1 January 1996 and 31 December 2009. Coverage assessment date was 72 months after the last birth date of each cohort up to December 2007 and then 60 months after the last birth date of each cohort.

\(^a\)4th dose of DTP\(\text{a}\) and polio, 2nd dose of MMR.
DTP\(\text{a}\): diphtheria–tetanus–acellular pertussis
MMR: measles–mumps–rubella
Source: Australian Childhood Immunisation Register.
A pneumococcal booster dose at 18–24 months of age has been recommended and funded for Indigenous children in the same four jurisdictions (the Northern Territory, Queensland, South Australia and Western Australia) since 2001; firstly as 23-valent pneumococcal polysaccharide vaccine then as 13-valent pneumococcal conjugate vaccine (13vPCV), from July 2013 in Queensland, South Australia and Western Australia, and from October 2013 in the Northern Territory. Coverage gradually increased from 47.0% in March 2007 to 63.4% in December 2011.
In 2012 coverage increased by 15 percentage points following the 13vPCV catch-up campaign that took place that year. Coverage then fell 14 percentage points during 2013 but increased by 9 percentage points in 2014 to 67.5%. There was a large variation between jurisdictions in coverage for the booster dose of pneumococcal conjugate vaccine, from a low of 41.2% in South Australia to a high of 85.4% in the Northern Territory (Table 8).

Table 7. Percentage of children fully immunised by 12 months, 24 months and 60 months of age, by Indigenous status and state or territory, Australia, assessed in 2014

<table>
<thead>
<tr>
<th>State or territory</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 months – fully immunised&lt;sup&gt;a&lt;/sup&gt;</td>
<td>93.6</td>
<td>90.5</td>
<td>88.3</td>
<td>86.8</td>
<td>87.5</td>
<td>87.4</td>
<td>87.5</td>
<td>84.8</td>
<td>88.0</td>
</tr>
<tr>
<td>24 months – fully immunised&lt;sup&gt;b&lt;/sup&gt;</td>
<td>93.9</td>
<td>91.3</td>
<td>92.0</td>
<td>92.4</td>
<td>91.4</td>
<td>91.5</td>
<td>91.6</td>
<td>91.7</td>
<td>91.7</td>
</tr>
<tr>
<td>60 months – fully immunised&lt;sup&gt;c&lt;/sup&gt;</td>
<td>88.2</td>
<td>85.9</td>
<td>85.4</td>
<td>84.2</td>
<td>80.8</td>
<td>80.8</td>
<td>80.7</td>
<td>79.2</td>
<td>83.7</td>
</tr>
</tbody>
</table>

<sup>a</sup>‘Fully immunised’ – 3 doses of a diphtheria-tetanus-pertussis (DTPa)-containing vaccine, 3 doses of polio vaccine, 2 or 3 doses of PRP-OMP-containing *Haemophilus influenzae* type b (Hib) vaccine or 3 doses of any other Hib vaccine, 3 doses of hepatitis B vaccine, and 3 doses of pneumococcal conjugate vaccine. Cohort born 1 January 2013 – 31 December 2013

<sup>b</sup>‘Fully immunised’ – 3 doses of a DTPa-containing vaccine, 3 doses of polio vaccine, 3 or 4 doses of PRP-OMP-containing Hib vaccine or 4 doses of any other Hib vaccine, 3 doses of hepatitis B vaccine, 2 doses of a measles-mumps-rubella (MMR)-containing vaccine, 1 dose of meningococcal C vaccine, and 1 dose of varicella vaccine. Cohort born 1 January 2012 – 31 December 2012

<sup>c</sup>‘Fully immunised’ – 4 doses of a DTPa-containing vaccine, 4 doses of polio vaccine, and 2 doses of an MMR-containing vaccine. Cohort born 1 January 2009 – 31 December 2009

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 Childhood Immunisation Register, data as at 31 March 2015.

Figure 6. Trends in ‘fully immunised’ vaccination coverage estimates for Indigenous children in Australia, 2002 to 2014, by age milestones.

