NSW GOVERNMENT Health

Vol. 22(9–10) • September–October 2011
ISSN 1034 7674

NSW PUBLIC HEALTH BULLETIN

Immunisation in NSW

NSW immunisation performance: continuing progress but no room for complacency

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Complacency is the greatest threat to successful immunisation programs. This has recently been demonstrated in many countries in Europe with resurgence of vaccine preventable diseases that were previously well controlled, particularly measles.[1] Thus in New South Wales (NSW), despite having a successful immunisation program, we must continue to review performance carefully, identify signals of complacency and strive to protect vulnerable members of our community with the wide range of vaccines that we have at our disposal.

This issue of the *NSW Public Health Bulletin* presents the second in a series of annual reports which provide a comprehensive overview of the current epidemiology of vaccine-preventable diseases in NSW and the status of our immunisation program. 2010 was the third year of NSW's second immunisation strategy (in place from 2008 to 2011)[2] and saw further progress in a number of areas such as vaccine coverage and timeliness. Changes in vaccine recommendations, the ongoing pertussis challenge and the adverse events associated with seasonal influenza vaccine use in young children, are some of the features highlighted.

In the *NSW Annual Vaccine Preventable Disease Report, 2010*, by Spokes and Gilmour, it is gratifying to see that most notifiable vaccine preventable diseases in NSW remain under good control. For example, cases of *Haemophilus influenzae* serotype B (Hib), meningococcal C and pneumococcal disease remain at low levels. Although rates of invasive pneumococcal disease are still highest in children below 5 years of age, almost all strains (94%) identified in cases were those not covered by the 7-valent conjugate pneumococcal vaccine (7vPCV). The introduction of a 13-valent PCV nationally in 2011, to replace the 7-valent vaccine, holds promise for further decline in disease incidence due to the additional six vaccine serotypes.

The ongoing pertussis epidemic poses important challenges.[3] 2010 saw changes in the epidemiology of the disease; notification rates decreased in children under 4 years of age (although these rates continue to be high) and increased in the 5–14-year age group. As seen in the Annual Coverage report by Hull et al, two high school-based cohorts of adolescents were provided with the adult and adolescent formulation of the diphtheria, tetanus and acellular pertussis-containing (dTpa) vaccine in 2010 (year 7 and year 10). This immunisation program aimed to increase and bring forward protection for adolescents, in whom immunity may be waning after the fourth booster dose (at 4 years of age). It was reassuring to see a more than 50% decline in notification rates among infants below 12 months of age. Earlier receipt of the first dose of pertussis-containing vaccine for infants (at 6 weeks rather than 2 months of age) has been recommended in NSW since 2009 in response to the current epidemic.[4] As reported by Hull et al, this earlier schedule has resulted in a large increase in the proportion of babies (over 60%) receiving the first dose before 8 weeks of age and thus being afforded at least partial protection against severe disease. Another strategy has been the provision of free vaccine to the parents and carers of young infants, funded in NSW as the 'cocoon program'.[4] This strategy is currently being formally evaluated for its impact on infant disease which should inform ongoing policy in this area. Clearly the focus of pertussis vaccination efforts must remain on preventing disease in those most vulnerable to severe morbidity and mortality – infants, especially those below 6 months of age.

Cases of measles, often introduced by young unimmunised Australians returning from travel overseas to measles endemic areas, or visitors from these areas, led to sporadic outbreaks of the disease across NSW in 2010, particularly in those aged 10–19 years. Index cases (the first to contract disease in an outbreak) often passed

CONTENTS – See back page

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the infection to unvaccinated family members. However, due to high population immunity and rapid public health responses, these outbreaks were usually quickly contained and, consequently, the re-establishment of endemic measles virus was prevented. This rapid containment is in contrast to the experience of other countries, such as New Zealand, the UK and Europe where measles outbreaks have been sustained and the endemic circulation of measles has been re-established.[1,5] These situations highlight the importance of ensuring that two doses of measles-mumps-rubella (MMR) vaccine are given to all non-immune persons: as adolescents and young adults are less likely to have received a second dose, and should therefore be targeted for vaccination. It is encouraging that since 2009, there has been sustained improvement in the timeliness of the second childhood dose of MMR vaccine, scheduled at 4 years of age, including in Aboriginal children. Australia is rapidly approaching the elimination of measles and should develop a specific measles elimination plan to build on the legacy of the enhanced control already achieved.

The *NSW Immunisation Coverage Report, 2010*, has extensive data on coverage and timeliness for all vaccines funded through the National Immunisation Program (NIP), for each Local Health District. NSW has reached coverage benchmarks of 90% for children at 12 and 24 months of age in almost all areas, with a substantial increase in coverage at 5 years to just below 90%. This latter improvement has occurred nationally, and probably arises from changes in overdue rules (the rules guiding when children are overdue for receipt of vaccinations), linked to incentive payments for parents and immunisation providers. Coverage of vaccines delivered to secondary school students remained steady, although at lower levels than for early childhood vaccines. These data are valuable to inform practitioners and programs, particularly in areas where coverage remains low, such as the Mid North Coast and Northern NSW. Across NSW, vaccine coverage continues to remain lower in Aboriginal compared with non-Aboriginal children in the first year of life, when children are generally most vulnerable to severe disease. However, the disparity in receipt of infant vaccines has almost disappeared by 24 months, suggesting further attention to timeliness could reap rewards in this population.

As described by Mahajan et al. in the *NSW Annual Report on Adverse Events Following Immunisation, 2010*, 2010 saw some landmark events in the field of vaccine safety. High reporting rates for adverse events following immunisation (AEFI) with influenza vaccine both within NSW and nationally reflect the major unexpected increased risk of fever and febrile convulsions in young children following the introduction of the 2010 seasonal influenza vaccine, Fluvax® (CSL Biotherapies).[6] Although reporting to passive surveillance systems for AEFI cannot provide population attributable rates of AEFI or determine causality, signal detection can occur. In 2010, signal detection led to the rapid suspension of the use of influenza vaccines in children under 5 years of age, and the detailed epidemiological investigations which followed identified the administration of the CSL vaccine in young children as the cause.[6] Overall, reports of AEFI with the two influenza vaccine types available in 2010, Panvax® (monovalent pandemic influenza vaccine, CSL Biotherapies) and seasonal influenza vaccines, dominated, representing 65% of all reports. Many reports for Panvax® were received directly from members of the public, as this was encouraged by the Therapeutic Goods Administration (TGA). However, most reports were of mild or expected events. This level of severity is consistent with that expected following the introduction of a new vaccine, as historical data in the Annual Report shows. Overall, after excluding reports for influenza vaccines, there was a threefold decrease in reports of AEFI due to routine vaccines in children below 7 years of age. The comprehensive data and interpretation of reporting trends for AEFI within NSW provided by Mahajan et al are important to continually assess and ensure the safe, as well as effective, use of vaccines. The increased reporting by community members highlights the public's interest in participating in, and being informed about, vaccine safety signals. An open dialogue with the public to ensure ongoing trust is crucial to the success of the program.

Immunisation programs in NSW continue to make important contributions to the health of our state's population. Although some challenges remain, such as the control of pertussis, the detailed reports provided in this issue of the Bulletin will inform the delivery of the NSW immunisation strategy.

References

1. Cottrell S, Roberts RJ. Measles outbreak in Europe. *BMJ* 2011; 342: d3724. doi:10.1136/bmj.d3724
2. NSW Immunisation Strategy 2008–2011. North Sydney: NSW Department of Health; 2007.
3. Spokes PJ, Quinn HE, McAnulty JM. Review of the 2008–2009 pertussis epidemic in NSW: notifications and hospitalisations. *N S W Public Health Bull* 2010; 21(7–8): 167–173. doi:10.1071/NB10031
4. New South Wales Department of Health. Whooping cough (Pertussis). Available at: http://www.health.nsw.gov.au/PublicHealth/Infectious/whoopingcough/index.asp (Cited 28 September 2011).
5. Centers for Disease Control and Prevention (CDC). Notes from the field: Multiple cases of measles after exposure during air travel. Australia and New Zealand, January 2011. *MMWR Morb Mortal Wkly Rep* 2011; 60(25): 851.
6. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. Investigation into febrile reactions in young children following 2010 seasonal trivalent influenza vaccination. Status report as at 2 July 2010 (updated 24 September 2010).

NSW Annual Vaccine-Preventable Disease Report, 2010

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Abstract: Aims: To describe trends in case notification data for vaccine-preventable diseases in NSW for 2010. **Methods:** Risk factor and vaccination status data were collected from cases through public health unit follow-up. Data from the NSW Notifiable Conditions Information Management System (NCIMS) were analysed by: local health district of residence; age; vaccination status; and sub-organism, where available. **Results:** Outbreaks of measles and pertussis were notified in 2010, associated with unimmunised groups (measles) or as a result of waning immunity (pertussis). **Conclusion:** With the exception of pertussis, most vaccine-preventable disease notifications remain low in NSW. Ensuring high levels of vaccination for travellers is important to prevent future outbreaks of vaccine-preventable disease, particularly measles.

The objectives of vaccine-preventable disease surveillance are to: detect and investigate outbreaks of vaccine-preventable disease; identify contacts of patients who may be at risk of infection; identify cases of potential vaccine failure; and understand the epidemiology of vaccine-preventable disease to inform the development of prevention strategies. Notified cases of vaccine-preventable disease were defined according to national criteria.[1] Under the NSW *Public Health Act 1991*, since 1991: medical practitioners have been required to notify patients diagnosed with measles and pertussis; laboratories have been required to notify patients diagnosed with measles, pertussis, rubella, *Haemophilus influenzae* serotype b invasive infection, meningococcal disease, mumps and rubella; and hospital general managers have been required to notify patients diagnosed with measles, pertussis, *H. influenzae* serotype b invasive infection, and meningococcal disease, to NSW Health (via public health units). Laboratories have also been required to notify patients with invasive pneumococcal infections since 2002.

Notifications of *H. influenzae* serotype b invasive infection, measles, meningococcal disease, pertussis, pneumococcal disease (people aged less than 5 years and 50 years and over) and tetanus prompt public health follow-up according to NSW case definitions and response protocols.[2] Notifications of mumps and rubella are not routinely followed-up by public health units in NSW.[2] Public health unit staff enter data gathered on notified cases into the statewide Notifiable Conditions Information Management System (NCIMS). This report describes notifications of vaccine-preventable diseases in New South Wales (NSW) in 2010 and compares this with recent trends in surveillance data.

Methods

Notification data from the NSW NCIMS were reviewed for cases of vaccine-preventable diseases with a date of onset in 2010. All rates were calculated using Australian Bureau of Statistics population estimates for the relevant year. Rates are presented as annual rates per 100 000 total population or population in age groups. Risk factor and vaccination status data were collected from notified cases through public health unit follow-up. In NSW, laboratories provide serotype data for measles, meningococcal and pneumococcal disease. Notified cases were analysed by place of usual residence according to geographical regions served by the relevant local health districts' public health unit.

