

NSW Annual Immunisation Coverage Report, 2013

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Abstract: This annual report documents trends in immunisation coverage in NSW for children, adolescents and the elderly, up to and including data for 2013. **Methods:** Data from the Australian Childhood Immunisation Register, the NSW School Vaccination Program and the NSW Population Health Survey were used to calculate various measures of population coverage, coverage for Aboriginal children and vaccination timeliness for Aboriginal and non-Aboriginal children. **Results:** Greater than 90% coverage has been reached for children at 12, 24 and 60 months of age. Delayed receipt of vaccines is still an issue for Aboriginal children. For adolescents, coverage for the third dose of HPV vaccine for females in the school program was 79% by age 15, an increase of 6 percentage points from 2012 (73%). For males it was 56% by age 15. Pneumococcal vaccination in the elderly remains lower than the influenza coverage estimates. **Conclusion:** This report provides trends in immunisation coverage in NSW across the age spectrum. Data provided in this report reflect continuing successful delivery of the vaccination program in New South Wales, while identifying some areas for improvement. Completion of the recommended immunisation schedule at the earliest appropriate age should be the public health goal at both the state and local health district level where high levels of vaccine coverage at milestone ages have been achieved.

Introduction

This series of *New South Wales (NSW) Annual Immunisation Coverage Reports* provides important information on trends and issues in immunisation coverage to facilitate the monitoring of NSW immunisation programs.

This report uses the longstanding international practice of reporting coverage at key milestone ages to measure coverage against national benchmarks and to track trends over time. It is adapted from annual national immunisation reports published since 2009.¹

High levels of reporting to the Australian Childhood Immunisation Register are maintained by a system of incentive payments for immunisation providers and parents/guardians.² However, changes to immunisation policy, the incentive payment system and changes to the 'fully immunised' coverage algorithms may have an impact on reported vaccination coverage; some recent changes are highlighted in Box 1 and also referred to in this report.

The Australian Childhood Immunisation Register (ACIR) was established on 1 January 1996 by incorporating demographic data from Medicare on all enrolled children aged less than 7 years.³ 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.² Children not enrolled in Medicare can also be added to the ACIR via a supplementary number. Since 2001, immunisations 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 immunisation 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 conscientious objection to immunisation is also recorded on the ACIR. All vaccination records for a child remain on the register indefinitely, but no new immunisation encounter records are added after the seventh birthday.²

Table 1 presents the NSW Immunisation Program for children in 2013. During 2013, the combined *Haemophilus influenzae* type b (Hib) and meningococcal serogroup C (MenC) vaccine, Menitorix®, was introduced to the NSW Immunisation Program schedule at 12 months of age. This combination vaccine replaces the single dose of monovalent meningococcal C conjugate vaccine

Box 1. Recent significant changes in immunisation policy, immunisation incentives and coverage calculation algorithms for NSW

July 2013 – The combined *Haemophilus influenzae* type b (Hib) and meningococcal serogroup C (MenC) vaccine, Menitorix[®], was added to the National Immunisation Program (NIP) schedule at 12 months of age. This combination vaccine replaces the single dose of monovalent meningococcal C conjugate vaccine (MenCCV) and booster dose of monovalent Hib vaccine previously scheduled at 12 months of age.

A combination measles, mumps, rubella, varicella (MMRV) vaccine for children aged 18 months was added to the NIP. The MMRV vaccine replaces the separate measles, mumps, rubella (MMR) vaccine previously given to 4 year olds, and the varicella vaccine (for chickenpox) previously given to 18 month olds.

February 2013 – Males 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.

July 2012 – Eligibility for the Family Tax Benefit Part A supplement requires that children are assessed as fully immunised. This replaced the Maternity Immunisation Allowance.

December 2011 – For Non-Indigenous adults aged >65 years who do not have any condition that predisposes them to an increased risk of IPD, a repeat dose of Pneumovax 23[®] is no longer recommended.

July 2011 – Prevenar 13[®] (13-valent pneumococcal conjugate vaccine, 13vPCV) replaced Prevenar[®] (7-valent pneumococcal conjugate vaccine, 7vPCV) on the NIP for children at 2, 4 and 6 months of age in all states and territories except Northern Territory (adopted 13vPCV from 1 October 2011).

December 2009 – Changes in the coverage calculation algorithms that tightened the rules regarding receipt of *Haemophilus influenzae* type b and hepatitis B vaccines for children aged 12 and 24 months to lead to more accurate measures of *Haemophilus influenzae* type b and hepatitis B vaccine coverage in Australia.

October 2009 – The recommendation by the Australian Technical Advisory Group on Immunisation (ATAGI) that the fourth dose of DTPa vaccine can be given from 3½ years of age instead of the previously recommended 4 years of age.

March 2009 – The recommendation by NSW Health and ATAGI to parents and immunisation providers to consider bringing the first dose of DTPa forward to 6 weeks of age to provide earlier protection.

January 2009 – Changes to the overdue rules so that children were classified as overdue for pre-school boosters at 4 years and 1 month instead of the previous 5 years of age. This applied to parental and provider incentive payments. The Maternity Immunisation Allowance changed from a full payment at 18–24 months of age to being paid in two instalments: the first when the child is fully immunised and aged between 18 and 24 months; and the second when the child is fully immunised and aged between 4 and 5 years. This applied only to children who had not yet already received the full payment at 2 years of age.

(MenCCV) and booster dose of monovalent Hib vaccine previously scheduled at 12 months of age. A combination measles, mumps, rubella, varicella (MMRV) vaccine for children aged 18 months was also introduced to the NSW Immunisation Program schedule in July 2013. The MMRV vaccine replaces the separate measles, mumps, rubella (MMR) vaccine previously given to 4 year olds, and the varicella vaccine (for chickenpox) given to 18 month olds. MMR continues to be offered at 4 years to children who were older than 18 months of age when MMRV was introduced.

Methods

Measuring immunisation coverage using the Australian Childhood Immunisation Register

The cohort method has been used for calculating coverage at the population level (national and state/territory)⁴ since the inception of the ACIR. 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 months), and 5 years of age (for vaccines due at 4 years). A 3-month lag period is allowed for the late notification of immunisations to the ACIR.⁴ If a child's record indicates receipt of the last dose of a vaccine that requires more than one 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.^{5,6}

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 was defined as a child having a record on the ACIR of a third dose of the combined DTPa-hepB-IPV-Hib vaccine. In

Table 1. Schedule of vaccines delivered through the NSW Immunisation Program, from 1 July 2013

Age	Vaccine							
Childhood vaccines								
Birth	Hep B							
6–8 weeks	Hep B	DTPa	Hib	Polio		13vPCV	Rotavirus	
4 months	Hep B	DTPa	Hib	Polio		13vPCV	Rotavirus	
6 months	Hep B	DTPa	Hib	Polio		13vPCV		
12 months			Hib-MenC ^h		MMR			
18 months						MMRV ^f		
4 years		DTPa		Polio	MMR ^g			
Adolescent vaccines								
12 years	Hep B ^a	dTpa		VZV ^a	HPV ^b			
15 years		dTpa			HPV ⁱ		Flu ^e	Pneumo ^d
Adult vaccines								
≥50 years							Flu ^e	Pneumo ^c
65 years							Flu ^e	Pneumo
<p>Hep B: hepatitis B vaccine; DTPa: diphtheria, tetanus, and acellular pertussis-containing vaccine; Hib: <i>Haemophilus influenzae</i> type b vaccine; MMR: measles–mumps–rubella vaccine; VZV: varicella zoster virus vaccine; PCV: pneumococcal conjugate vaccine; Men C: meningococcal C vaccine; HPV: human papilloma virus vaccine; Flu: influenza vaccine; Pneumo: Pneumovax 23 vaccine.</p> <p>^aCatch-up only.</p> <p>^bFemales and males.</p> <p>^cAll Aboriginal adults only.</p> <p>^dAboriginal adults with medical risk factors.</p> <p>^eAnnual vaccination, all aged ≥6 months with medical risk factors, Aboriginal adults ≥15 years, non-Aboriginal adults ≥65 years.</p> <p>^fMeasles, mumps, rubella, varicella introduced onto Schedule on 1 July 2013.</p> <p>^gThe dose of measles, mumps, rubella at 4 years of age will cease on the 1 January 2016.</p> <p>^hIn July 2013, the combined <i>Haemophilus influenzae</i> type b (Hib) and meningococcal serogroup C (MenC) vaccine, Menitorix®, was added to the National Immunisation Program (NIP) schedule at 12 months of age. This combination vaccine replaces the single dose of monovalent meningococcal C conjugate vaccine (MenCCV) and booster dose of monovalent Hib vaccine previously scheduled at 12 months of age.</p> <p>ⁱMales only in a 2 year catch up 2013–2014.</p> <p>Source: National Immunisation Program Schedule.</p>								

July 2013 a third dose of pneumococcal conjugate vaccine was added to the ‘fully immunised’ coverage algorithm. ‘Fully immunised’ at 24 months of age was defined as a child having a record on the ACIR of a third dose of the combined DTPa-hepB-IPV-Hib vaccine, a fourth dose of *Haemophilus influenzae* type b (PRP-T) vaccine, and a first dose of a measles, mumps and rubella-containing (MMR) vaccine. ‘Fully immunised’ at 60 months of age was defined as a child having a record on the ACIR of a fourth dose of a DTPa-IPV containing vaccine, and a second dose of an MMR-containing vaccine.