MMR: measles–mumps–rubella

Source: Australian Childhood Immunisation Register.
Seasonal influenza vaccine coverage

Seasonal influenza vaccine has been recommended and funded for children with underlying medical conditions for many years. In 2008 a funded seasonal influenza vaccination program for all children aged from 6 months to less than 5 years was introduced in Western Australia. In 2013 seasonal influenza vaccine was recommended (but not funded) for all Australian children aged from 6 months to less than 5 years, and in 2015 it was included on the NIP for all Aboriginal and Torres Strait Islander children aged 6 months to less than 5 years. This report provides baseline coverage data up to 2014 to inform future monitoring of coverage under this program, although these data should be interpreted with caution due to the potential for under-reporting, possibly due to influenza vaccine notifications by immunisation providers not resulting in any notification payments unlike other vaccines on the NIP. Influenza vaccine coverage recorded in the ACIR in this age group was less than 2.5% in both Indigenous and non-Indigenous Australian children (excluding Western Australia) from 2005 through to 2014 (Figure 8). Coverage in Western Australian children rose to around 28% in 2009 following introduction of their universal funded program, but has been substantially lower since, following the much publicised issues of increased incidence of high fevers and febrile convulsions post vaccination with one particular vaccine brand in 2010. The percentage of influenza vaccinated children aged 6 months to less than 5 years recorded in the ACIR as having received 2 doses in their first year of influenza vaccination, as recommended, ranged from 32% to 61% between 2007 and 2014 for both Indigenous and
non-Indigenous children, apart from a sharp decline to less than 10% in 2010 following suspension of influenza vaccine use in this age group in that year (not shown).

**Timeliness of immunisation**

We examined timeliness of immunisation in 2014 for vaccines requiring multiple doses (DTPa, PCV and MMR) or a single dose (meningococcal C) at 12 and 24 months of age.

As demonstrated in previous reports, the proportion with vaccination delay increased with older age (Figure 9). The greatest proportion with any delay was seen with the 2nd dose of MMR vaccine due at 48 months, with 38.5% of doses given late and 5.9% given very late at 6 months (Table 9). These figures are an improvement from the 2013 report (50.7% and 6.9%, respectively).

For the 3rd dose of DTPa vaccine, there was greater delay for Indigenous children than for non-Indigenous children, with a 20.2% differential in on-time vaccination by 7 months of age (Figure 10). The same pattern was found for timeliness of the 1st dose of MMR vaccine by 13 months of age, but with a smaller differential of 11.5% (Figure 11). This differential in on-time vaccination between Indigenous and non-Indigenous children was slightly improved from the 2013 report, where the corresponding differentials for the 3rd dose of DTPa and 1st dose of MMR were 21.6% and 12.9%, respectively. In contrast to the 3rd dose of DTPa and the 1st dose of MMR, analysis of timeliness of immunisation for a vaccine due at 48 months of age, the 2nd dose of MMR, showed a much smaller differential in delayed receipt between Indigenous and non-Indigenous children, of 3% by 49 months of age (Figure 12a). We also examined the timeliness of
immunisation for the 2nd dose of MMR as the coverage algorithm for the 24-month old age group changed in July 2014 to include this dose at 18 months of age. Timeliness of the 2nd dose of MMR improved for non-Indigenous children from 58.0% (when due at 48 months) to 63.4% (when due at 18 months) but decreased for Indigenous children (from 55.0% to 48.5%, respectively) (Figure 12b).

As a consequence, there was a greater differential in on-time vaccination between Indigenous and non-Indigenous children in 2014 (15.3 percentage points).

Delayed receipt of the 3rd dose of DTPa and the 1st dose of MMR by 1–6 months was found in 28–38% of Indigenous children and 17–24% of non-Indigenous children in 2014.