Results

Haemophilus influenzae *serotype b invasive infection*

H. influenzae serotype b (Hib) is a bacillus which may form part of the flora of the upper respiratory tract. The bacteria are spread through contact with droplets from the nose or throat of a person with the infection, usually in household-like settings. Infection can result in invasive disease including meningitis, epiglottitis, septic arthritis, cellulitis and pneumonia.[3] Since 1993, vaccination against *H. influenzae* serotype b has been available and is provided for infants at 2, 4, 6 and 12 months of age.[4] In 2006, the *H. influenzae* serotype b vaccine changed to PRP-T from PRP-OMP.

Summary of notified cases

In 2010, six cases of *H. influenzae* serotype b infection were notified which is similar to previous years. Two cases were children aged less than 1 year, two cases were children aged between 1–6 years, and two cases were adults aged 35 and 55 years. Three cases were male; no cases were notified in Aboriginal people in 2010.

Vaccination status of cases

Of the four cases of *H. influenzae* serotype b infection notified in children in 2010, one was unvaccinated and three were fully vaccinated for their age (an infant aged 7 months with three doses and two children aged 3 years with four doses).

Comment

H. influenzae serotype b is now rarely seen in NSW children. *H. influenzae* serotype b vaccination has successfully reduced the rate of disease incidence in unvaccinated populations.

Measles

Measles is an acute, highly infectious viral disease that can have serious complications. Prodromal symptoms of measles include fever, tiredness, cough, runny nose, sore red eyes and feeling unwell. A characteristic rash appears 3–7 days after the prodrome, beginning on the face and spreading down the body. The rash usually lasts 4–7 days.[3]

Summary of notified cases

In 2010, 26 cases of measles were notified in NSW, compared to 19 in 2009. The highest notification rates were reported among young people aged at onset of their illness 10–14 years (10 cases, 2.2 per 100 000 population) and 15–19 years (seven cases, 1.5 per 100 000 population) (Figure 1). Eighteen cases (69%) were male; no cases were notified in Aboriginal people. Geographically, the highest notification rates were reported from the Northern NSW Local Health District (4.0 per 100 000 population) (Table 1).

Vaccination status of cases

Of the 26 cases, 18 (69%) were unvaccinated, two (8%) were vaccinated, two (8%) were partially vaccinated and four adult cases (15%) were unable to recall their vaccination status.

Outbreaks

Most cases of measles in NSW are notified either in non-immune travellers who return with the infection from countries where measles is endemic, or in non-immune people who are exposed to a known case.[5] Of the 26 cases notified in 2010, six (23%) were associated with overseas travel. Three of these cases resulted in further transmission affecting 20 people. One case who acquired the infection overseas was associated with transmission to one unvaccinated family member and one unvaccinated community contact. A second case who acquired the infection overseas was associated with transmission to three unvaccinated family members and one airplane contact with uncertain vaccination history. A third overseas case, from the Northern NSW Local Health District, was associated with transmission in a high school (eight cases), a prison (four cases) and the community (two cases).

Genotype

There are different genotypes of the measles virus. In 2010, eight cases had measles genotype information identified. Of these, one were identified as H1 (associated with travel to Vietnam), one was D8 (associated with travel to Sri Lanka), one was D4 (associated with travel to Italy), and five were D9 (one associated with travel to China, and four from the Northern NSW Local Health District cluster initially associated with travel to Malaysia).

Comment

People at risk of contracting measles are those who have never had measles or who have never been vaccinated. A second dose of measles-mumps-rubella (MMR) vaccine

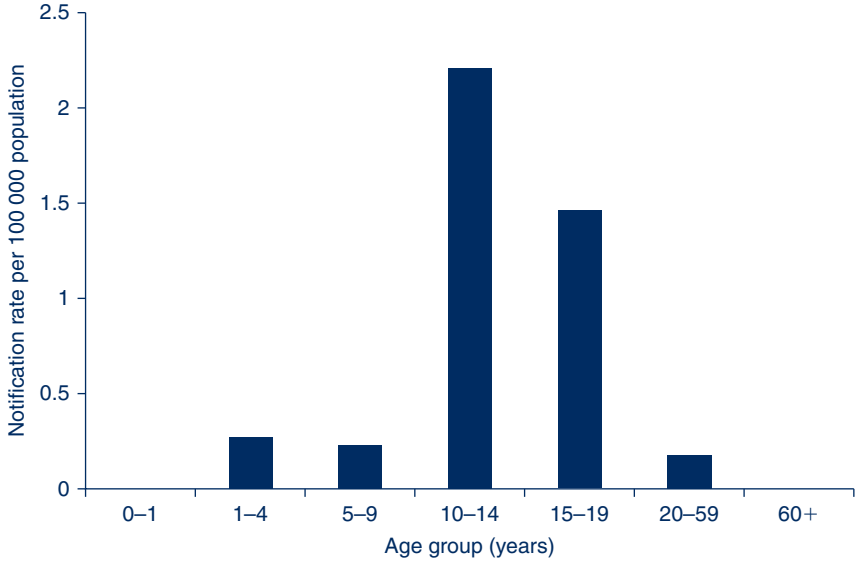

Figure 1. Annual notification rates of measles disease by age group, NSW, 2010.
Source: NSW Notifiable Conditions Information Management System

Table 1. Number and rate per 100 000 of notifications of vaccine-preventable diseases by local health district, NSW, 2010

Local Health District	*Haemophilus influenzae* b infection		Measles		Meningococcal disease (invasive)		Mumps		Pertussis		Pneumococcal disease (invasive)		Rubella		Tetanus	
	n	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate
Central Coast	0	0	3	1.0	10	3.2	2	0.6	192	60.6	20	6.3	2	0.6	0	0
Far West	0	0	0	0	0	0	0	0	114	260.3	3	6.8	0	0	0	0
Hunter New England	1	0.1	0	0	14	1.8	3	0.4	773	98.1	64	8	2	0.3	1	0.1
Illawarra Shoalhaven	1	0.3	0	0	8	2.1	3	0.8	539	139.6	27	7	0	0	0	0
Justice Health[a]	–	n/a	4	n/a	–	n/a	–	n/a	–	n/a	1	n/a	–	n/a	0	0
Mid North Coast	1	0.3	0	0	5	1.7	0	0	148	49.4	7	2.3	0	0	0	0
Murrumbidgee	0	0	1	0.4	1	0.4	1	0.4	535	196.8	14	5.2	0	0	0	0
Nepean Blue Mountains	1	0.3	1	0.3	5	1.5	1	0.3	442	136.2	27	8.3	0	0	0	0
Northern NSW	0	0	12	4	1	0.3	0	0	216	72.7	23	7.7	1	0.3	0	0
Northern Sydney	0	0	4	0.5	1	0.1	5	0.6	1628	195.5	63	7.6	2	0.2	0	0
South Eastern Sydney	0	0	1	0.1	5	0.6	6	0.7	1187	139.7	74	8.7	3	0.4	0	0
South Western Sydney	1	0.1	0	0	9	1	8	0.9	912	105.1	56	6.1	1	0.1	0	0
Southern NSW	0	0	0	0	1	0.5	0	0	501	229	17	7.8	0	0	0	0
Sydney	0	0	0	0	3	0.5	6	1.1	677	122.1	35	6.3	2	0.4	0	0
Western NSW	1	0.4	0	0	5	1.8	0	0	407	145.5	28	10	0	0	0	0
Western Sydney	0	0	0	0	6	0.7	3	0.4	1009	122.6	44	5.2	0	0	0	0

[a]Rates for Justice Health are not able to be calculated

was added to the National Immunisation Program in 1992.[4] Endemic genotypes of the measles virus have disappeared through control. The variety of genotypes described indicates that most cases are imported.

Invasive meningococcal disease

Invasive meningococcal disease is an acute bacterial disease that typically causes septic shock or meningitis (or a combination of both).[3] Invasive meningococcal disease is caused by infection with meningococcus bacteria, of which there are several serogroups. A vaccine against serogroup C meningococcal disease was added to the National Immunisation Program in 2003 for children at 12 months of age and offered to all people aged 1–19 years between 2003 and 2004.[4]

Summary of notified cases

In 2010, 74 cases of invasive meningococcal disease were notified in NSW (66 confirmed and eight probable), compared with 92 cases notified in 2009. Five deaths were notified in 2010 (three caused by serogroup B, one serogroup W135, and one with an unknown serogroup) compared to four deaths in 2009 (two caused by serogroup B, one serogroup W135, and one with an unknown serogroup).

The highest notification rates of invasive meningococcal disease were among children aged less than 5 years at onset of illness (29 cases, 6.2 per 100 000 population) and young people aged 15–19 years (10 cases, 2.1 per 100 000 population). Of the notifications among children aged less than 5 years, the highest rates were reported from children aged 12–24 months (10 cases, 10.1 per 100 000 population) and infants aged less than 12 months (eight cases, 8.4 per 100 000 population) (Figure 2).

In 2010, 36 cases (49%) of invasive meningococcal disease were in males. Seven cases were notified in Aboriginal people. Geographically, the highest notification rates were from the Central Coast (3.2 per 100 000 population) and Illawarra Shoalhaven Local Health Districts (2.1 per 100 000 population) (Table 1).

Vaccination status of cases

Information describing vaccination status was complete for 60 cases (81%). Of the cases with known vaccination status, 37 (62%) were vaccinated against serogroup C. Of the vaccinated cases, 29 (78%) were from serogroup B (for which there is no vaccine), one (3%) was from serogroup W135 and six (16%) were unable to be typed. No cases reported in people who were vaccinated were due to serogroup C.

Serogroup

Of the 74 cases notified in NSW in 2010, serogroup information was recorded for 62 (84%). Of the cases with known serogroup information, 49 (79%) were caused by

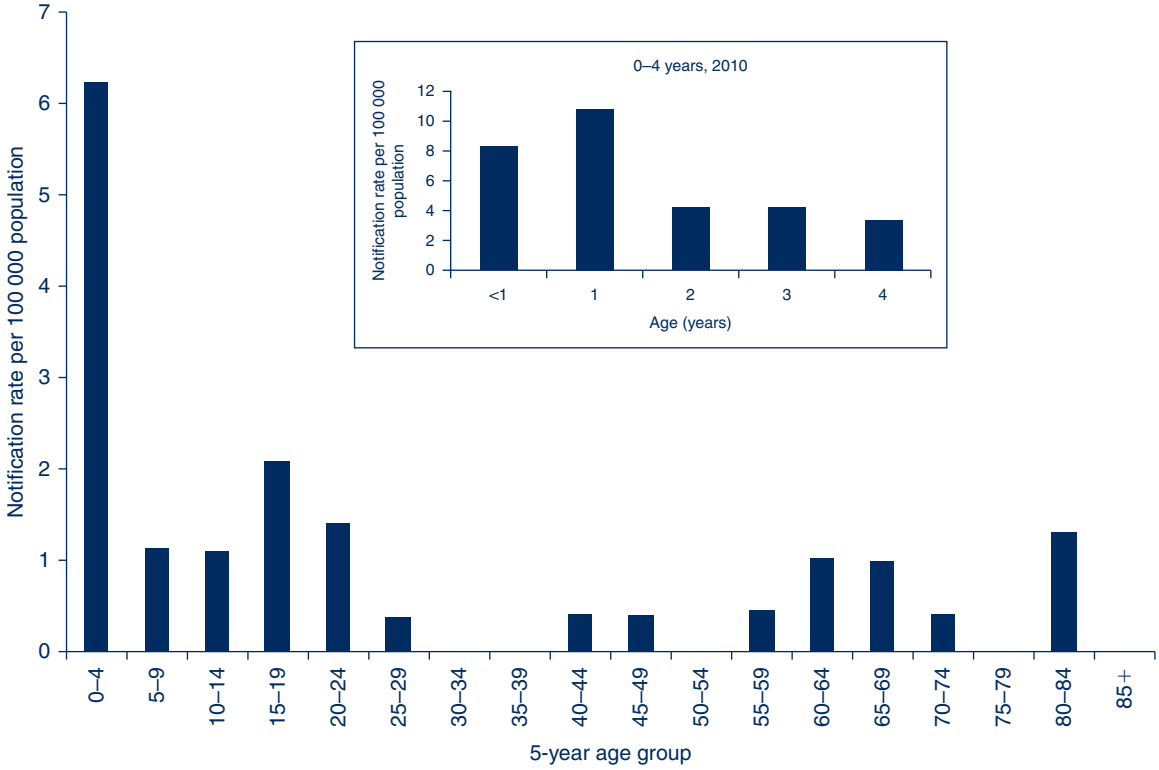

Figure 2. Annual notification rates of invasive meningococcal disease by 5-year age groups, NSW, 2010. Inset: Annual notification rates for children aged below 5 years for 2010 for each year of age.
Source: NSW Notifiable Conditions Information Management System

serogroup B (for which there is no vaccine), six (10%) were serogroup C, four (6%) were serogroup W135 and three (5%) were serogroup Y. Of the 12 cases (19%) with unknown serogroup information, the serogroup could not be typed for five cases and seven cases were clinical diagnoses.