Immunisation coverage estimates were also calculated for individual National Immunisation Program vaccines, including those not included in calculations for incentive payments and ‘fully immunised’ status. They were: the second dose of rotavirus vaccine by 12 months of age; and one dose each of varicella and meningococcal C vaccines by 24 months of age.

Timeliness

Delayed vaccination was categorised as 1–6 months and greater than 6 months. All children included in the analysis were old enough to potentially experience delays in immunisation greater than 6 months for immunisation due by 24 months of age or earlier. Timeliness of different vaccines and doses was also compared by plotting the cumulative percentage receiving each vaccine dose by age, with the proportion ever immunised set as 100%.

Local health districts

Immunisation coverage estimates and vaccination delay estimates are presented in this report by NSW local health district (LHD). LHDs were introduced in January 2011, replacing area health services. There are 15 LHDs in NSW, eight in metropolitan NSW and seven in rural and regional NSW.

Aboriginal status

Indigenous status on the ACIR is recorded nationally 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, two categories of children were considered: 'Aboriginal' (Indigenous) and 'non-Aboriginal' (non-Indigenous). Children with unknown Aboriginal status were presumed to be 'non-Aboriginal'. Coverage estimate time trends are presented from 2004 only, due to poor rates of reporting of Aboriginal status prior to that time.⁷

Small area coverage

Coverage was calculated for the Australian Bureau of Statistics (ABS)-defined SA3s (statistical area level 3), which form part of the new Australian Statistical Geography Standard (ASGS).⁸ SA3s were chosen as areas to be mapped because they provide more detail than LHDs but are not too small to render maps unreadable (population sizes for a year-wide birth cohort of children for SA3s in NSW range from 4 to 3500 children). SA3s with a population size for a year-wide birth cohort of children less than 26 were excluded from any mapping due to the imprecision of any coverage estimates calculated for these areas. Maps were created using MapInfo mapping software (version 12, MapInfo Corporation, New York, USA) and the ABS Census Boundary Information. As postcode is the only geographical indicator on the ACIR, the ABS Postal Area to Statistical Area Level 3 Concordance 2011 was used to match ACIR residential postcodes of the children to SA3s.⁹

Vaccine objectors/No vaccines recorded

Parents who object to vaccination can lodge a conscientious objection to immunisation form with the ACIR. This renders them eligible for immunisation incentive payments despite their children not being vaccinated. Other parents may also object to immunisation but refuse to lodge any official objection. Proportions of children with: official vaccine objector status and no vaccines recorded on the ACIR; official vaccine objector status and at least one vaccine recorded on the ACIR and; no official vaccine objector status and no vaccines recorded on the ACIR were calculated for all LHDs from the cohort of children registered with Medicare and born between 1 January 2006 and 31 December 2012. At the time of data extraction these children were aged between 12 and 72 months. We chose this cohort when calculating proportions so that children under the age of 12 months were not included, to allow sufficient time for registration of objection and to exclude infants late for vaccination.

Coverage in the elderly and adolescents

Influenza and pneumococcal vaccination coverage estimates in the elderly were from the 2013 NSW Population

Health Survey. This is a rolling random digit-dialled telephone survey, with vaccination status determined from patient recall at the time of the interview. Influenza and pneumococcal vaccination coverage estimates are based on 4164 and 3858 respondents in NSW, respectively.¹⁰ Coverage for vaccines given to adolescents was collected from the NSW School Vaccination Program. Vaccination status is recorded by school immunisation teams and counts collated by LHDs and NSW Health. The denominator is the school population, start of year enrolments. The coverage rates may underestimate the true vaccination coverage as they represent only those vaccinations received through the school program and do not include doses received from general practitioners or other immunisation providers.¹¹

Summary of results

Coverage (all children)

- Overall in NSW coverage measured at 12 months was around 90% during 2013 (Table 2).
- Coverage measured at 24 months is stable at 92% (Table 3), and coverage at 5 years of age continues to improve (92%) (Table 4 and Figure 1).
- For all LHDs in NSW except Mid North Coast, Northern NSW, South Western Sydney, Sydney and Western Sydney 'fully immunised' coverage at 12 months of age and coverage for all individual vaccines (except rotavirus) is greater than 90% (Table 2 and Figure 2).
- Coverage for rotavirus is lower than other vaccines as catch-up cannot be given once infants turn 15 weeks (dose 1) and 25 weeks (dose 2) of age.
- For all LHDs except Mid North Coast and Northern NSW, 'fully immunised' coverage at 24 months of age and coverage for all individual vaccines (except varicella) is also greater than 90% (Table 3 and Figure 3).
- Varicella coverage increased 0.4 of a percentage point (2013 LHD range 77.9–88.4%) from 84.4% in 2012 to 84.8% in 2013.
- Recorded 'fully immunised' coverage for the 5-year age group and coverage for all individual vaccines is greater than 90% in all but one LHD (Northern NSW) (Table 4).
- In 2013, the 5-year coverage for DTPa, polio and MMR continued to increase markedly from 2012 to be greater than 92% (Table 4 and Figures 1 and 4).

Indigenous coverage

- In 2013, for all vaccines due by 24 months of age, there is little difference in coverage between Aboriginal and non-Aboriginal children with disparities occurring for children at the 12-month and 60-month milestones (Table 5). For all vaccines due by 12 months of age, coverage in 2013 is lower for Aboriginal children than non-Aboriginal children. In contrast, for all vaccines due by 60 months of

Table 2. Percentage of children immunised at 12 months of age, by vaccine for each local health district in NSW, compared with NSW and Australia, 2013

Vaccine	Local Health District ^a																	
	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NV %	NN %	NS %	SES %	SWS %	SN %	SYD %	WN %	WS %	NSW %	Australia %
Diphtheria, tetanus, pertussis	93.2	90.0	92.8	92.0	88.2	92.5	91.4	92.8	85.5	91.8	91.4	90.5	92.6	90.7	91.5	90.7	91.2	91.6
Poliomyelitis	93.1	90.0	92.7	92.0	88.2	92.5	91.3	92.5	85.4	91.7	91.3	90.2	92.5	90.4	91.5	90.6	91.1	91.5
<i>Haemophilus influenzae</i> type b	93.0	90.0	92.5	91.8	88.1	92.4	91.0	92.0	85.3	90.8	90.8	89.9	92.3	89.7	91.5	90.1	90.7	91.2
Hepatitis B	93.0	90.0	92.5	91.7	88.0	92.4	91.0	92.5	85.3	90.8	90.7	90.0	92.1	89.6	91.5	90.2	90.7	91.1
Rotavirus	87.7	91.3	88.2	87.2	83.8	87.2	86.7	88.9	81.0	86.8	86.7	85.9	88.2	85.7	86.4	85.9	86.4	83.3
13vPCV	93.0	90.0	92.4	91.6	88.1	92.3	91.1	92.5	85.1	90.5	90.5	90.1	92.1	89.7	91.2	90.1	90.6	90.9
Fully immunised ^b	92.8	90.0	92.3	91.6	87.9	92.4	90.8	92.0	85.1	90.0	90.4	89.7	91.9	89.2	91.5	89.7	90.4	90.8
Fully immunised (including 13vPCV)	92.6	90.0	91.9	91.3	87.6	92.1	90.5	92.0	84.8	89.4	89.7	89.3	91.6	88.5	91.1	89.2	89.9	90.3
Total number of children	4038	400	11 544	4615	2352	3050	4949	683	3210	11 129	11 297	13 677	2245	8157	3911	14 630	99 887	308 495

Birth cohort from 2012.
^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.
^bThree doses of the combined DTPa-hepB-IPV-Hib vaccine. The third dose assumption is applied.
Source: Australian Childhood Immunisation Register.