### Table 9. Vaccination delay, by Indigenous and remoteness status for 2-year olds,a Australia, 2014

<table>
<thead>
<tr>
<th>Vaccine dose</th>
<th>Indigenous status</th>
<th>Remoteness category</th>
<th>1–&lt;6 months after schedule point %</th>
<th>≥6 months after schedule point %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTPa3</td>
<td>Indigenous</td>
<td>Major Cities</td>
<td>27.7</td>
<td>9.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inner and Outer Regional</td>
<td>29.4</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remote and Very Remote</td>
<td>37.5</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>Non-Indigenous</td>
<td>Major Cities</td>
<td>16.5</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inner and Outer Regional</td>
<td>18.1</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remote and Very Remote</td>
<td>18.3</td>
<td>2.4</td>
</tr>
<tr>
<td>MMR1</td>
<td>Indigenous</td>
<td>Major Cities</td>
<td>31.5</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inner and Outer Regional</td>
<td>31.3</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remote and Very Remote</td>
<td>33.0</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Non-Indigenous</td>
<td>Major Cities</td>
<td>23.2</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inner and Outer Regional</td>
<td>23.3</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remote and Very Remote</td>
<td>23.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

aThe cohort of children born in 2012 and assessed in 2014.

DTPa3: 3rd dose of diphtheria–tetanus–acellular pertussis vaccine

MMR1: 1st dose of measles–mumps–rubella vaccine

Source: Australian Childhood Immunisation Register, data as at 31 March 2015.
depending on remoteness status (Table 9). Vaccination delay was greater for Indigenous children than for non-Indigenous children for both vaccines across all categories (major cities, inner/outer regional and remote/very remote areas).

Vaccination delay for Indigenous children by jurisdiction was measured for the 3rd dose of PCV, with the highest proportions experiencing delays of 1–<6 months in Western Australia (34.5%) and the Northern Territory (33.6%), and...
delays of ≥6 months in South Australia (12.6%) and Western Australia (11.5%) (Figure 13).

Trends in timeliness of the 3rd dose of PCV and the 1st dose of MMR vaccine by Indigenous status are provided in Figures 14 and 15. Timeliness for the 3rd dose of PCV improved marginally over time for non-Indigenous children, from 78% in the 2007 birth cohort to 80% in the 2012 birth cohort; however, no improvements were seen for Indigenous children (Figure 14). Timeliness for the 1st

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**Figure 12b.** Timeliness of the 2nd dose of MMR vaccine (MMR2) due at 18 months, by Indigenous status, Australia.

*Percentage covered: number of children who received vaccine dose at particular ages/the total number of children who received the vaccine dose, expressed as a percentage.

Cohort born in 2012.

Source: Australian Childhood Immunisation Register, data as at 31 March 2015.

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**Figure 13.** Vaccination delay for Indigenous children for the 3rd dose of pneumococcal conjugate vaccine, by state or territory, Australia, 2014.

Cohort born in 2012.

Source: Australian Childhood Immunisation Register, data as at 31 March 2015.
Recommendation to give 1st dose of DTPa from 6 weeks of age and the 4th dose of DTPa from 3.5 years of age

In response to a pertussis epidemic, and to provide early protection to young infants, the Australian Technical Advisory Group on Immunisation (ATAGI) recommended in March 2009 that immunisation providers give the

dose of MMR vaccine improved over time for non-Indigenous children, from 70.0% in the 2007 birth cohort to 75.0% in the 2012 birth cohort. Timeliness also improved marginally over time for Indigenous children, from 61.0% in the 2007 birth cohort to 63.0% in the 2012 birth cohort (Figure 15).

Figure 14.  Timeliness of the 3rd dose of pneumococcal vaccine, by Indigenous status and year of birth, Australia, 2007 to 2012, assessed in 2014.
Source: Australian Childhood Immunisation Register.

Figure 15.  Timeliness of the 1st dose of MMR vaccine, by Indigenous status and year of birth, Australia, 2007 to 2012, assessed in 2014.
Source: Australian Childhood Immunisation Register.
1st dose of DTPa vaccine at 6 weeks of age instead of 8 weeks (2 months) of age. This was promoted in that year during epidemics in New South Wales and Tasmania and later in other jurisdictions. Prior to this, very few children received the vaccine dose at less than 8 weeks of age but over the next few years the percentage rose and by late 2014 it was greater than 70% in all jurisdictions except Western Australia and the Northern Territory (Figure 16).