Comment

The number of notified cases of invasive meningococcal disease has declined significantly since the National Meningococcal C Immunisation Program commenced in 2003. The greatest reduction in notified cases of meningococcal disease has been for serogroup C, from 44 cases (29%) with known serogroup in 2003 to six cases (10%) in 2010. Serogroup C meningococcal disease is now mainly reported from young adults (aged 15–29 years) and unimmunised children. The number of cases of meningococcal disease associated with serogroup B has also decreased over time. However, due to reductions in serogroup C disease, notifications of serogroup B disease now account for a larger proportion of the meningococcal disease notifications in NSW. Serogroups not included in vaccines (W135 and Y) have remained relatively stable over time.

Mumps

Mumps is an acute infectious disease caused by the mumps virus. Common symptoms of mumps include fever, loss of appetite, tiredness and headaches followed by swelling and tenderness of the salivary glands. Illness is usually more severe in people who contract the infection after puberty.[3] In NSW, vaccination is provided using MMR vaccine at 12 months and 4 years of age.[4]

Summary of notified cases

In 2010, 38 cases of mumps were notified in NSW compared to 40 in 2009. The highest notification rates of mumps were among young adults aged 25–29 years at onset of illness (10 cases, 2.0 per 100 000 population). In 2010, 13 cases (34%) were male. Geographically, the highest rates were notified from the Sydney Local Health District (1.1 per 100 000 population) (Table 1).

Comment

In NSW, notified cases of mumps are not routinely followed up by public health units. A significant increase in mumps notifications (largely from young adults in the South Eastern Sydney Local Health District) was reported in 2007.[6] No outbreaks or clusters of mumps cases were notified in 2010.

Pertussis

Pertussis (or whooping cough) is a disease caused by infection of the throat with the bacteria *Bordetella pertussis*. Pertussis can be very serious in small children. Older children and adults may have a less serious illness, with bouts of coughing that continue for many weeks regardless of treatment.[3] Pertussis vaccination is combined with diphtheria and tetanus (DTPa) in a primary course at 2, 4 and 6 months of age (can be given at 6 weeks of age) and a booster at 4 years of age (can be given from 3½ years). A second booster dose is given between 15 and 17 years of age using the adult dTpa formulation.[4]

Summary of notified cases

In 2010, 9287 cases of pertussis were notified in NSW compared with 12 448 in 2009. Following an epidemic period during 2008 and 2009,[7] notifications of pertussis declined and stabilised in the first half of 2010 (2376 notified to 30 June 2010) compared to the same period in 2009 when 8777 cases were notified. Notifications of pertussis increased during the second half of 2010 (6911), peaking in November at 1866 cases.

The highest pertussis notification rates were in children aged 5–9 years (2730 cases, 616.9 per 100 000 population) and 10–14 years (1614 cases, 356.5 per 100 000 population). The age groups 5–9 and 10–14 years were the only age groups showing an increase in notification rates in 2010 compared with 2009, in contrast to younger age groups. Notifications of pertussis in children aged 0–4 years were significantly lower in 2010 (1394 cases, 298.8 per 100 000 population) compared to 2009 (2821 cases, 621.6 per 100 000 population). Of the cases aged less than 5 years, the highest notification rates were in children aged 3 years (364 cases, 384.7 per 100 000 population) and infants aged less than 12 months (302 cases, 315.4 per 100 000 population) (Figure 3).

In 2010, 4026 cases (43%) were male. Of the 1394 cases aged 0–4 years (who are followed up by public health units), 49 (4%) were notified in Aboriginal children. Geographically, the highest notification rates were reported in the Far West (260.3 per 100 000 population), Murrumbidgee (196.8 per 100 000 population) and North Sydney (195.5 per 100 000 population) Local Health Districts (Table 1).

Vaccination status of cases

In 2010, 302 cases were notified in infants aged less than 12 months of age. Of these, 204 (68%) were infants too young to be fully vaccinated. Of the 1092 cases of pertussis notified in children aged 1–4 years, 83 (8%) had no immunisation recorded, 123 (10%) had less than three doses of vaccine recorded, and 882 (81%) had three or more doses recorded.

Comment

In 2010, the number of notifications of pertussis was significantly lower in children aged 0–4 years compared to the previous year. This was particularly striking for children aged 3 years at onset of illness (384.7 per 100 000 population in 2010 compared to 810.9 per 100 000 population in 2009) and infants aged less than 12 months of age

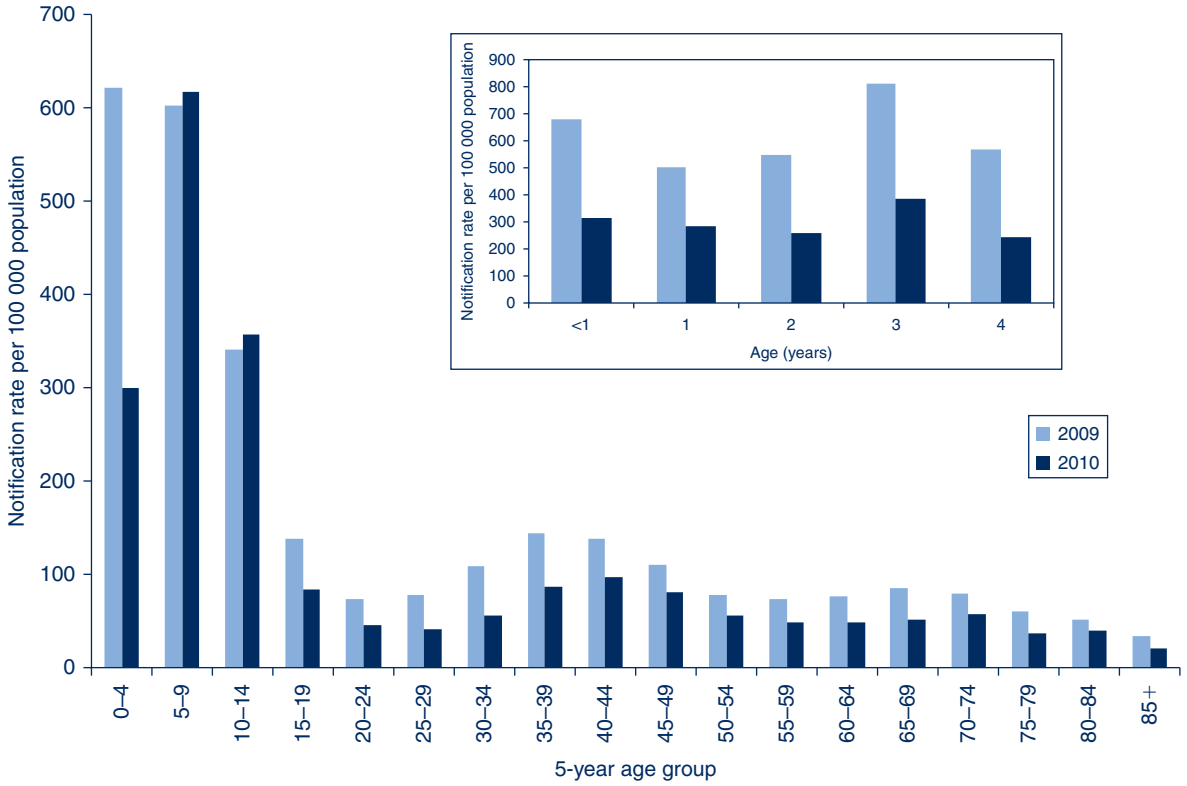

Figure 3. Annual notification rates of pertussis by 5-year age groups, NSW, 2009 and 2010. Inset: Annual notification rates for children aged below 5 years for 2009 and 2010 for each year of age.
Source: NSW Notifiable Conditions Information Management System

(315.4 per 100 000 population in 2010 compared to 677.2 per 100 000 population in 2009).

The reduction in notifications in these age groups may be in part due to a statewide community awareness campaign to protect infants. The key messages were: for infants to receive their first dose of vaccine at 6 weeks (from 8 weeks); for children to receive their first booster dose of vaccine at 3½ years (from 4 years); and to promote free vaccination for new parents, grandparents and carers of infants.[8]

Pneumococcal disease (invasive)

Pneumococcal disease is caused by infection with the bacteria *Streptococcus pneumonia* and is a frequent cause of serious bacterial infections.[3] There are more than 90 different serotypes that can cause the disease. Vaccines for children aged less than 5 years (7-valent pneumococcal conjugate vaccine – 7vPCV) and adults older than 65 years (23-valent pneumococcal polysaccharide vaccine – 23vPPV) were introduced into the National Immunisation Program in 2005.[4] In NSW, cases of all ages are notified, but only those aged less than 5 years or older than 50 years are routinely followed up by public health units to gather vaccination and serotype data.

Summary of notified cases

In 2010, 503 cases of invasive pneumococcal disease were notified compared to 478 in 2009. Forty-six deaths were identified in 2010 compared to 53 in 2009. Two deaths were notified in fully vaccinated children aged less than 2 years (disease caused by serotypes not included in the vaccine), five in people aged 5–49, and 39 in people aged older than 50 years.

The highest notification rates of invasive pneumococcal disease were in adults aged older than 85 years (45 cases, 32.6 per 100 000 population), 80–84 years (34 cases, 22.5 per 100 000 population) and children aged less than 5 years (98 cases, 21.1 per 100 000 population) (Figure 4). Of the cases aged less than 5 years, the highest notification rates were in children aged 12–23 months (35 cases, 38.0 per 100 000 population) and infants aged less than 12 months (26 cases, 27.2 per 100 000 population).