Table 3. Percentage of children immunised at 24 months of age, by vaccine for each local health district in NSW, compared with NSW and Australia, 2013

Vaccine	Local Health District ^a																	
	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NV %	NN %	NS %	SES %	SWS %	SN %	SYD %	WN %	WS %	NSW %	Australia %
Diphtheria, tetanus, pertussis	96.1	94.9	96.5	95.3	92.3	96.4	95.4	96.6	89.5	94.2	93.9	94.8	94.3	93.5	96.2	94.3	94.6	94.8
Poliomyelitis	96.1	94.9	96.5	95.2	92.3	96.4	95.4	96.4	89.4	94.1	93.9	94.7	94.2	93.4	96.2	94.3	94.6	94.7
<i>Haemophilus influenzae</i> type b	96.0	96.3	96.7	95.6	92.6	96.8	95.9	96.2	89.7	93.8	94.0	95.4	94.4	93.5	96.5	94.3	94.8	94.7
Hepatitis B	95.5	94.6	96.3	94.8	91.7	96.1	95.2	96.1	88.9	92.4	93.2	94.5	94.1	92.5	96.0	96.0	94.0	94.1
Measles–mumps–rubella ^c	94.9	94.9	95.7	94.9	92.0	95.7	94.7	96.2	88.2	92.9	92.7	93.6	93.2	92.4	95.4	93.4	93.7	93.9
Varicella ^c	85.0	86.7	88.1	85.1	82.4	87.8	85.3	88.4	77.9	83.2	84.1	83.1	85.5	83.5	85.6	83.9	84.4	84.8
Meningococcal C	94.6	94.6	95.5	94.5	91.1	95.4	94.2	95.9	87.7	92.2	92.0	92.7	92.5	91.5	94.9	92.3	93.0	93.2
Fully immunised ^b	93.7	92.9	94.6	93.2	89.8	94.6	93.2	93.8	86.4	90.1	90.8	91.9	92.2	90.0	94.3	90.9	91.8	92.1
Fully immunised (including varicella and meningococcal C)	83.7	83.8	86.7	83.5	80.2	86.3	83.3	86.0	76.0	80.4	81.6	80.7	84.3	80.5	84.1	80.8	82.1	82.9
Total number of children	4201	352	11 480	4725	2579	2983	5093	612	3300	10 846	10 743	13 411	2268	7587	3803	14 424	99 099	304 123

Birth cohort from 2011.
^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.
^bA third dose of the combined DTPa-hepB-IPV-Hib vaccine, a fourth dose of *Haemophilus influenzae* type b (PRP-T) vaccine, and a first dose of a measles, mumps and rubella-containing (MMR) vaccine.
^cMMRV coverage for children born July–December 2011 not shown due to initial reporting errors after the introduction of MMRV vaccine.
Source: Australian Childhood Immunisation Register.

Table 4. Percentage of children immunised at 5 years of age, by vaccine for each local health district in NSW, compared with NSW and Australia, 2013

Disease	Local Health District ^a																	NSW %	Australia %
	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NV %	NN %	NS %	SES %	SWS %	SN %	SYD %	WN %	WS %			
Diphtheria, tetanus, pertussis	93.7	91.8	94.9	95.2	90.9	94.5	94.2	94.1	87.6	90.7	90.6	93.2	93.3	90.2	94.9	92.4	92.5	92.2	
Poliomyelitis	93.8	92.0	94.8	95.2	90.8	94.5	94.1	94.1	87.6	90.6	90.6	93.2	93.0	90.2	94.9	92.4	92.5	92.2	
Measles–mumps–rubella	93.6	92.8	94.9	95.2	91.1	94.6	93.9	94.4	87.3	90.2	90.4	93.2	93.1	90.0	94.9	92.4	92.4	92.2	
Fully immunised ^b	93.3	91.8	94.5	94.8	90.6	94.3	93.7	93.9	86.9	89.8	90.0	92.8	92.6	89.6	94.5	91.8	92.0	92.0	
Total number of children	4467	388	11 696	4850	2696	3267	5054	642	3663	11 565	10 225	13 937	2541	6882	4002	13 881	100 460	309 970	

Birth cohort from 2008.

^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.

^bA fourth dose of combined DTPa-IPV vaccine, and a second dose of an MMR-containing vaccine.

Source: Australian Childhood Immunisation Register.

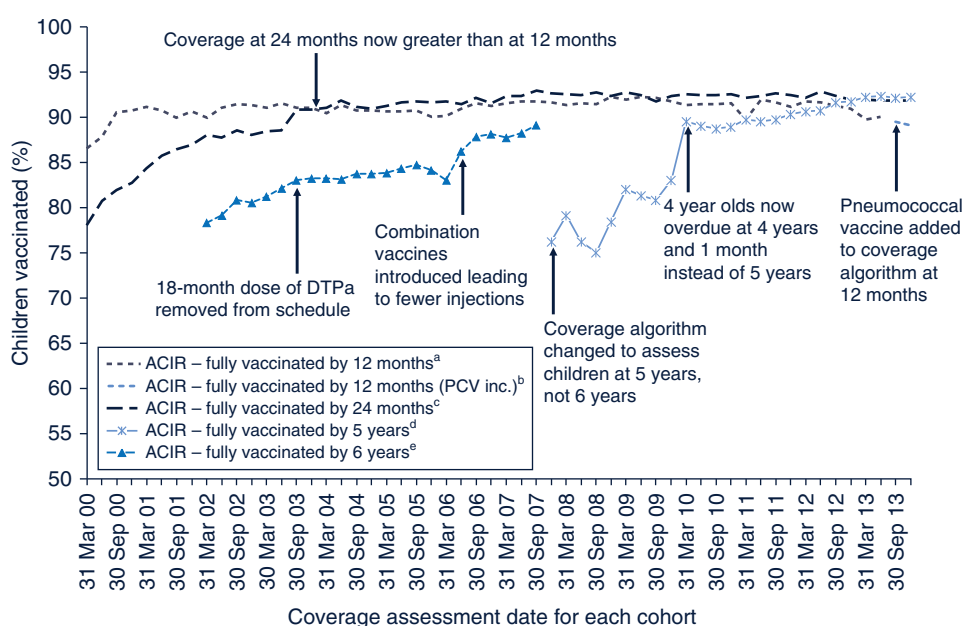


Figure 1. Trends in ‘fully immunised’^{a,b,c,d,e} vaccination coverage, NSW, 2000–2013.

^aA third dose of the combined DTPa-hepB-IPV-Hib vaccine up until July 2013.

^bA third dose of the combined DTPa-hepB-IPV-Hib vaccine and a third dose of pneumococcal conjugate vaccine since July 2013.

^cA third dose of the combined DTPa-hepB-IPV-Hib vaccine, a fourth dose of Haemophilus influenzae type b (PRP-T) vaccine, and a first dose of a measles, mumps and rubella-containing (MMR) vaccine.

^dA fourth dose of combined DTPa-IPV vaccine, and a second dose of an MMR-containing vaccine by 5 years of age.

^eA fourth dose of combined DTPa-IPV vaccine, and a second dose of an MMR-containing vaccine by 6 years of age.

Source: Australian Childhood Immunisation Register.

age, coverage in 2013 is higher for Aboriginal children than non-Aboriginal children. However, the disparities have narrowed since 2012.

- The disparity in coverage between Aboriginal and non-Aboriginal children at the 12-month milestone also

exists at the Local Health District level and across almost all LHDs (Table 6). Fully immunised coverage is much lower in some LHDs (e.g. Western NSW, Western Sydney, Southern NSW, Murrumbidgee, and Illawarra Shoalhaven).

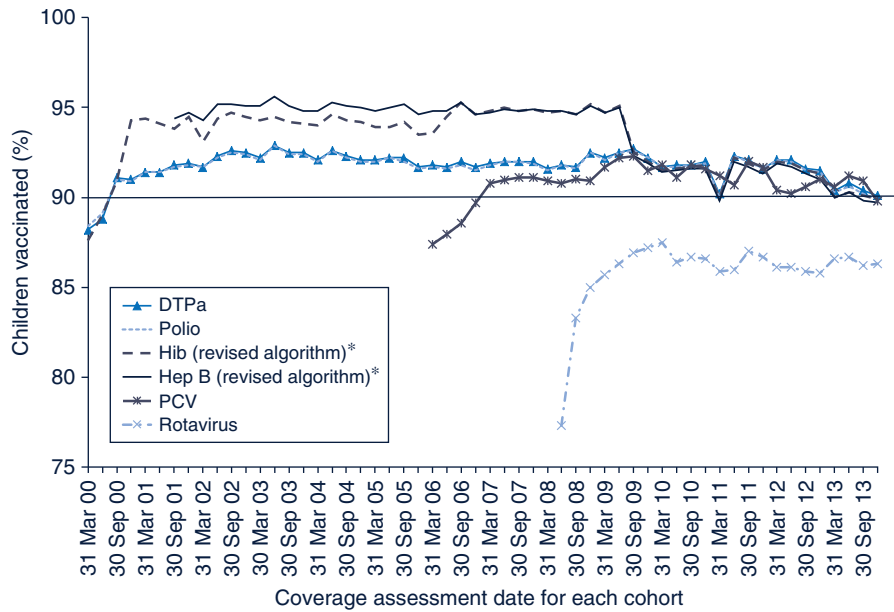


Figure 2. Trends in vaccination coverage estimates by vaccine at 12 months of age (third dose of DTPa, polio, hepatitis B, Hib, rotavirus and 13vPCV), NSW, 2000–2013.