ATAGI also recommended in October 2009 that the pre-school booster dose of DTPa-IPV could be given from 3.5 rather than 4 years of age. Take-up of this recommendation was slower with no jurisdiction giving the vaccine in any great numbers at 3.5 to 4 years of age until November 2010 (Figure 9). As at December 2014, more than 35% of children in three jurisdictions (the Australian Capital Territory, the Northern Territory and South Australia) were receiving the dose at 3.5 to 4 years of age (Figure 17).

Objection to vaccination and incomplete immunisation

Registered objection
The percentage of children with a registered vaccination objection, with or without any vaccines recorded on the ACIR, and children without a registered objection but with either no vaccines recorded or partially immunised (i.e. some vaccines but not fully immunised) at 24 months of age, for all jurisdictions and Australia, is shown in Table 10. Some of the children in the latter two groups may be incompletely immunised due to unregistered vaccine objection. Of the four groups, the largest is those without a registered objection and partially immunised.

The rate of registered objection in 2014 for Australia was 1.8% and this varied by jurisdiction with a high of 2.4% in Queensland and a low of 1.1% in Tasmania.

The proportions of children with a registered objection to vaccination are presented by Statistical Area 3 (SA3) in Figure 18. The map shows pockets of high levels of registered objection in 2014, particularly in coastal areas of northern and south-east Queensland, northern New South Wales, the Adelaide Hills and the Margaret River/Busselton region. These areas have had consistently high levels of registered objection over many years.

Partially immunised children
The percentage of partially immunised children (excluding those with a registered vaccination objection) who were up-to-date in 2014 for specific vaccines due by 24 months of age is shown in Table 11, by jurisdiction. The vaccines that partially immunised children were most commonly missing by 24 months of age were the 2nd dose of MMR and the dose of varicella (Table 11).

Human papillomavirus vaccine coverage
Vaccination coverage, as notified to the HPV Register, for dose 3 of the HPV vaccine for females and males aged 10 years or older.
15 years in 2014 is shown in Table 12. For females in Australia, 73.4% completed a full course of the vaccine, up from 71.4% in 2013. Coverage varied by jurisdiction from a low of 67.7% in Tasmania to a high of 77.4% in Victoria in 2014. Coverage in all age groups was higher for earlier doses, as high as 85.0% for the 1st dose in females aged 14–15 years (Figure 19). Coverage was higher in the younger age groups than the older age groups, with only 52.0% of females aged 20–26 years fully vaccinated. For males in Australia, 61.4% completed a full course of the vaccine. Coverage varied by
jurisdiction from a low of 55.1% in Tasmania to a high of 67.8% in Victoria in 2014. As with data for females, coverage in all age groups was higher for earlier doses, as high as 75.0% for the 1st dose in males aged 14–15 years. HPV coverage by Indigenous status is not available due to limitations in Indigenous status reporting on the HPV Register.

Coverage in the elderly

According to a Newspoll Omnibus Survey, 73% of Australian adults aged 65 years and older had received an influenza vaccination in 2014 as at mid-June.

Mechanisms of reporting to the ACIR

The proportions of vaccinations on the ACIR lodged by electronic/online mechanisms versus non-electronic mechanisms by jurisdiction are shown in Figure 21. Most reporting in 2014 occurred through electronic/online mechanisms, for all jurisdictions, with the proportion reported through this method varying from 96.3% in the Northern Territory to 84.6% in New South Wales.

Discussion

In 2014 ‘fully immunised’ coverage was higher than in 2013 nationally for children at 12 and 60 months of age (91.5% and 92.0% versus 90.8% and 91.2%, respectively) but lower for children at 24 months of age (86.8% versus 92.1%). However, this decline in coverage at the 24-month age milestone was predominantly a measurement artefact due to the immunisation coverage assessment algorithm for ‘fully immunised’ at the 24-month milestone being amended in July 2014 to include a dose of meningococcal vaccine, a dose of varicella vaccine and a 2nd dose of MMR vaccine.
Aside from minor fluctuations and the impact of changes to assessment algorithms, ‘fully immunised’ coverage has been largely stable at the 12- and 24-month age milestones since late 2003. The more than 10 percentage points increase in coverage at 60 months of age since 2009 is likely due to a focus on improved timeliness of vaccination, facilitated by a change to the ACIR overdue rules in January 2009, where children became overdue for their pre-school boosters at 49 months of age instead of the previous 60 months. This change had an impact on eligibility for parent incentive payments and outcome payments for providers.