Fifty-six percent of cases were male. Of the 371 cases aged 0–4 years or older than 50 years (who are followed up by public health units), 13 (4%) were notified in Aboriginal people. Geographically, the highest notification rates were reported in the Western NSW (10.0 per 100 000 population), South Eastern Sydney (8.7 per 100 000 population) and Nepean Blue Mountains (8.3 per 100 000 population) Local Health Districts (Table 1).

Serotype

Of the 503 cases of invasive pneumococcal disease notified in 2010, 400 (80%) had complete serotype

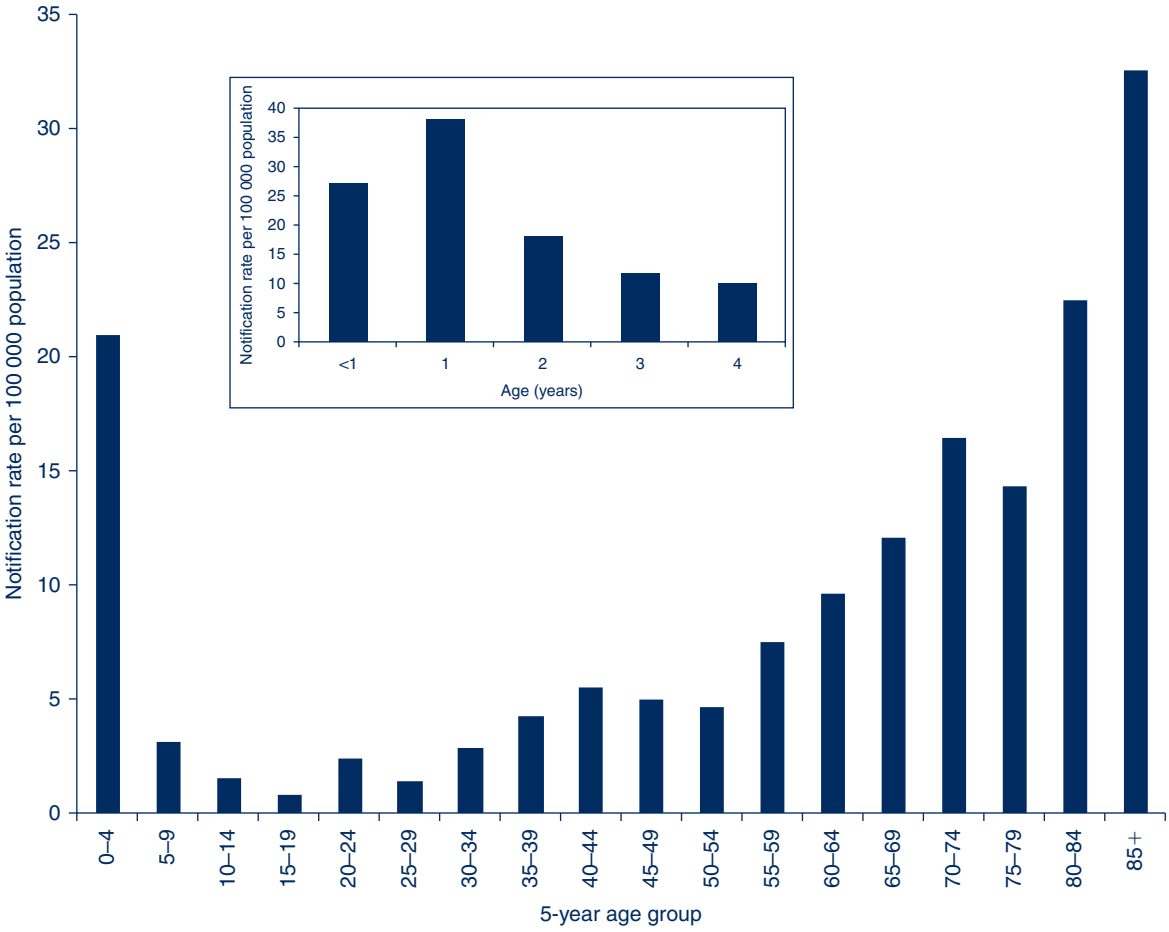

Figure 4. Annual notification rates of invasive pneumococcal disease by 5-year age groups, NSW, 2010. Inset: Annual notification rates in children aged below 5 years for 2010 for each year of age.
Source: NSW Notifiable Conditions Information Management System

information. For children aged less than 5 years with known serotype information, 92 (94%) were notified with serotypes not included in the 7vPCV, two (2%) were notified with invasive disease caused by a serotype included in the 7vPCV (19F and 23F), and four (4%) were unable to be typed. For people aged 5–49 years with known serotype information, 95 (81%) were notified with serotypes not included in the 7vPCV, 17 (15%) were notified with invasive disease caused by a serotype included in the 7vPCV, and five (4%) were unable to be typed. For adults aged older than 50 years, 70 cases (28%) were caused by a non-vaccine-related serotype.

Comment

Invasive pneumococcal disease has significantly decreased in children aged less than 5 years, with moderate reductions in adults aged older than 50 years, following the addition of pneumococcal vaccine onto the National Immunisation Program in 2005.[9] In children, disease caused by serotypes included in the 7vPCV are uncommon, however, disease caused by serotypes not included in the 7vPCV has continued to increase (particularly disease caused by serotype 19A).

Rubella

Rubella (or German measles) is an infectious viral disease. Although a mild infection in most people, infection in early pregnancy can cause serious birth defects or miscarriage. Rubella is spread from a person with the infection by droplets from the nose or mouth or by direct contact.[3] Rubella is easily spread to people who have not been vaccinated or not previously had the infection. Rubella vaccination is provided using MMR vaccine at 12 months and 4 years of age.[4]

Summary of notified cases

In 2010, 13 cases of rubella were notified in NSW compared to seven in 2009. All cases were notified in adults aged 20–50 years. Six cases (46%) were male. Geographically, the highest notification rates were in the Central Coast Local Health District (0.6 per 100 000 population) (Table 1).

Comment

It is likely that many cases of rubella are diagnosed clinically and are never confirmed by pathology tests. Therefore, the notifications are likely to represent an

underestimation of the true incidence of rubella in the community. Rubella cases are not routinely followed up by public health units in NSW. Notifications have declined over time.

Tetanus

Tetanus is a disease caused by the bacteria *Clostridium tetani*. Toxin made by the bacteria, which grows at the site of an injury, attacks a person's nervous system. Although now rare due to immunisation, tetanus can be fatal. *C. tetani* bacteria are found in dust and animal faeces and infection may occur after minor injury (sometimes unnoticed punctures to the skin that are contaminated with soil, dust or manure) or after major injuries such as open fractures, dirty or deep penetrating wounds, and burns.[3] Tetanus is not passed from one person to another. Vaccination against tetanus is given to children with diphtheria and pertussis (DTPa) in a primary course at 2, 4 and 6 months of age. A booster dose of DTPa is given at 4 years.[4] A second booster dose has been included in the National Immunisation Program for those aged 15–17 years since 2004 using the adult dTpa formulation.

Summary of notified cases

In 2010, one case of tetanus was notified in NSW. The case, an elderly man, was unsure of his vaccination history.

Comment

The number of notified cases of tetanus has remained relatively stable over the past 5 years, ranging from one to two cases annually. In Australia, tetanus mostly occurs in older adults who are not adequately immunised.

Discussion

The numbers of notified cases of many vaccine-preventable diseases remain low in NSW, however, outbreaks do occur. High rates of pertussis infection have been notified in recent years, in part due to waning immunity and increased use of more sensitive tests. Outbreaks of measles have occurred as a result of non-vaccinated people travelling to countries where vaccine-preventable disease is more common. Maintaining high levels of vaccination coverage for overseas travellers is important for future vaccine-preventable disease control, particularly for measles.

Notification data for vaccine-preventable diseases are subject to several limitations and are likely to underestimate the true incidence of disease. Firstly, some infections can be mild, so people may not present for medical attention. Secondly, for those who do present to healthcare providers, notification relies on a diagnosis being made and in the absence of a doctor notifying the case, appropriate laboratory tests being ordered. Thirdly, positive diagnoses may not be notified by the doctor, laboratory or hospital to public health units as required under the Public Health Act for a variety of reasons. Nonetheless, assuming these biases are relatively stable over time, vaccine-preventable disease notification data do provide a useful indication of the trends in disease incidence in NSW.

Conclusion

With the exception of pertussis, most vaccine-preventable diseases are currently notified in low numbers in NSW. This is the result of reaching and maintaining high vaccination coverage levels. Notification and disease estimates from surveillance systems can be affected by changes in disease awareness, laboratory diagnostic tests and testing protocols, case definitions, and reporting practices over time. However, ongoing surveillance for vaccine-preventable disease is important to identify changes to disease incidence and to inform appropriate public health action.

Acknowledgments

The authors would like to thank and acknowledge the NSW public health network including laboratory staff for their work in identifying and managing cases of vaccine-preventable disease in NSW.

References

1. Australian Government Department of Health and Ageing. Australian national notifiable diseases case definitions. Available from: http://www.health.gov.au/internet/main/publishing.nsf/content/cdna-casedefinitions.htm (Cited June 2011.)
2. Communicable Diseases Branch. NSW Department of Health. Disease Control Guidelines. Available from: http://www.health.nsw.gov.au/publichealth/Infectious/controlguide.asp (Cited June 2011.)
3. Heymann DL, ed. Control of Communicable Diseases Manual. 19th ed. Washington: American Public Health Association; 2008.
4. National Health and Medical Research Council. The Australian Immunisation Handbook. 9th ed. Canberra: Australian Government Department of Health and Ageing; 2008.
5. Brotherton J. EpiReview: Measles in NSW, 1991–2000. *N S W Public Health Bull* 2001; 12(7): 200–4. doi:10.1071/NB01068
6. Ferson MJ, Konecny P. Recent increases in mumps incidence in Australia: the 'forgotten' age group in the 1998 Australian Measles Control Campaign. *Med J Aust* 2009; 190(5): 283–4.
7. Spokes PJ, Quinn HE, McAnulty JM. Review of the 2008–2009 pertussis epidemic in NSW: notifications and hospitalisations. *N S W Public Health Bull* 2010; 21(7–8): 167–73. doi:10.1071/NB10031
8. Whooping Cough information campaign, NSW Department of Health. Available from: http://www.health.nsw.gov.au/PublicHealth/Infectious/whoopingcough/index.asp (Cited June 2011).
9. Gilmour R. EpiReview: Invasive pneumococcal disease, NSW, 2002. *N S W Public Health Bull* 2005; 16(1–2): 26–30.

NSW Annual Immunisation Coverage Report, 2010

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Abstract: This annual report, the second in the series, documents trends in immunisation coverage in NSW for children, adolescents and the elderly, to the end of 2010. **Methods:** Data from the Australian Childhood Immunisation Register, the NSW School Immunisation Program and the NSW Population Health Survey were used to calculate various measures of population coverage, coverage for Aboriginal children and vaccination timeliness for all children. **Results:** Over 90% coverage has been reached for children at 12 and 24 months of age. For children at 5 years of age there was an improvement during 2010 in timeliness for vaccines due at 4 years and coverage almost reached 90%. Delayed receipt of vaccines is still an issue for Aboriginal children. For adolescents, there is good coverage for the first and second doses of human papillomavirus vaccine and the dose of diphtheria, tetanus and acellular pertussis. The pneumococcal vaccination rate in the elderly has been steadily rising, although it has remained lower than the influenza coverage estimates. **Conclusion:** Completion of the recommended immunisation schedule at the earliest appropriate age should be the next public health goal at both the state and local health district level. Official coverage assessments for 'fully immunised' should include the 7-valent pneumococcal conjugate and meningococcal C vaccines, and wider dissemination should be considered.