By 3-month birth cohorts born between 1 January 1999 and 31 December 2012. Coverage assessment date was 12 months after the last birth date of each cohort.

*Prior to September 2009, the algorithm stated that receipt of two or three doses of *Haemophilus influenzae* type b (Hib) and hepatitis B vaccines rendered a child ‘fully immunised’ for these vaccines. After September 2009, changes to the algorithm were made to tighten the rules regarding ‘fully immunised’ for Hib and hepatitis B vaccines. The new algorithm assessed two or three doses of PRP-OMP containing *Haemophilus influenzae* type b (Hib) vaccine or three doses of any other *Haemophilus influenzae* type b (Hib) vaccine, and two or three doses of Comvax hepatitis B vaccine or three doses of all other hepatitis B vaccines.

13vPCV: 13-valent pneumococcal conjugate vaccine

DTPa: diphtheria–tetanus–pertussis (acellular) – paediatric formulation

Source: Australian Childhood Immunisation Register.

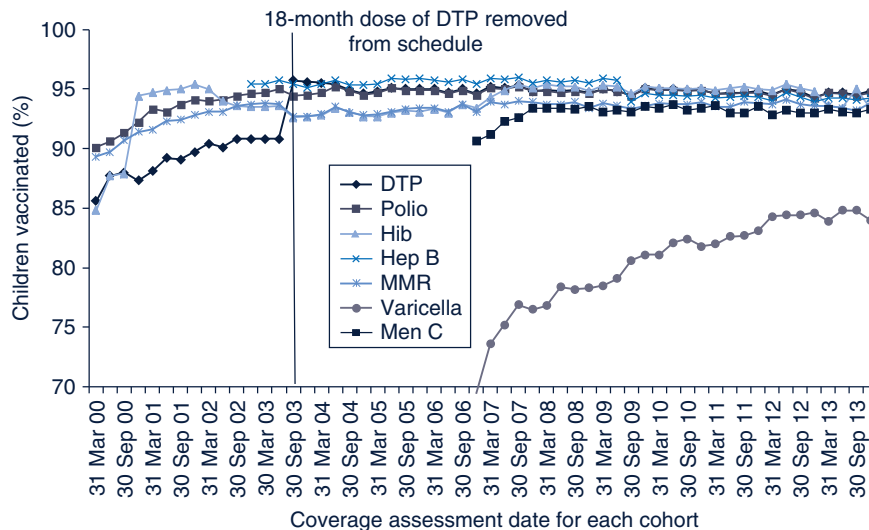


Figure 3. Trends in vaccination coverage estimates by vaccine at 24 months of age (third dose of DTPa (fourth dose – pre-Sept 2003), third dose of polio, third dose of hepatitis B, fourth dose of Hib, first dose of MMR^a, one dose of varicella^a and one dose of Men C), NSW 2000–2013.

By 3-month birth cohorts born between 1 January 1998 and 31 December 2011. Coverage assessment date was 24 months after the last birth date of each cohort.

^aMMRV coverage for children born July – December 2011 not shown due to data system issues.

DTPa: diphtheria–tetanus–pertussis (acellular) – paediatric formulation

Hep B: hepatitis B

Hib: *Haemophilus influenzae* type b

Men C: meningococcal C

MMR: measles–mumps–rubella

Source: Australian Childhood Immunisation Register.

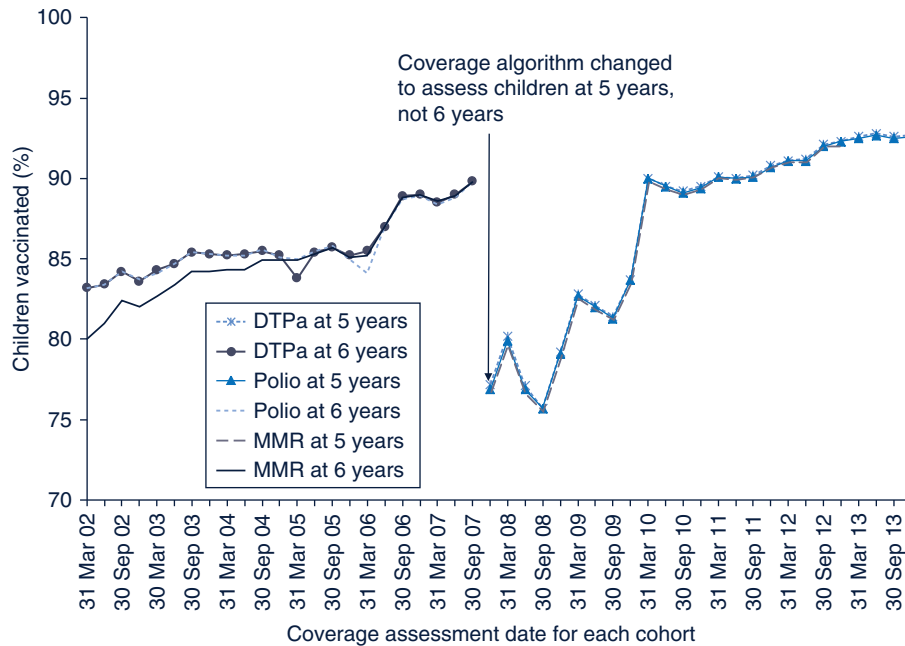


Figure 4. Trends in vaccination coverage estimates by vaccine (fourth dose of DTPa and polio and second dose of MMR) at 5 years of age (6 years up to December 2007), NSW 2002–2013.

By 3-month birth cohorts born between 1 January 1996 and 31 December 2008. 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.
 DTPa: diphtheria–tetanus–pertussis (acellular) – paediatric formulation
 MMR: measles-mumps-rubella

Source: Australian Childhood Immunisation Register.

- For the 24-month milestone, the disparities in fully immunised coverage between Aboriginal children and non-Aboriginal children vary with some LHDs experiencing higher coverage for Aboriginal children (Mid North Coast and Southern NSW) and some experiencing higher coverage for non-Aboriginal children (Far West and Western NSW) (Table 6).
- In 2013, at the 60-month milestone, there are 10 LHDs with ‘fully immunised’ coverage higher for Aboriginal than non-Aboriginal children (e.g. Mid North Coast, Northern NSW and Western Sydney) (Table 6). This was not the case in 2010 where coverage was lower for Aboriginal children in all LHDs.

Timeliness

- Improvements in timeliness can be observed by the higher coverage at 24 months of age for vaccines not requiring an additional dose from 12 months of age (Tables 2 and 3).
- For the third dose of DTPa and second dose of MMR vaccines, there is significantly greater delay in immunisation for Aboriginal children than non-Aboriginal children (Figures 5 and 6). However, the disparities have decreased from the 2012 report. This disparity in vaccination delay for the third dose of DTPa between

Aboriginal children and non-Aboriginal children varies between LHDs (Table 7). For almost all LHDs in NSW Aboriginal children experience higher levels of vaccination delay greater than 6 months with levels as high as 19% in the Sydney LHD (Table 8).

- During most of 2013, more than 70% of children in NSW received their first dose of hexavalent combination vaccine between 6 and less than 8 weeks (Figure 7). This percentage has been increasing since 2009 when vaccination at 6 weeks was encouraged to provide early protection against whooping cough.

Small area coverage

- Rotavirus (75.6–92.6%), pneumococcal conjugate (78.5–95%), and the second dose of MMR vaccine (80.4–96.9%) coverage for small areas varied across the state (Figures 8–10).