Coverage estimates for varicella vaccine and the 2nd dose of MMR were substantially lower than for other vaccines included in the algorithm for ‘fully immunised’ at the

Table 11. Percentage of partially immuniseda 2-year-old childrenb who have received individual vaccines by state or territory, Australia, 2014

<table>
<thead>
<tr>
<th>State or territory</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total number of children</strong></td>
<td>100</td>
<td>2597</td>
<td>84</td>
<td>1202</td>
<td>526</td>
<td>194</td>
<td>1930</td>
<td>865</td>
<td>7498</td>
</tr>
<tr>
<td>3 doses of diphtheria, tetanus, acellular pertussis vaccine</td>
<td>88.0</td>
<td>77.9</td>
<td>83.3</td>
<td>79.2</td>
<td>80.6</td>
<td>75.3</td>
<td>81.6</td>
<td>79.5</td>
<td>79.6</td>
</tr>
<tr>
<td>4 doses of Haemophilus influenzae type b vaccine</td>
<td>59.0</td>
<td>58.5</td>
<td>61.9</td>
<td>61.7</td>
<td>60.1</td>
<td>60.3</td>
<td>56.6</td>
<td>59.4</td>
<td>58.8</td>
</tr>
<tr>
<td>3 doses of hepatitis B vaccine</td>
<td>82.0</td>
<td>74.0</td>
<td>83.3</td>
<td>76.0</td>
<td>76.6</td>
<td>74.7</td>
<td>78.2</td>
<td>74.3</td>
<td>75.8</td>
</tr>
<tr>
<td>1 dose of meningococcal C conjugate vaccine</td>
<td>62.0</td>
<td>63.5</td>
<td>73.8</td>
<td>69.6</td>
<td>68.6</td>
<td>68.0</td>
<td>65.3</td>
<td>66.1</td>
<td>65.8</td>
</tr>
<tr>
<td>2 doses of measles, mumps, rubella vaccine</td>
<td>23.0</td>
<td>27.2</td>
<td>34.5</td>
<td>28.0</td>
<td>28.5</td>
<td>29.4</td>
<td>28.7</td>
<td>23.7</td>
<td>27.5</td>
</tr>
<tr>
<td>1 dose of varicella vaccine</td>
<td>25.0</td>
<td>27.1</td>
<td>21.4</td>
<td>21.3</td>
<td>25.3</td>
<td>26.8</td>
<td>26.3</td>
<td>23.0</td>
<td>25.3</td>
</tr>
</tbody>
</table>

aRecord of at least 1 vaccine recorded on the ACIR, no recorded vaccination objection, and not ‘fully immunised’ by 24 months of age. ‘Fully immunised’ – 3 doses of a DTPa-containing vaccine, 3 doses of polio vaccine, 3 or 4 doses of PRP-OMP-containing Hib vaccine or 4 doses of any other Hib vaccine, 3 doses of hepatitis B vaccine, 2 doses of a measles–mumps–rubella (MMR)-containing vaccine, 1 dose of varicella vaccine, and 1 dose of meningococcal C vaccine.
bCohort born 1 October – 31 December 2012 and assessed in 2014.

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 Childhood Immunisation Register, data as at 31 March 2015.

Table 12. Coverage (%) for 3 doses of human papillomavirus (HPV) vaccine for girls 15 years of age in 2011, 2012, 2013 and 2014, and males age 15 years in 2014, by state or territory, Australia