This is the second *New South Wales (NSW) Annual Immunisation Coverage Report.* This series of annual reports provides information on trends and issues in immunisation coverage in NSW 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 carers. These have been discussed in detail elsewhere.[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 was established on 1 January 1996 by incorporating demographic data from Medicare on all enrolled children aged less than 7 years.[3] The operations of the Australian Childhood Immunisation Register have been discussed in detail elsewhere.[2]

Table 1 presents the vaccines delivered through the NSW Immunisation Program for children in 2010. No new vaccines were introduced into the NSW Immunisation Program during 2010.

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 Australian Childhood Immunisation Register. 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 Australian Childhood Immunisation Register.[4] If a child's records indicate receipt of the last dose of a vaccine that requires more than one dose to complete the series, it is

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

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 that the fourth dose of diphtheria, tetanus and acellular pertussis (DTPa)-containing 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 the Australian Technical Advisory Group on Immunisation 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 payment applied only to children who had not yet already received the full payment at 2 years of age.

October 2008 – The General Practice Immunisation Incentive Service Incentive Payment ($18.50 for completing a schedule point) ceased. Information payments of $6 were retained.

December 2007 – Coverage algorithm for immunisations due at 4 years of age changed to assess children at 5 years, not 6 years.

Table 1. Schedule of vaccines delivered through the NSW Immunisation Program, to children, adolescents and adults in 2010

Age	Vaccine										
Childhood vaccines											
Birth	Hep B										
2 months	Hep B	DTPa	Hib	Polio			7vPCV		Rotavirus		
4 months	Hep B	DTPa	Hib	Polio			7vPCV		Rotavirus		
6 months	Hep B	DTPa	Hib	Polio			7vPCV				
12 months			Hib		MMR			Men C			
18 months						VZV					
4 years		DTPa		Polio	MMR						
Adolescent vaccines											
12 years	Hep B	dTpa				VZV	HPV				
15 years		dTpa								Flu[a,c]	23vPPV[b]
Adult vaccines											
≥50 years										Flu[a,c]	23vPPV[a]
65 years										Flu[c]	23vPPV

Hep B: hepatitis B vaccine; DTPa: diphtheria, tetanus and acellular pertussis-containing vaccine; dTpa: adolescent and adult formulation DTPa; Hib: *Haemophilus influenzae* type b vaccine; MMR: measles-mumps-rubella vaccine; VZV: varicella zoster virus vaccine; 7vPCV: 7-valent pneumococcal conjugate vaccine; Men C: meningococcal C vaccine; HPV: human papilloma virus vaccine (females only); Flu: influenza vaccine; 23vPPV: 23-valent pneumococcal polysaccharide vaccine

[a]All Aboriginal adults only

[b]Aboriginal adults with medical risk factors

[c]Annual vaccination, all aged ≥6 months with medical risk factors, Aboriginal adults ≥15 years, non-Aboriginal adults ≥65 years

Source: National Immunisation Program Schedule.

Table 2. Percentage of children immunised at 12 months of age, by vaccine, for 15 local health districts in NSW, and for Network with Victoria, compared with NSW and Australia, 2010

Vaccine	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	92.9	94.0	93.3	92.5	88.6	94.0	92.3	93.9	86.8	92.4	91.9	92.3	93.1	92.2	92.6	92.6	92.2	92.3
Poliomyelitis	92.9	94.0	93.2	92.5	88.6	94.0	92.2	93.9	86.8	92.3	91.8	92.2	93.0	92.1	92.6	92.6	92.2	92.2
Haemophilus influenzae type b	92.8	94.0	93.1	92.4	88.6	93.9	92.1	93.9	86.6	92.1	91.6	92.0	92.9	91.9	92.5	92.3	92.0	92.1
Hepatitis B	92.6	94.0	93.0	92.2	88.2	94.0	92.0	93.9	86.4	91.4	91.4	92.1	92.7	91.6	92.4	92.2	91.8	91.8
Rotavirus	87.0	89.3	87.8	85.4	83.6	88.5	86.3	87.6	81.8	86.2	86.0	87.2	88.8	86.1	86.5	86.4	86.4	84.7
7vPCV[b]	92.4	93.7	92.9	92.1	88.2	93.8	91.7	93.8	86.0	91.1	90.9	91.8	92.7	91.1	92.1	91.6	91.5	91.5
Fully immunised[c]	92.6	94.0	93.0	92.2	88.2	93.9	91.9	93.9	86.3	91.1	91.1	91.9	92.6	91.3	92.3	92.0	91.7	91.6
Fully immunised (including rotavirus and 7vPCV)	85.2	87.4	85.7	83.3	81.2	86.6	83.8	87.1	79.8	84.3	83.8	84.0	87.2	83.6	84.1	83.8	84.1	85.2
Total number of children	**4121**	**366**	**10 927**	**4648**	**2390**	**3181**	**5020**	**644**	**3453**	**10 564**	**10 948**	**13 071**	**2324**	**7769**	**3866**	**13 516**	**97 303**	**296 794**

Birth cohort born in 2009

[a]CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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

[b]7-valent pneumococcal conjugate vaccine (7vPCV)

[c]Three doses of a diphtheria, tetanus and acellular pertussis-containing vaccine (DTPa), 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

*NV: Network with Victoria (2 postcodes in Albury NSW)

Source: Australian Childhood Immunisation Register.

Table 3. Percentage of children immunised at 24 months of age, by vaccine, for 15 local health districts in NSW, and for Network with Victoria, compared with NSW and Australia, 2010

Vaccine	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	95.1	93.8	96.4	95.6	92.8	96.6	95.3	96.3	89.4	94.3	93.5	95.2	95.2	93.4	96.2	94.6	94.6	94.7
Poliomyelitis	95.1	93.8	96.4	95.6	92.9	96.6	95.2	96.5	89.4	94.2	93.4	95.2	95.2	93.4	96.2	94.6	94.6	94.6
Haemophilus influenzae type b	95.1	94.1	96.7	95.9	92.9	97.0	95.4	96.2	89.5	94.1	93.5	95.7	94.7	93.5	96.5	94.7	94.8	94.6
Hepatitis B	94.7	93.8	96.2	95.2	92.5	96.5	94.9	96.3	88.9	92.9	92.7	94.9	94.5	92.4	96.0	94.1	94.1	94.1
Measles-mumps-rubella	94.1	93.8	96.0	95.3	91.7	96.2	94.2	95.6	87.4	93.0	92.2	94.6	94.0	92.2	95.8	93.9	93.8	93.9
Varicella	82.3	83.3	85.0	80.6	79.7	86.6	80.7	89.0	75.3	80.6	80.6	83.4	82.4	81.1	83.8	82.7	82.1	83.0
Meningococcal C	93.9	93.8	95.8	94.8	91.7	96.0	93.7	95.7	87.2	92.4	91.6	94.2	93.5	92.0	95.6	93.3	93.4	93.6
Fully immunised[b]	93.2	91.9	95.0	93.9	90.6	95.2	92.9	94.4	86.0	90.7	90.0	92.8	92.6	90.0	94.5	91.9	92.1	92.1
Fully immunised (including varicella and meningococcal C)	81.1	80.6	83.8	79.2	78.5	85.1	79.1	87.5	73.9	78.0	78.0	80.9	81.0	78.5	82.3	80.0	80.0	81.1
Total number of children	**4319**	**371**	**11 258**	**4725**	**2604**	**3236**	**4964**	**656**	**3516**	**10 853**	**10 598**	**13 439**	**2414**	**7649**	**3963**	**13 528**	**98 729**	**300 560**

Birth cohort born in 2008

[a]CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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

[b]Three or four doses of a diphtheria, tetanus and acellular pertussis-containing vaccine (DTPa), three doses of polio vaccine, three or four doses of PRP-OMP containing *Haemophilus influenzae* type b (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 vaccine

*NV: Network with Victoria (2 postcodes in Albury NSW)

Source: Australian Childhood Immunisation Register.

Table 4. Percentage of children immunised at 5 years of age, by vaccine, for 15 local health districts in NSW, and for Network with Victoria, compared with NSW and Australia, 2010

Vaccine	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	92.2	90.0	92.8	90.9	88.4	92.7	90.6	94.1	83.4	88.3	88.1	88.9	89.0	87.8	89.8	89.0	89.5	89.7
Poliomyelitis	92.2	90.0	92.7	90.8	88.4	92.4	90.5	94.1	83.4	88.2	88.0	88.9	88.8	87.9	89.6	89.1	90.0	89.5
Measles-mumps-rubella	92.2	89.4	92.8	91.0	88.5	92.9	90.2	94.1	83.2	87.8	87.6	88.8	88.9	87.7	89.6	88.8	89.3	89.6
Fully immunised[b]	91.9	89.4	92.5	90.6	88.1	92.3	89.9	94.0	82.8	87.4	87.3	88.5	88.4	87.2	89.3	88.4	88.9	89.1
Total number of children	**4231**	**369**	**11 072**	**4675**	**2578**	**3128**	**4940**	**663**	**3513**	**10 630**	**9519**	**12 942**	**2301**	**6111**	**3742**	**12 691**	**93 742**	**285 332**

Birth cohort born in 2005
[a]CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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
[b]Four or five doses of a diphtheria, tetanus and acellular pertussis-containing vaccine (DPTa), four doses of polio vaccine, and two doses of a measles- mumps- and rubella-containing vaccine
*NV: Network with Victoria (2 postcodes in Albury NSW)
Source: Australian Childhood Immunisation Register.