Vaccine objection and children with no vaccines recorded

- The percentage of official vaccine objectors varied by LHD from a high of 6.8% in Northern NSW to a low of 0.7% in Western Sydney (Table 9). Further, the

Table 5. Vaccination coverage estimates by age, disease and Aboriginal status in NSW, 2013

Disease	Milestone age	Aboriginal	Non-Aboriginal
Diphtheria–tetanus–pertussis	12 months ^a	88.4	91.4
	24 months ^b	94.6	94.6
	5 years ^c	94.3	92.5
Poliomyelitis	12 months ^a	88.3	91.2
	24 months ^b	94.6	94.6
	5 years ^c	94.2	92.4
<i>Haemophilus influenzae</i> type b	12 months ^a	88.2	90.8
	24 months ^b	95.2	94.8
	5 years ^c	NI	NI
Hepatitis B	12 months ^a	88.2	90.8
	24 months ^b	94.6	94.0
	5 years ^c	NI	NI
Measles–mumps–rubella	12 months ^a	NI	NI
	24 months ^b	93.6	93.7
	5 years ^c	94.5	92.3
Varicella	12 months ^a	NI	NI
	24 months ^b	81.8	84.5
	5 years ^c	NI	NI
Meningococcal C	12 months ^a	NI	NI
	24 months ^b	93.9	93.0
	5 years ^c	NI	NI
Pneumococcal conjugate vaccine	12 months ^a	88.2	90.7
	24 months ^b	NI	NI
	5 years ^c	NI	NI
Rotavirus	12 months ^a	80.7	86.7
	24 months ^b	NI	NI
	5 years ^c	NI	NI

^aBirth cohort born 1 January 2011–31 December 2012.
^bBirth cohort born 1 January 2010–31 December 2011.
^cBirth cohort born 1 January 2007–31 December 2008.
NI: this vaccine at this age milestone is not included in the calculation of coverage estimates
Source: Australian Childhood Immunisation Register.

percentage of children with no vaccines recorded and with no official objection also varied by LHD (Table 9).

Adolescent coverage

- Coverage in adolescents varies by vaccine and dose with better coverage for the first and second doses of human papillomavirus vaccine (HPV) in both females and males and the dose of dTpa in Year 7 attendees (Table 10). Across the four years 2010–2013, there has been a considerable increase in coverage for adolescents for all vaccines, with the exception of hepatitis B. In particular, coverage for the third dose of HPV vaccine for females increased 6 percentage points from 2012 (73% to 79%), and varicella coverage increased from 32% in 2010 to 53% in 2013 (Table 10). Hepatitis B uptake was lower in 2013 as this was the last year of

the catch-up program, and many children in this cohort received the full course as infants.

- Coverage estimates are for school attendees and do not include doses administered in general practice.

Coverage in the elderly

- The proportion of people aged ≥ 65 years reporting vaccination for influenza in the past 12 months has remained relatively stable and over 70% in NSW during the period 2002–2013 (Figure 11 and Table 11). However, the percentage reporting pneumococcal vaccination in the previous 5 years (23vPPV) had been steadily rising up to 2011 but decreased in 2012 and 2013 and still remains lower than the influenza coverage estimates (Figure 11 and Table 11). This is likely due to the

Table 6. Percentage of children fully immunised at 12 months, 24 months and 5 years of age, by Aboriginal status for each local health district in NSW, compared with NSW and Australia, 2013

Child age and Aboriginal status	Local Health District ^a														NSW %	Australia %	
	CC %	FW %	HNE %	IS %	MM %	NBM %	NV %	NN %	NS %	SES %	SWS %	SN %	SYD %	WN %			WS %
12 months – fully immunised^b																	
Aboriginal	90.6	87.7	91.0	86.2	87.3	87.3	87.1	97.6	83.4	88.5	87.0	88.4	89.2	86.4	86.1	88.1	86.3
Non-Aboriginal	93.0	90.5	92.5	92.0	92.8	90.9	90.9	91.6	85.3	90.0	89.8	92.2	89.2	92.7	89.8	90.5	91.0
12 months – fully immunised (including PCV)																	
Aboriginal	90.6	87.7	91.0	86.2	86.9	87.1	87.1	97.6	83.1	88.5	86.7	88.4	87.5	86.3	86.1	88.0	86.0
Non-Aboriginal	92.7	90.5	92.1	91.7	92.6	90.6	90.6	91.2	95.0	89.4	89.4	91.8	88.5	92.2	89.3	90.0	90.6
24 months – fully immunised^c																	
Aboriginal	93.8	87.1	94.0	91.3	92.4	90.3	90.3	94.3	86.7	90.3	89.7	93.0	90.7	91.6	87.5	91.6	92.0
Non-Aboriginal	93.7	94.3	94.7	93.4	94.8	93.3	93.3	93.8	86.4	90.1	91.9	92.2	90.0	95.0	91.0	91.8	92.1
24 months – fully immunised (including varicella and meningococcal C)																	
Aboriginal	84.5	75.7	84.9	79.0	79.7	80.5	80.5	77.1	75.3	67.7	76.8	77.5	68.0	76.9	75.9	79.6	80.5
Non-Aboriginal	83.7	85.8	86.8	83.8	86.9	83.4	83.4	86.5	76.0	80.5	80.8	84.7	80.7	85.8	80.9	82.2	83.0
5 years – fully immunised^d																	
Aboriginal	94.2	86.6	95.5	95.1	92.1	93.1	93.1	97.6	93.6	97.4	93.3	93.3	86.6	94.2	93.2	93.8	93.0
Non-Aboriginal	93.3	92.8	94.4	94.8	94.5	93.7	93.7	93.7	86.2	89.7	92.8	92.6	89.7	94.6	91.8	91.9	91.6

^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.

^bThree doses of diphtheria (D), tetanus (T) and pertussis-containing (P) vaccine, three doses of polio vaccine, two or three doses of PRP-OMP containing *Haemophilus influenzae* type b (Hib) vaccine or three doses of any other Hib vaccine, and two or three doses of Comvax hepatitis B vaccine or three doses of all other hepatitis B vaccines.

^cThree or four doses of a DTP-containing vaccine, three doses of polio vaccine, three or four doses of PRP-OMP containing Hib vaccine or four doses of any other Hib vaccine, three or four doses of Comvax hepatitis B vaccine or four doses of all other hepatitis B vaccines, and one dose of a measles- mumps- and rubella-containing (MMR) vaccine.

^dFour or five doses of a DTP-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine.

Source: Australian Childhood Immunisation Register.

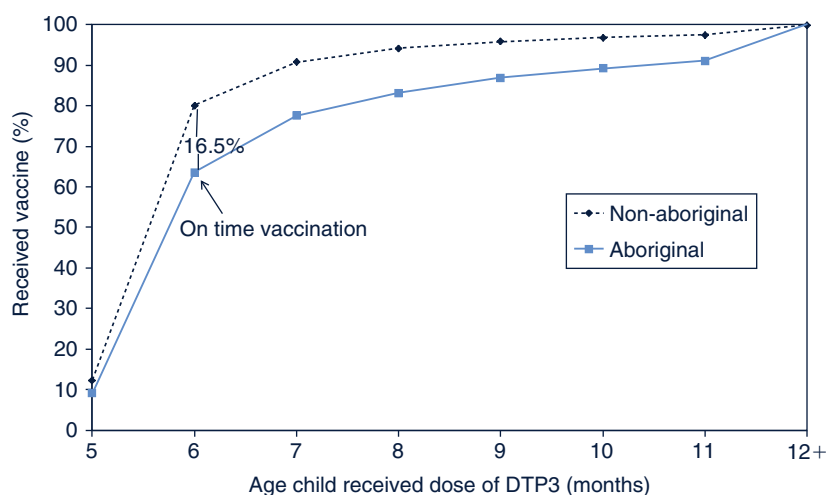


Figure 5. Timeliness of the third dose of DTPa vaccine (DTP3) by Aboriginal status for the cohort of children born in 2011 in NSW.

Percentage covered = number of children who received vaccine dose at particular ages/the total number of children who received the vaccine dose.

DTPa: diphtheria–tetanus–pertussis (acellular) – paediatric formulation

Source: Australian Childhood Immunisation Register.

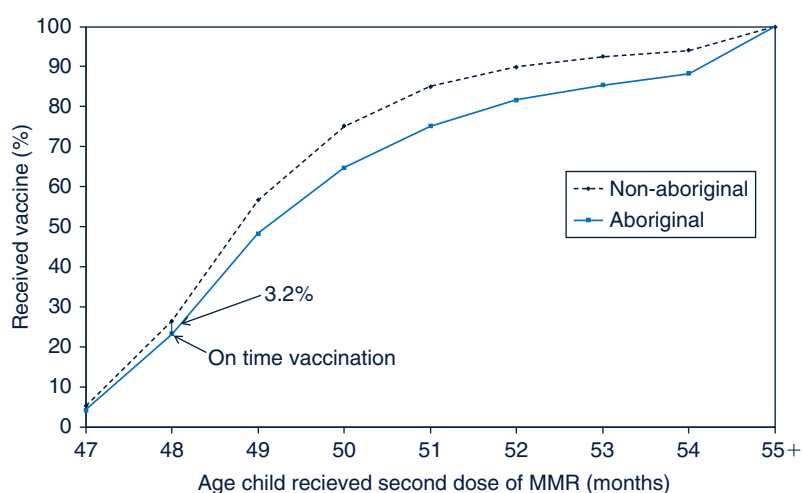


Figure 6. Timeliness of the second dose of MMR vaccine by Aboriginal status for the cohort of children born in 2007 in NSW.