<table>
<thead>
<tr>
<th>State or territory</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>74.2</td>
<td>74.5</td>
<td>87.0</td>
<td>72.4</td>
<td>68.0</td>
<td>66.5</td>
<td>76.5</td>
<td>64.6</td>
<td>72.9</td>
</tr>
<tr>
<td>2012</td>
<td>74.4</td>
<td>71.0</td>
<td>84.5</td>
<td>69.4</td>
<td>71.0</td>
<td>64.7</td>
<td>74.2</td>
<td>70.1</td>
<td>71.4</td>
</tr>
<tr>
<td>2013</td>
<td>74.0</td>
<td>68.6</td>
<td>81.4</td>
<td>71.0</td>
<td>72.4</td>
<td>64.1</td>
<td>75.2</td>
<td>71.2</td>
<td>71.4</td>
</tr>
<tr>
<td>2014</td>
<td>70.0</td>
<td>69.8</td>
<td>77.3</td>
<td>73.5</td>
<td>73.1</td>
<td>67.7</td>
<td>77.4</td>
<td>76.0</td>
<td>73.4</td>
</tr>
<tr>
<td>2014 malesa</td>
<td>64.2</td>
<td>56.9</td>
<td>55.4</td>
<td>61.1</td>
<td>63.3</td>
<td>55.1</td>
<td>67.8</td>
<td>61.0</td>
<td>61.4</td>
</tr>
</tbody>
</table>

Includes doses that comply with the recommended vaccine dosage and administration as per The Australian Immunisation Handbook (up to 3 doses administered at prescribed intervals).

ACT: Australian Capital Territory; NSW: New South Wales; NT: Northern Territory; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Australia

Denominator data used is ABS ERP (Estimated Resident Population) on 2012 boundaries (final) as at 30 June in the relevant year. Earlier coverage reports utilised interim ABS ERP data. As a result, small changes in coverage rates may be apparent if compared to earlier reports.

aReflected male catch-up vaccination program 2013–2014. Routine immunisation ongoing at age 12–13 years.

Source: National HPV Vaccination Program Register, January 2016.
24-month milestone. Varicella vaccine coverage is probably lower due to both the shorter time it has been on the NIP and the age of administration (18 months). The 18-month schedule point was historically associated with lower coverage levels prior to 2003, when there was an 18-month pertussis booster, and there was a gap of over 2 years from 2003 to 2005 when no vaccine was administered at 18 months. When we assessed varicella vaccine coverage at 60 months of age instead of 24 months, we observed much higher estimates across all jurisdictions, ranging from 6.0 to 10.4 percentage points higher. We also found that national varicella vaccine coverage increased by 3.7 percentage points after the introduction of MMRV vaccine in mid-2013, so further increases in coverage may occur as a result of this schedule change. For rotavirus vaccines, strict upper age limits for administration, which reduce the ability to receive late doses, are likely to explain lower coverage when compared to other vaccines assessed at 12 months of age. The implications of lower coverage for rotavirus and varicella vaccines also differ. In the case of rotavirus vaccine, coverage of 80% or greater has resulted in substantial herd immunity and decreases in rotavirus hospitalisations in Australia and elsewhere.\textsuperscript{23,24} In contrast, modelling studies suggest that low coverage (70–90\%) with varicella vaccine may result in a shift of disease to older age groups with higher disease severity.\textsuperscript{25}

Coverage for vaccines recommended for Indigenous children only (i.e. hepatitis A and a booster dose of pneumococcal vaccine) remained suboptimal in 2014. The extent of under-reporting to the ACIR for these vaccines is unknown but may be more than for ‘universal’ vaccines, given the lack of incentive payments for notification to the ACIR. However, lower coverage for vaccines targeted at Indigenous people has been a relatively consistent finding using a range of different methods for both children\textsuperscript{26} and adults.\textsuperscript{27} Both a lack of provider knowledge about the recommendations for high-risk groups, and poor identification of Indigenous children by immunisation providers, are likely to be important contributing factors. While coverage for 2 doses of hepatitis A vaccine was only 63\%, an additional 17\% of Indigenous children received a single dose, which provides a protective antibody response in most children.\textsuperscript{28}

\textsuperscript{a}In some states those aged 12–13 years in 2014 are not eligible for vaccination until 2015. Notification of 2015 doses to the Register is in progress.

\textbf{Technical notes:}

Data extracted from the National HPV Vaccination Program Register (HPV Register) as at 19 January 2016. Includes doses that comply with the recommended vaccine dosage and administration as per The Australian Immunisation Handbook (up to 3 doses administered at prescribed intervals).

Population is Estimated Resident Population (ERP) 2014 (as at 30/06/2014) from the Australian Bureau of Statistics Cat 3101.0 Australian Demographic Statistics, tables 51 to 58: Estimated resident population by single year of age by state and territory. Interim data published December 2014.