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' was calculated using the number of Medicare-registered children who were 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 Australian Childhood Immunisation Register of three doses of a diphtheria, tetanus and pertussis (DTP)-containing vaccine, three doses of polio vaccine, three doses of *Haemophilus influenzae* type b (Hib) vaccine and three doses of hepatitis B vaccine. 'Fully immunised' at 24 months of age was defined as three or four doses of a DTP-containing vaccine, three doses of polio vaccine, four doses of Hib vaccine, three doses of hepatitis B vaccine, and one dose of a measles- mumps- rubella-containing (MMR) vaccine. 'Fully immunised' at 5 years of age was defined as four or five doses of a DTP-containing vaccine, four doses of polio vaccine and two doses 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 third dose of 7-valent pneumococcal conjugate vaccine (7vPCV) and 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

Age-appropriate immunisation was defined as receipt of a scheduled vaccine dose within 30 days of the recommended age. We categorised vaccination at 1–6 months or more than 6 months after the recommended age as delayed. 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 18 LHDs in NSW, eight in metropolitan NSW, seven in rural and regional NSW, two specialist networks focusing on Children's and Paediatric Services, and one specialist network focusing on Forensic Mental Health. Another geographical area,

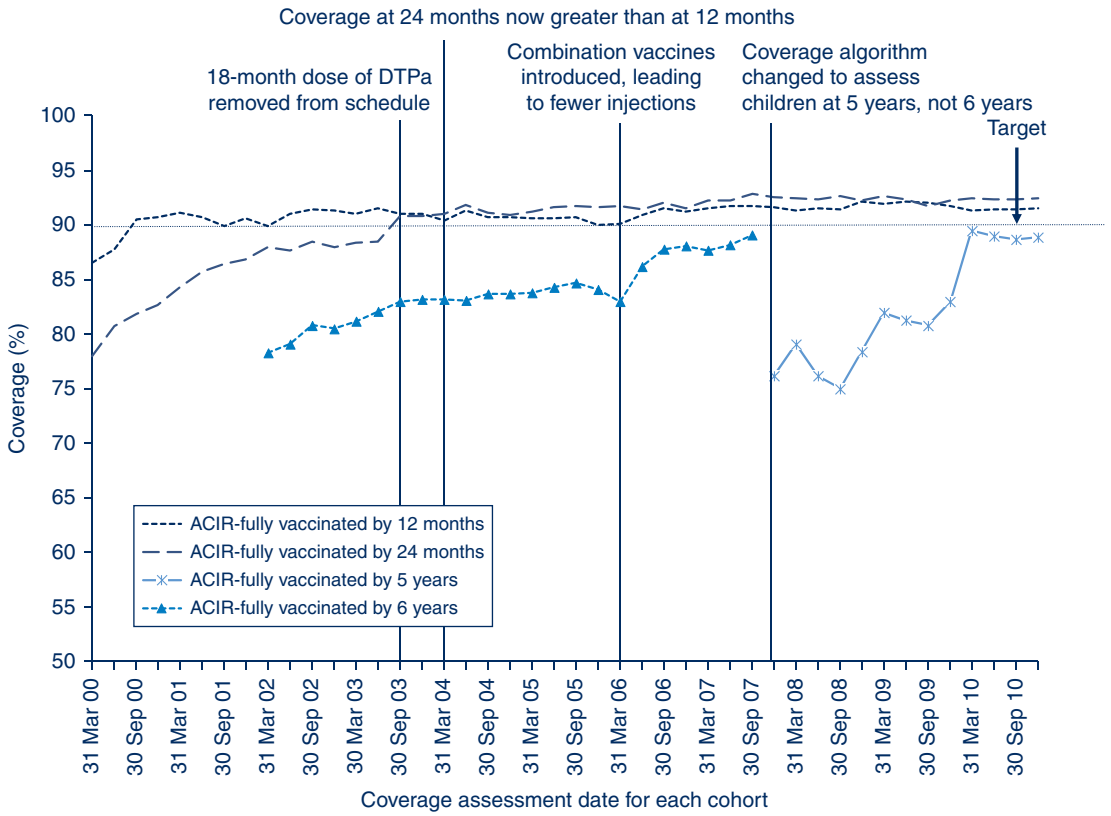

Figure 1. Trends in 'fully immunised'[a,b,c] vaccination coverage, NSW, 2000–2010, for four age cohorts

[a]Three doses of a diphtheria, tetanus and acellular pertussis-containing (DTPa) 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.
[b]Three or four doses of a DTPa-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 (MMR)-containing vaccine.
[c]Four or five doses of a DTPa-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine.
ACIR: Australian Childhood Immunisation Register

Source: Australian Childhood Immunisation Register.

Network with Victoria, consists of two postcodes (2640 and 2641) both of which are in Albury NSW.

Aboriginal status

Indigenous status on the Australian Childhood Immunisation Register 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 Australian Childhood Immunisation Register. For this report we considered two categories of children: '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 before that time.[7]

Small area coverage

Coverage was calculated for Australian Bureau of Statistics (ABS)-defined statistical subdivisions.[8] We chose ABS-defined statistical subdivisions as areas to be mapped because they provide more detail than LHDs but are not too small to render maps unreadable (child population sizes for statistical subdivisions in NSW range from 90 to 7000 children). Maps were created using MapInfo mapping software (version 10, MapInfo Corporation, New York, USA) and the ABS Census Boundary Information. As postcode is the only geographical indicator on the Australian Childhood Immunisation Register, the ABS Postal Area to Statistical Local Area Concordance 2006 was used to match Australian Childhood Immunisation Register residential postcodes of the children to statistical subdivisions.[9]

Conscientious objection and no vaccine recorded

A child must be registered with Medicare before his or her parent(s) can lodge a conscientious objection to immunisation with the Australian Childhood Immunisation Register. Conscientious objectors are eligible for immunisation incentive payments without the need for immunisation,

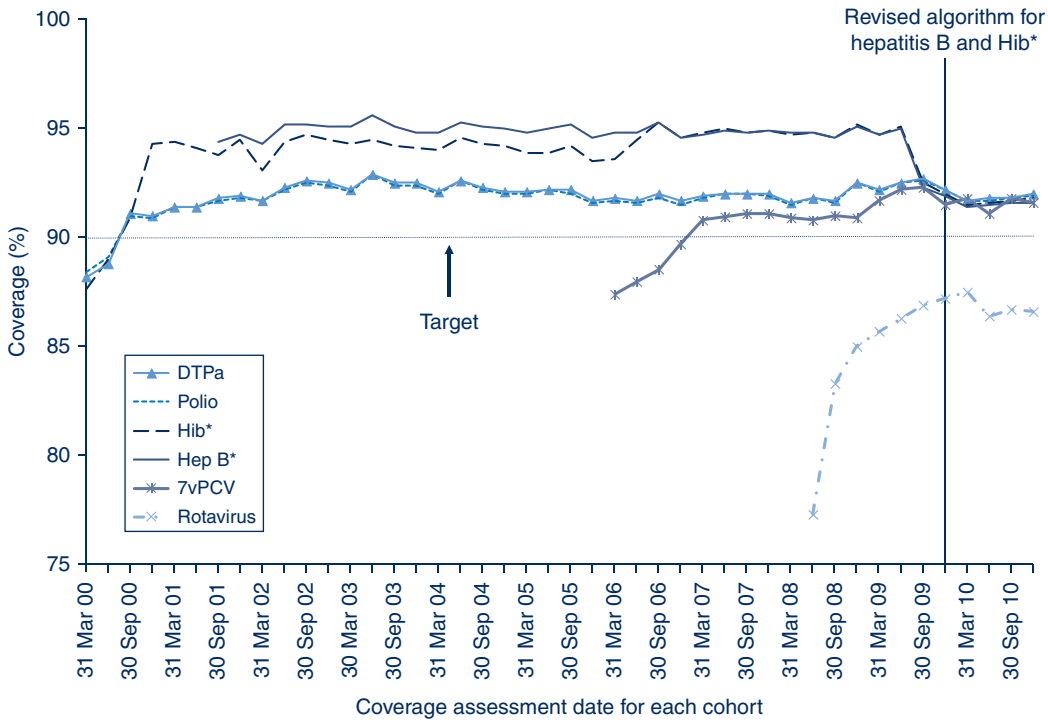

Figure 2. Trends in vaccination coverage estimates for individual vaccines at 12 months of age (third dose of DTPa, polio, hepatitis B, Hib, rotavirus and 7vPCV), NSW, 2000–2010

By 3-month birth cohorts born between 1 January 1999 and 31 December 2009. 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.
7vPCV: 7-valent pneumococcal conjugate vaccine
DTPa: diphtheria, tetanus, pertussis (acellular) – paediatric formulation

Source: Australian Childhood Immunisation Register.

but parents may also object to immunisation but refuse to lodge any official objection. We used the percentage of children with no vaccines recorded on the Australian Childhood Immunisation Register as a proxy measure of the total number of children whose carers were opposed to immunisation, whether or not they are registered as such. Proportions of conscientious objectors and children with no vaccines recorded by LHD were calculated from the cohort of children registered with Medicare and born between 1 January 2004 and 31 December 2009; 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 elderly people were obtained from the 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 3568 and 3342 respondents in NSW, respectively. Methods and results are presented in more detail elsewhere.[10] Coverage for vaccines given to adolescents was collected from the NSW School Immunisation 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. Methods are presented in more detail elsewhere.[11]

Results

Overall coverage estimates

In the majority of LHDs in NSW, coverage for all individual vaccines (except rotavirus) for the 12-month age group

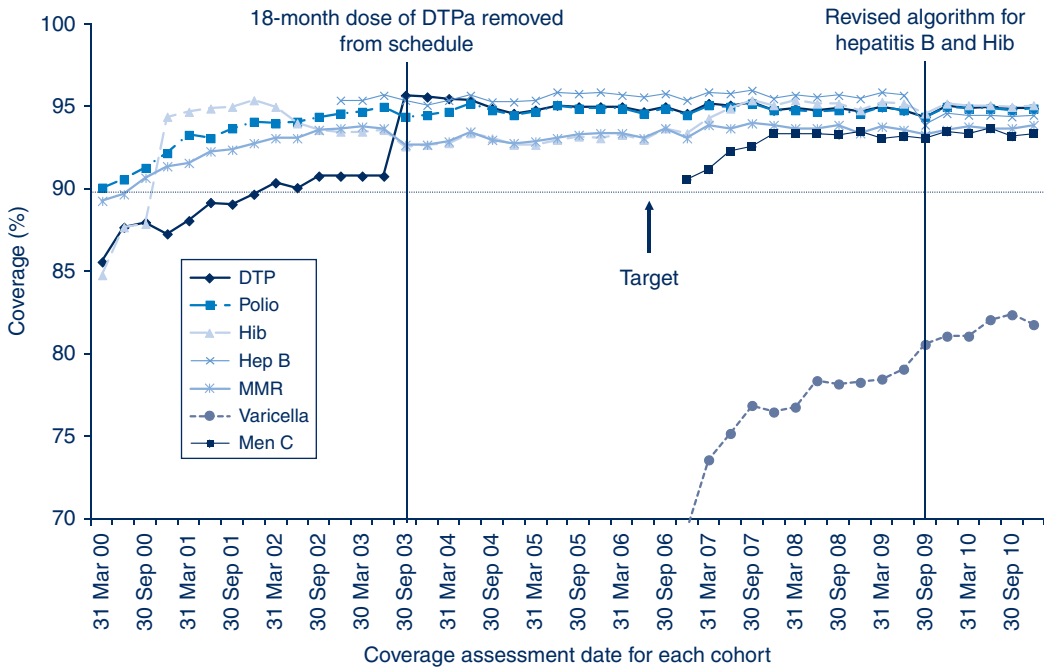

Figure 3. Trends in vaccination coverage estimates for individual vaccines at 24 months of age (DTPa, polio, hepatitis B, Hib, MMR, varicella, Men C),[a] for NSW 3-month birth cohorts between 1999 and 2008

By 3-month birth cohorts born between 1 January 1999 and 31 December 2008. Coverage assessment date was 24 months after the last birth date of each cohort.
[a]Third dose of DTPa (fourth dose – pre-Sept 2003); third dose of polio; third dose of hepatitis B, third dose of Hib; MMR; one dose of varicella and one dose of Men C).
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.

is greater than 90%. Two LHDs (Mid North Coast and Northern NSW) had 12-month coverage estimates ranging from 81.8% to 88.6% for all individual vaccines for the 12-month age group (Table 2). Similarly, in all LHDs except Northern NSW, coverage for all individual vaccines (except varicella) for the 24-month age group is also higher than 90% (Table 3). Recorded coverage for the 5-year age group is slightly below 90% for all vaccines (Table 4). Figure 1 shows time trends in 'fully immunised' childhood vaccination coverage at three milestone ages in NSW. The proportion 'fully immunised' at 1 and 2 years of age has been at high levels since 2003 whereas coverage at 5 years of age increased markedly in 2009 and 2010.