Percentage covered = number of children who received vaccine dose at particular ages/the total number of children who received the vaccine dose.

MMR: measles–mumps–rubella

Source: Australian Childhood Immunisation Register.

Table 7. Percentage of children with vaccination delay for the third dose of DTPa by Aboriginal status for each local health district for the cohort of children born in NSW in 2011

Vaccination delay and Aboriginal status	Local Health District ^a														NSW		
	CC	FW	HNE	IS	MN	MM	NBM	NV	NN	NS	SES	SWS	SN	SYD		WN	WS
1–6 months late																	
Aboriginal (%)	26.7	23.1	21.9	30.1	28.4	30.3	25.7	31.4	25.3	10.3	19.1	25.5	23.8	37.1	28.6	21.8	25.8
Non-Aboriginal (%)	17.7	15.4	14.8	17.1	16.7	15.0	17.3	13.0	17.2	13.2	12.8	17.8	15.1	12.5	16.5	13.9	15.0
>6 months late																	
Aboriginal (%)	4.5	4.6	6.7	7.5	6.6	5.8	3.7	2.9	9.3	3.5	6.0	5.8	4.1	4.3	9.6	10.0	7.0
Non-Aboriginal (%)	2.1	3.7	1.7	2.3	3.2	1.9	1.9	2.7	3.3	1.2	1.4	2.4	2.1	1.2	2.3	1.9	1.9

^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.

DTPa: diphtheria–tetanus–pertussis (acellular) – paediatric formulation

Source: Australian Childhood Immunisation Register.

Table 8. Percentage of children with vaccination delay for the second dose of measles-mumps-rubella by Aboriginal status for each local health district for the cohort of children born in NSW in 2007

Vaccination delay and Aboriginal status	Local Health District ^a																
	CC	FW	HNE	IS	MN	MM	NBM	NV	NN	NS	SES	SWS	SN	SYD	WN	WS	NSW
1–6 months late																	
Aboriginal (%)	35.8	32.6	44.1	53.5	45.7	48.1	48.3	44.4	48.3	34.8	50.7	49.7	52.0	39.6	40.3	48.0	45.2
Non-Aboriginal (%)	49.3	44.3	43.2	48.5	47.5	44.3	46.8	40.4	49.1	44.1	44.2	45.6	48.5	40.9	45.7	41.6	44.7
>6 months late																	
Aboriginal (%)	10.6	13.0	12.1	12.4	11.8	11.7	12.9	5.63	10.3	4.4	8.2	10.9	10.7	18.9	17.4	12.7	12.6
Non-Aboriginal (%)	5.5	9.43	5.1	5.7	6.3	5.6	7.3	6.0	6.1	6.8	6.3	6.4	7.7	6.3	6.5	6.9	6.3

^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.

Source: Australian Childhood Immunisation Register.

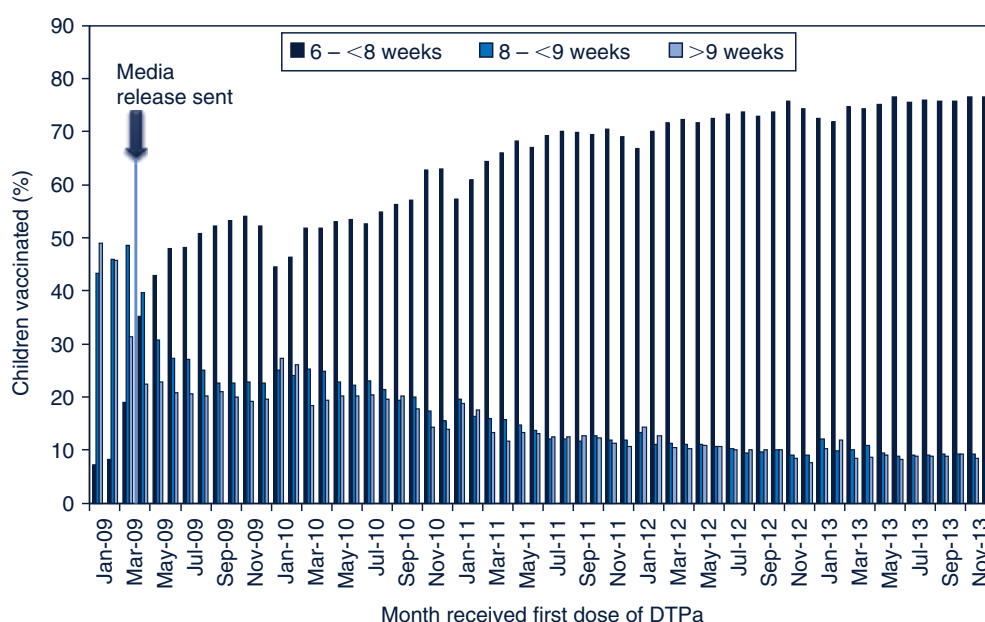


Figure 7. Age at which children in NSW received their first dose of hexavalent combination vaccine by month of receipt, January 2009–December 2013.

The media release was a message for providers and the public on 10 March 2009 that asked parents and providers to consider bringing the first dose of pertussis-containing vaccine forward to 6 weeks of age to provide earlier protection. Hexavalent combination: diphtheria–tetanus–pertussis (acellular), polio, Hib, hepatitis B – paediatric formulation

Source: Australian Childhood Immunisation Register.

change in recommendation that now states that non-Indigenous adults aged >65 years who do not have any condition that predisposes them to an increased risk of invasive pneumococcal disease no longer require a repeat dose.

Conclusion

Data provided by the Australian Childhood Immunisation Register in this report reflect the successful delivery of the National Immunisation Program in NSW, while identifying some areas for improvement, especially with regard to vaccination delay in Aboriginal children. The continuing

improvement of coverage at the 60-month milestone, especially for Aboriginal children, is welcome. ‘Fully immunised’ coverage for this age group and coverage for all individual vaccines is now greater than 90% in all but one LHD. Improvements in timeliness of immunisation over time have also been observed, especially for the first dose of hexavalent vaccine, which demonstrates early protection of many young infants from pertussis infection. There has been a considerable increase in coverage for adolescents for all vaccines and, in particular, coverage for the third dose of HPV vaccine. The Australian Childhood Immunisation Register, the NSW Population Health Survey and monitoring through the NSW School Vaccination

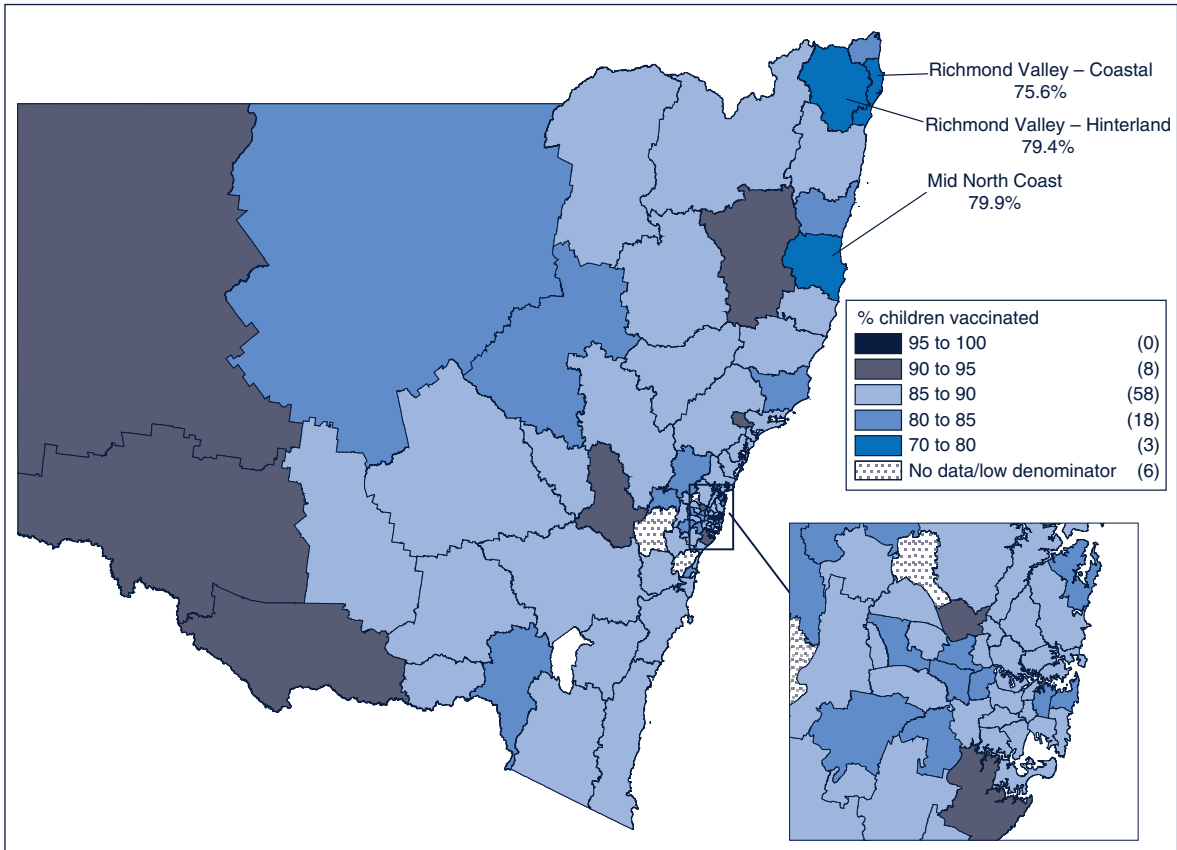


Figure 8. Rotavirus vaccine coverage at 12 months of age, by statistical areas level 3, NSW, for the cohort of children born in 2012. Source: Australian Childhood Immunisation Register.