Age is age as at date of ERP estimate (30 June 2014).

Coverage is calculated as doses administered and reported to the HPV Register/Estimated Resident Population expressed as a percentage.

Excludes consumers who do not wish their details to be recorded on the HPV Register.

Source: National HPV Vaccination Program Register, January 2016.
Figure 20. Proportion of vaccinations on the ACIR given by provider type, January to December 2014, by state or territory, Australia.

ACIR: Australian Childhood Immunisation Register
ACT: Australian Capital Territory; NSW: New South Wales; NT: Northern Territory; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Australia; AUST: Australia

Source: Australian Childhood Immunisation Register, data as at 31 March 2015.

Figure 21. Proportion of immunisations on the ACIR lodged by type of reporting mechanism, January to December 2014, by state or territory, Australia.

ACIR: Australian Childhood Immunisation Register
ACT: Australian Capital Territory; NSW: New South Wales; NT: Northern Territory; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Australia; AUST: Australia

Source: Australian Childhood Immunisation Register, data as at 31 March 2015.
Although most children eventually complete the scheduled vaccination series by the 24-month milestone, many still do not do so in a timely manner. On-time vaccination for vaccines assessed at 12 and 24 months of age in 2014 increased for Indigenous children but decreased for non-Indigenous children. However, while the differential in on-time vaccination between Indigenous and non-Indigenous children in 2014 did improve marginally from 2013, timeliness is still a significant problem for Indigenous children in Australia. Poorer timeliness in Indigenous children aged 2 years of age has been noted previously.\(^{29}\) Timeliness continued to improve for vaccines due at 48 months of age and assessed at 60 months of age, for both Indigenous and non-Indigenous children. In 2014 more than 70% of children in all jurisdictions except Western Australia and the Northern Territory received the 1st dose of DTPa vaccine prior to 8 weeks of age, in line with recommendations encouraging early protection of young infants from pertussis infection.

Immunisation at the earliest appropriate age should be a public health goal for countries such as Australia where high levels of vaccine coverage at milestone ages have been achieved. This is especially so for the 2nd dose of the measles vaccine where vaccination delay has consistently been an issue. The change in scheduling of this dose to 18 months of age that occurred in mid-2013 has led to an improvement in the timeliness of this dose but in non-Indigenous children only.

Analysis of ACIR data has demonstrated the rapid uptake by the population of new vaccines in the Australian setting, unlike some other developed countries.\(^{30,31}\) Only 1.8% of children are registered as having parental vaccination objection and some others are likely unvaccinated due to unregistered objection. However, incomplete immunisation is also often due to access and logistic issues. Further in-depth analysis and interpretation of the data about incompletely immunised children will be the subject of an upcoming NCIRS report. Further vaccination coverage estimates in small areas have been provided by the National Health Performance Authority for children in 2013–2015.\(^{32}\)

Coverage data for the HPV vaccine from the National HPV Vaccination Program Register reflect a successful school-based program with lower but still substantial coverage for the catch-up program in older females.\(^{33–35}\) The coverage achieved in the program has resulted in demonstrable decreases in HPV prevalence in young women,\(^{36}\) and in genital warts\(^{37}\) and cervical abnormalities.\(^{38}\) Coverage achieved during the catch-up program for 14–15-year-old males in 2013–2014 indicates that the vaccine is acceptable to most parents of boys but that further work may be needed to normalise HPV vaccination for males and raise coverage to the same level as achieved in females. Ongoing routine HPV vaccination of both sexes, and a possible change to a 2-dose schedule for adolescents aged under 15 years at 1st dose in future, as endorsed by WHO in 2014,\(^{39}\) will hopefully facilitate further increases in HPV vaccine coverage.

Data provided in this report reflect continuing successful delivery of the NIP in Australia, while identifying some areas for improvement. Coverage for rotavirus vaccine, varicella vaccine and the 2nd dose of MMR vaccine is below that for other vaccines. Timeliness of vaccination could be improved, particularly for Indigenous children, and coverage for vaccines recommended only for Indigenous children is lower than for other vaccines.

Acknowledgements
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References