Coverage estimates for children aged less than 3 years

In NSW before 2009, coverage for the 12-month and 24-month age groups for Hib and hepatitis B vaccines was greater than for DTPa and polio, due to a less stringent algorithm for calculating coverage. Since the change in algorithm in the latter half of 2009, coverage estimates for Hib and hepatitis B have lowered and become similar to those of DTPa and polio at just under 95% (Figures 2 and 3). These newer estimates more accurately reflect the true proportion of children fully vaccinated for these vaccines.

Coverage for 7vPCV has remained at high levels, with an increase from 87.4% in March 2006 to 91.6% in the last cohort assessed in December 2010 (Figure 2). It was similar in all LHDs at greater than 90% except in the Mid North Coast and Northern NSW (Table 2).

Rotavirus vaccine was added to the National Immunisation Program in July 2007; coverage for two doses at 12 months of age was calculated only from the July 2008 quarter onwards. Coverage increased in NSW from 77.3% in July 2008 to 86.6% in December 2010 (Figure 2) and was lower and had greater variation between LHDs compared to other vaccines given at 2, 4 and 6 months of age (Table 2).

In 2010, coverage for the MMR and meningococcal C vaccines for the 24-month age group was around 94% and 93% respectively. Coverage for meningococcal C has remained at high levels since first calculated for NSW in

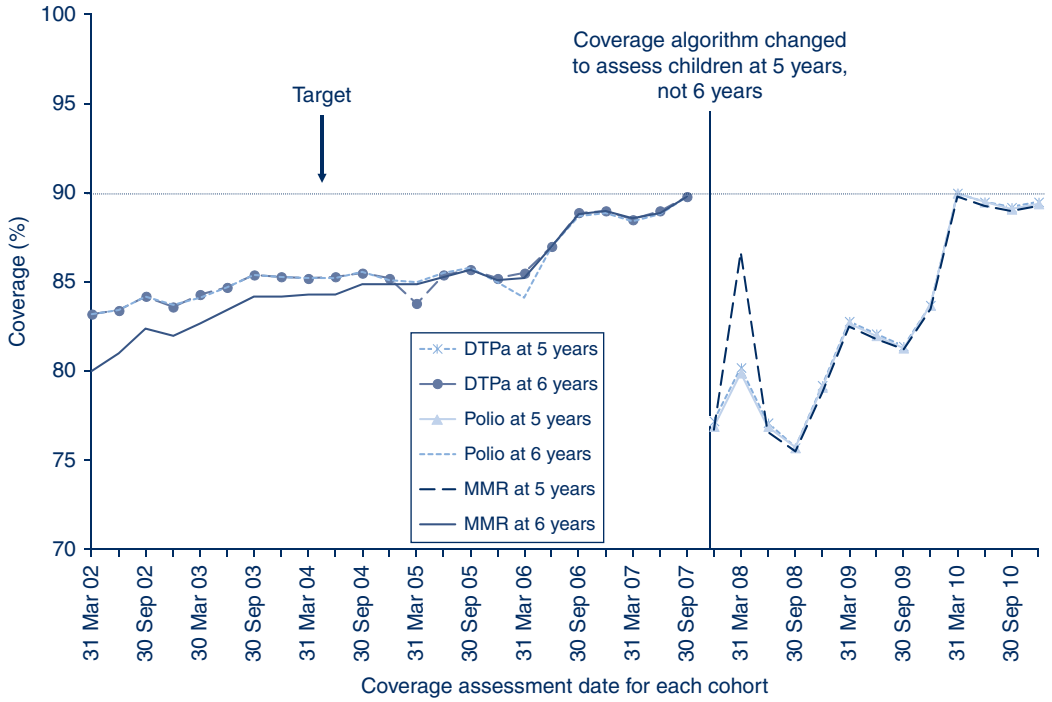

Figure 4. Trends in vaccination coverage estimates for individual vaccines (DTPa, polio and MMR)[a] at 5 years of age (6 years up to December 2007)

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]Fourth dose of DTPa and polio and second dose of MMR
DTPa: diphtheria, tetanus, pertussis (acellular) – paediatric formulation
MMR: measles-mumps-rubella

Source: Australian Childhood Immunisation Register.

early 2006 though it was added to the National Immunisation Program in January 2003. It was greater than 91% in all LHDs except Northern NSW (Table 3).

Varicella vaccine coverage for all LHDs was much lower than for meningococcal C (Table 3), ranging from 75.3% in Northern NSW to 89% in Albury (Network with Victoria).

Coverage estimates for children aged 5–6 years

The trends in childhood vaccination coverage in NSW for individual vaccines (DTPa, polio and MMR) at 6 years of age (5 years of age from December 2007) are shown in Figure 4. Coverage for all three vaccines was almost identical and remained steady across the whole period until mid-2006 when a sharp increase of almost 5% was recorded, likely due to the introduction of combination vaccines. Coverage at 5 years of age was substantially lower than at 6 years of age due to the shorter time for the recording of delayed vaccinations. However, in 2010, the 5-year coverage for DTPa, polio and MMR increased markedly to be slightly above 89%. The overall 'fully immunised' rate for 5-year coverage was approximately 89% in NSW, which was similar to the national 5-year coverage rate of 89.1%. All LHDs in NSW had more than 85% 5-year coverage rates for all vaccines, except Northern NSW which had approximately 83% (Table 4).

Coverage estimates for Aboriginal children

Vaccination coverage estimates for the three milestone ages for individual vaccines for Aboriginal status for 2010 are shown in Tables 5 and 6. These tables show that coverage is lower for Aboriginal children than non-Aboriginal children at the 12-month and 5-year age milestones, but there was little difference at 24 months of age.

At 12 months of age, at the LHD level, coverage was lower among Aboriginal children in all LHDs except Northern Sydney (91.1% non-Aboriginal; 100% Aboriginal) and Central Coast (92.6% non-Aboriginal; 93.0% Aboriginal). The extent of the difference varied among LHDs, ranging from 0.1% to 12%. However, by the age of 24 months, coverage disparities between Aboriginal and all other NSW children had almost disappeared in most LHDs, with the proportion 'fully immunised' at 91.5% for Aboriginal and 92.1% for all other NSW children (Tables 3 and 6). All LHDs in NSW had more than 90% coverage for Aboriginal

Table 5. Vaccination coverage estimates for NSW children by age, disease and Aboriginal status, 2010

Vaccine	Milestone age	Aboriginal	Non-Aboriginal
Diphtheria-tetanus-pertussis	12 months[a]	87.3	92.4
	24 months[b]	94.3	94.7
	5 years[c]	84.8	89.6
Poliomyelitis	12 months[a]	87.2	92.4
	24 months[b]	94.3	94.6
	5 years[c]	84.7	89.6
Haemophilus influenza type b	12 months[a]	87.2	92.2
	24 months[b]	95.0	94.8
	5 years[c]	NI	NI
Hepatitis B	12 months[a]	87.2	92.0
	24 months[b]	94.3	94.1
	5 years[c]	NI	NI
Measles-mumps-rubella	12 months[a]	NI	NI
	24 months[b]	93.6	93.8
	5 years[c]	85.2	89.4
Varicella	12 months[a]	NI	NI
	24 months[b]	81.0	82.1
	5 years[c]	NI	NI
Meningococcal C	12 months[a]	NI	NI
	24 months[b]	93.3	93.4
	5 years[c]	NI	NI
7-valent pneumoccocal conjugate vaccine	12 months[a]	87.1	91.7
	24 months[b]	NI	NI
	5 years[c]	NI	NI
Rotavirus	12 months[a]	80.6	86.6
	24 months[b]	NI	NI
	5 years[c]	NI	NI

[a]Birth cohort born 1 January 2009–31 December 2009
[b]Birth cohort born 1 January 2008–31 December 2008
[c]Birth cohort born 1 January 2005–31 December 2005
NI: this vaccine at this age milestone is not included in the calculation of coverage estimates
Source: Australian Childhood Immunisation Register.

children with the highest 24-month coverage for Aboriginal children observed in the Illawarra Shoalhaven LHD.

At 5 years of age, the proportion recorded as being 'fully immunised' was lower than that at earlier age milestones. There was a small difference between Aboriginal and other NSW children (84.4% and 88.9% respectively) while, for individual LHDs, coverage in Aboriginal children ranged from 0.8% lower (in Albury [Network with Victoria]) to 14% lower (in Southern NSW) than in non-Aboriginal children (Tables 4 and 6).

Coverage in adolescents

NSW Adolescent Vaccination Program coverage data for high school students for 2010 are shown in Table 7. Coverage varies by vaccine and dose with better coverage for the first and second doses of human papillomavirus vaccine (HPV) and the dose of dTpa in Year 7 attendees. Vaccine coverage by LHD was not available for 2010.

Vaccines for the elderly (pneumococcal and influenza)

The proportion of people aged 65 years and over who were vaccinated for influenza in the past 12 months has remained relatively stable and is over 70% in NSW for the period 2002–2010. However, pneumococcal vaccination (23-valent pneumococcal polysaccharide vaccine; 23vPPV) in the previous 5 years has been steadily rising, although it has remained lower than the influenza coverage estimates. The highest coverage rate for pneumococcal vaccination in the elderly was observed in 2006, the year after its inclusion on the National Immunisation Program (Figure 5).

In 2010, influenza (in the previous 12 months) and pneumococcal (in previous 5 years) vaccine coverage in the

Table 6. Percentage of children fully immunised at 12 months, 24 months and 5 years of age, by Aboriginal status for 15 local health districts in NSW, and for Network with Victoria, compared with NSW and Australia, 2010

Age	Local health district[a]																NSW	Australia
Aboriginal status	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NV* %	NN %	NS %	SES %	SWS %	SN %	SYD %	WN %	WS %	%	%
12 months – fully immunised[b]																		
Aboriginal	93.0	86.4	86.8	86.6	88.2	89.2	87.2	100.0	85.7	100.0	90.4	87.3	87.6	83.5	86.7	80.2	87.1	85.3
Non-Aboriginal	92.6	96.1	93.4	92.4	88.3	94.3	92.0	93.6	86.4	91.1	91.2	92.0	92.8	91.4	93.5	92.1	91.8	91.9
12 months – fully immunised (including rotavirus and 7vPCV)																		
Aboriginal	83.9	80.3	77.1	75.0	73.8	67.9	80.8	88.6	75.3	97.1	81.9	78.4	79.4	78.0	74.8	67.3	76.1	74.2
Non-Aboriginal	85.2	89.5	86.4	83.7	82.2	87.9	83.8	87.0	80.2	84.3	83.8	84.1	87.5	83.7	85.9	84.1	84.4	85.7
24 months – fully immunised[c]																		
Aboriginal	94.7	88.1	92.7	95.1	92.7	91.2	90.7	88.9	87.6	95.0	85.1	90.1	91.2	86.0	92.7	87.8	91.5	91.3
Non-Aboriginal	93.2	92.6	95.2	93.8	90.3	95.5	93.0	94.8	85.9	90.7	90.1	92.9	92.7	90.1	94.8	92.0	92.1	92.2
24 months – fully immunised (including varicella and meningococcal C)																		
Aboriginal	76.1	74.6	81.7	79.1	79.6	78.9	74.8	84.4	75.3	82.5	70.2	74.3	77.6	76.0	77.5	79.2	78.3	79.2
Non-Aboriginal	81.3	81.7	84.0	79.2	78.3	85.6	79.3	87.7	73.8	78.0	78.0	81.0	81.2	78.5	83.2	80.0	80.1	81.2
5 years – fully immunised[d]																		
Aboriginal	88.1	87.0	89.4	88.5	86.0	90.4	88.3	93.2	82.1	86.7	82.4	81.9	75.0	75.3	78.1	80.1	84.4	85.3
Non-Aboriginal	92.0	90.0	92.7	90.6	88.3	92.5	90.0	94.0	82.8	87.4	87.4	88.6	89.0	87.3	91.1	88.5	89.1	89.3

[a]CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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

[b]Three doses of a diphtheria, tetanus and acellular pertussis-containing vaccine (DTPa) 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

[c]Three or four doses of a DTPa-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 (MMR)-containing vaccine

[d]Four or five doses of a DTP-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine

*NV: Network with Victoria (2 postcodes in Albury NSW)

Source: Australian Childhood Immunisation Register.