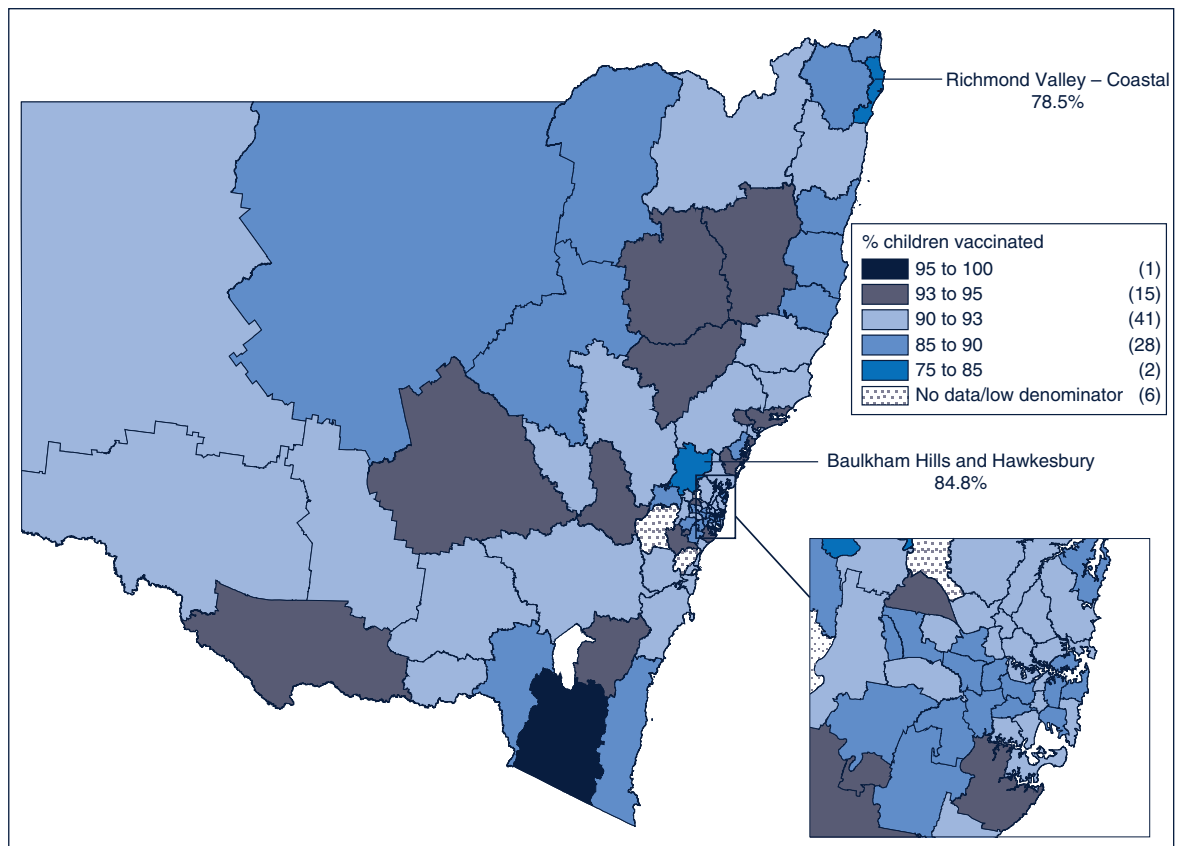


Figure 9. Pneumococcal conjugate vaccine coverage at 12 months of age, by statistical area level 3, NSW, for the cohort of children born in 2012. Source: Australian Childhood Immunisation Register.

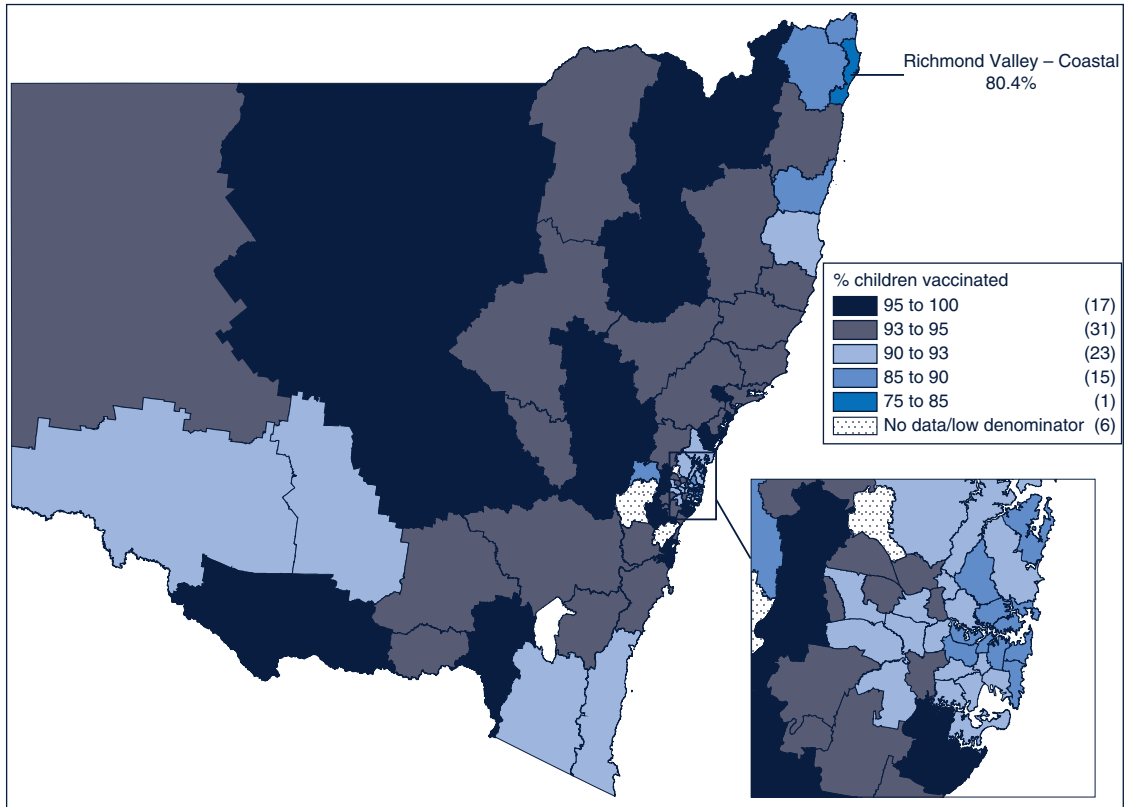


Figure 10. Second dose MMR vaccine coverage at 60 months of age, by statistical area level 3, NSW, for the cohort of children born in 2008.

Source: Australian Childhood Immunisation Register.

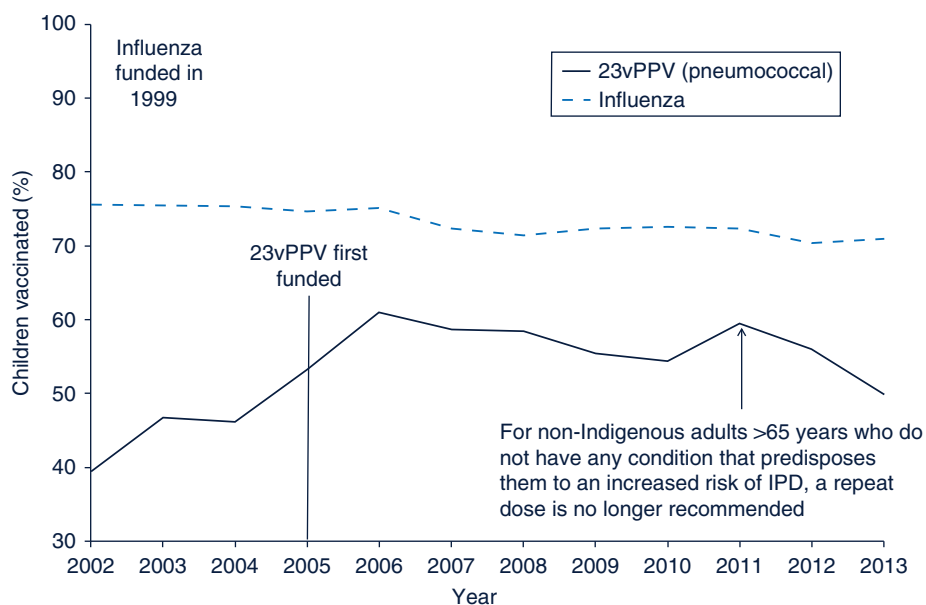


Figure 11. Trends in vaccination coverage estimates by vaccine for adults aged 65 years and over in NSW, vaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months, 2002-2013.

23vPPV: 23-valent pneumococcal polysaccharide vaccine

Source: NSW Population Health Survey 2013 (SAPHaRI). Centre for Epidemiology and Evidence, NSW Ministry of Health.

Table 9. The percentage of vaccine objectors and children with no vaccines recorded on the Australian Childhood Immunisation Register for the cohort born 1 January 2007 – 31 December 2012 and assessed in 2013, for each local health district in NSW, compared with NSW

Vaccine	Local Health District ^a																
	CC	FW	HNE	IS	MN	MM	NBM	NV	NN	NS	SES	SWS	SN	SYD	WN	WS	NSW
Objection with no vaccines recorded (%)	1.4	0.6	0.8	1.0	2.5	0.8	0.9	1.2	4.4	0.9	0.8	0.4	1.5	0.8	0.5	0.4	0.9
Objection with at least one vaccine recorded (%)	1.2	0.4	0.7	0.7	1.5	0.5	0.7	0.7	2.4	1.0	0.9	0.4	1.1	0.6	0.4	0.3	0.7
Total official objection	1.6	1.0	1.5	1.7	4.0	1.3	1.6	1.9	6.8	1.9	1.7	0.8	2.6	1.4	0.9	0.7	1.6
No objection and no vaccines recorded (%)	1.4	0.9	1.3	1.7	2.1	1.4	1.6	1.2	2.8	3.0	2.9	2.1	1.7	3.0	1.3	2.6	2.2

^aCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NV: Network with Victoria; NN: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SN: Southern NSW; SYD: Sydney; WN: Western NSW; WS: Western Sydney; NSW: New South Wales.
Source: Australian Childhood Immunisation Register.

Table 10. Vaccination coverage estimates for individual vaccines, NSW adolescent school attendees in NSW, 2013

Vaccine	2013 Coverage (%)	2013 Doses given	2012 Coverage (%)	2012 Doses given	2011 Coverage (%)	2011 Doses given	2010 Coverage (%)	2010 Doses given
HPV dose 1 ^{a,b} – females	86	36 911	86	36 811	81	34 524	77	32 975
HPV dose 2 ^{a,b} – females	84	35 855	83	35 749	76	32 582	72	30 793
HPV dose 3 ^{a,b} – females	79	34 090	73	31 562	71	30 426	66	28 537
HPV dose 1 ^{a,b} – males	80	36 268	na	na	na	na	na	na
HPV dose 2 ^{a,b} – males	78	35 406	na	na	na	na	na	na
HPV dose 3 ^{a,b} – males	75	33 857	na	na	na	na	na	na
Hepatitis B dose 1 ^b	51	44 933	69	60 925	68	30 426	63	54 701
Hepatitis B dose 2 ^b	46	40 233	63	54 948	63	53 517	57	49 507
dTpa ^b	81	71 918	81	70 997	77	65 756	70	61 262
dTpa ^c	na	na	67	58 065	66	57 633	63	56 384
Varicella ^b	53	46 738	50	43 714	45	38 409	32	27 775
HPV dose 1 ^d – males	70	31 940	na	na	na	na	na	na
HPV dose 2 ^d – males	67	30 373	na	na	na	na	na	na
HPV dose 3 ^d – males	56	25 277	na	na	na	na	na	na

^aHPV vaccination coverage includes dose 2 and 3 catch-up vaccination offered to students in Year 8 in Terms 1–2 in 2014 who commenced the three-dose course of HPV vaccine in Year 7 in 2013. Coverage for this cohort is preliminary as data are not yet available for catch-up doses given to students in Terms 3–4 in 2014.

^bYear 7 school attendees.

^cYear 10 school attendees.

^dYear 9 school attendees.

na: not applicable

HPV: human papillomavirus

dTpa: diphtheria–tetanus–pertussis (acellular) – adolescent and adult formulation

Source: NSW School Vaccination Program.

Table 11. Percentage of adults aged 65 years and over reporting vaccination^a against pneumococcal disease and influenza for each Local Health District in NSW, and for NSW, 2013

Vaccine	Local Health District ^b															
	CC	FW	HNE	IS	MNC	MM	NBM	NNSW	NS	SES	SWS	SNSW	SYD	WNSW	WS	NSW
Pneumococcal % vaccinated	51.2	55.4	54.7	59.0	46.4	53.7	47.4	47.3	52.0	39.4	49.0	49.4	44.6	50.8	50.5	49.9
Influenza % vaccinated	75.3	81.2	72.9	81.3	64.2	67.3	66.6	65.8	71.9	69.2	70.5	70.7	64.5	70.8	73.9	71.0

^aVaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months.

^bCC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MNC: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; NNSW: Northern NSW; NS: Northern Sydney; SES: South Eastern Sydney; SWS: South Western Sydney; SNSW: Southern NSW; SYD: Sydney; WNSW: Western NSW; WS: Western Sydney; NSW: New South Wales.

Source: New South Wales Population Health Survey 2013 (SAPHaRI). Centre for Epidemiology and Evidence, NSW Ministry of Health.

Program continue to be very useful tools for administering the National Immunisation Program and monitoring its implementation in NSW.

References

- Hull B, Deeks S, Menzies R, McIntyre P. Immunisation coverage annual report, 2007. *Commun Dis Intell* 2009; 33: 170–87.
- Hull BP, Deeks SL, McIntyre PB. The Australian Childhood Immunisation Register—a model for universal immunisation registers? *Vaccine* 2009; 27: 5054–60. doi:10.1016/j.vaccine.2009.06.056
- Hull BP, McIntyre PB, Heath TC, Sayer GP. Measuring immunisation coverage in Australia. A review of the Australian Childhood Immunisation Register. *Aust Fam Physician* 1999; 28: 55–60.
- O'Brien ED, Sam GA, Mead C. Methodology for measuring Australia's childhood immunisation coverage. *Commun Dis Intell* 1998; 22(3): 36–7.
- Hull BP, McIntyre PB. Immunisation coverage reporting through the Australian Childhood Immunisation Register – an evaluation of the third-dose assumption. *Aust N Z J Public Health* 2000; 24(1): 17–21. doi:10.1111/j.1467-842X.2000.tb00717.x
- Hull BP, Lawrence GL, MacIntyre CR, McIntyre PB. Estimating immunisation coverage: is the 'third dose assumption' still valid? *Commun Dis Intell* 2003; 27(3): 357–61.
- Rank C, Menzies RI. How reliable are Australian Childhood Immunisation Register coverage estimates for indigenous children? An assessment of data quality and coverage. *Commun Dis Intell* 2007; 31(3): 283–7.
- Australian Bureau of Statistics (ABS). Australian Statistical Geography Standard (ASGS), 2011. Canberra: ABS; 2011. Available from: <http://www.abs.gov.au/websitedbs/d3310114.nsf/home/australian+statistical+geography+standard+%28asgs+%29> (Cited 6 September 2013).
- Australian Bureau of Statistics (ABS). Australian Statistical Geography Standard (ASGS): Correspondences, July 2011. Available from: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1270.0.55.006Main+Features1July%202011?OpenDocument> (Cited 6 September 2013).
- NSW Health. New South Wales Population Health Survey. 2013. Available from: http://www.health.nsw.gov.au/surveys/adult/Publications/hsa_10.pdf (Cited 28 January 2014).
- Ward KF, Menzies RI, Quinn HE, Campbell-Lloyd S. School-based vaccination in NSW. *N S W Public Health Bull* 2010; 21(9–10): 237–42. doi:10.1071/NB10046