Table 7. Vaccination coverage estimates for individual vaccines, NSW adolescent school attendees in NSW, 2010

Vaccine	Coverage (%)	Doses administered (n)
HPV dose 1[a]	77	32 975
HPV dose 2[a]	72	30 793
HPV dose 3[a]	66	28 537
Hepatitis B dose 1[a]	63	54 701
Hepatitis B dose 2[a]	57	49 507
dTpa[a]	70	61 262
Varicella[a]	32	27 775
dTpa[b]	63	56 384

[a]Year 7 school attendees
[b]Year 10 school attendees
HPV: human papillomavirus
dTpa: diphtheria, tetanus, pertussis (acellular) – adolescent and adult formulation
Source: NSW School Immunisation Program.

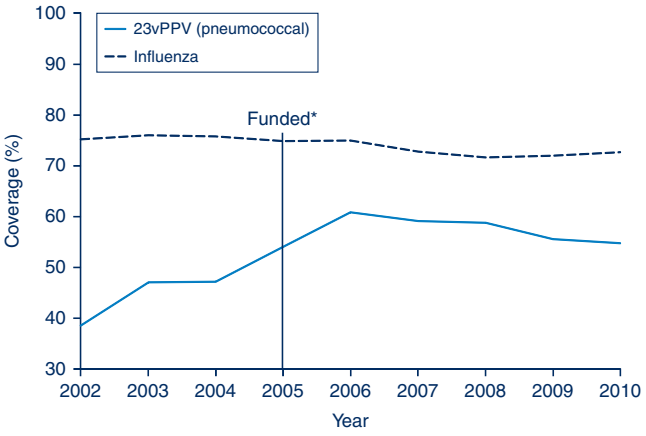

Figure 5. Trends in vaccination coverage estimates for individual vaccines (23vPPV and influenza) for adults aged 65 years and over[a] in NSW, 2002–2010

[a]Vaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months
*In 2005, 23vPPV was included in the National Immunisation Program
23vPPV: 23-valent pneumococcal polysaccharide vaccine

Source: NSW Population Health Survey 2010 (HOIST). Centre for Epidemiology and Research, NSW Department of Health.

elderly was highest in the Central Coast and Hunter New England LHDs and lowest in the Nepean Blue Mountains LHD.[10]

Timeliness of immunisation

For the third dose of DTPa, there was significantly greater delay in immunisation for Aboriginal children than non-Aboriginal children, with a 16.8% differential at 7 months of age (Figure 6). A smaller differential of 6% was found for the second dose of MMR at 49 months of age (Figure 7). There was a marked improvement in the timeliness of the second dose of MMR from 2009 for both population groups, with 28.6% and 33.3% of doses given by 50 months of age in Aboriginal and non-Aboriginal children respectively in 2009, compared to 45.2% and 51.3% in 2010.

A similar pattern is seen when vaccination delay is categorised into 1–6 months and greater than 6 months (Tables 8 and 9). The Northern Sydney LHD had the lowest degree of vaccination delay 1–6 months in length for both Aboriginal and non-Aboriginal children. The Far West LHD had the lowest degree of vaccination delay greater than 6 months in length for both Aboriginal and non-Aboriginal children. The LHDs experiencing the greatest overall delay were Northern NSW and the Mid North Coast. The degree of vaccination delay for the second dose of MMR vaccine was substantially higher for all LHDs in NSW and for both Aboriginal and non-Aboriginal children (Table 9). Compared to 2009, the proportion of doses delayed in 2010 by more than 6 months decreased by 4.5% in Aboriginal and 7.5% in non-Aboriginal children, while the 1–6-month delays increased by 0.3% and 3.8% respectively.

In response to the current pertussis epidemic and to provide early protection for young infants, it was recommended in March 2009 that NSW immunisation providers give the first dose of DTPa vaccine (given in a hexavalent combination of DPTa, Hep B, Hib and inactivated polio-virus) at 6 weeks of age instead of 8 weeks of age. Figure 8 shows the age at which children in NSW were given the first dose of DTPa by month of vaccination during 2009 and 2010. Before the recommendation, very few children received the vaccine dose at 6 weeks of age but the percentage rose over the 2 years with more than 60% of children receiving the dose before 8 weeks of age in November 2010.

Conscientious objectors and no vaccines recorded

The percentage of children with no vaccines recorded in NSW is greater than those recorded as conscientious objectors (Table 10). Both indicators varied by LHD with a high percentage of objectors and children with no vaccines recorded in the Northern NSW LHD and the lowest in the Western NSW LHD.

Small area coverage

'Fully immunised' coverage in NSW by statistical sub-division for the 5-year milestone age group in 2010 varies substantially within the state, with many areas having recorded coverage below 90%, putting them at higher risk of outbreaks of highly contagious diseases such as measles and pertussis (Figure 9). However, coverage across the state improved markedly from 2009 with many

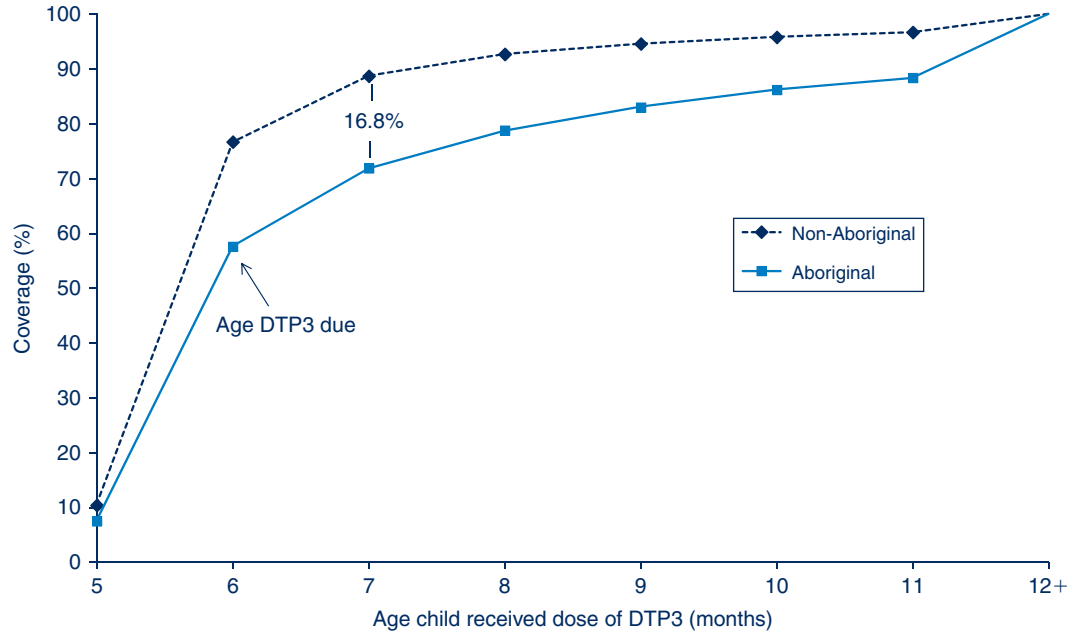

Figure 6. Timeliness of the third dose of diphtheria, tetanus and acellular pertussis-containing (DTPa) vaccine for the cohort of Aboriginal and non-Aboriginal children born in 2007 in NSW

Percentage covered = number of children who received vaccine dose at particular ages/the total number of children who received the vaccine dose
DTP3: third dose of DTPa – paediatric formulation

Source: Australian Childhood Immunisation Register.

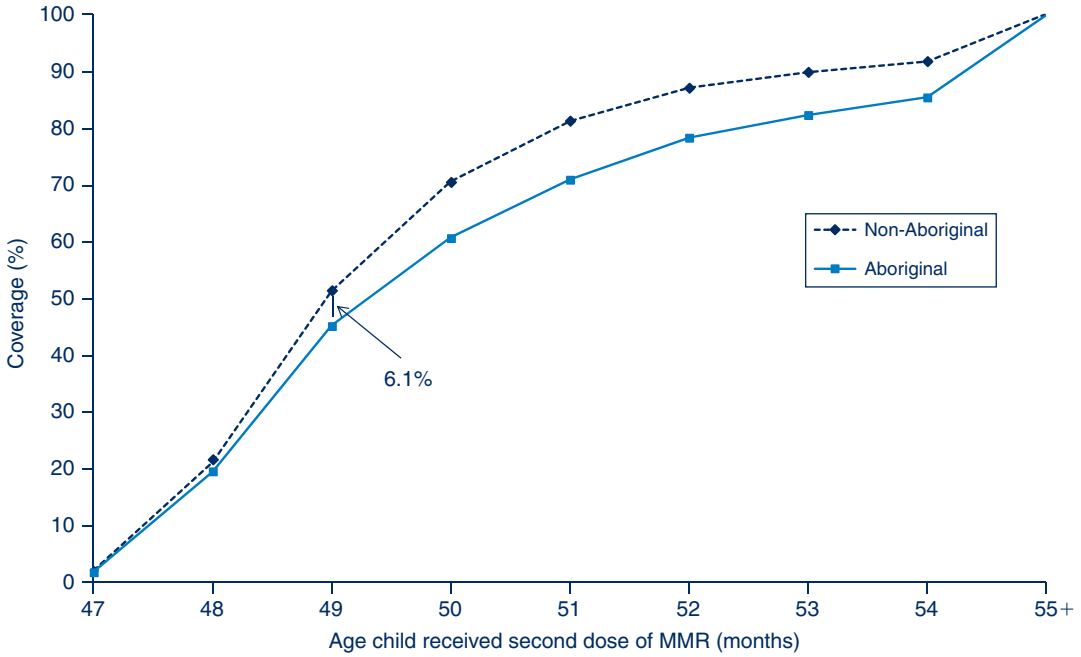

Figure 7. Timeliness of the second dose of measles-mumps-rubella (MMR) vaccine for the cohort of Aboriginal and non-Aboriginal children born in 2004 in NSW

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 8. Percentage of children with vaccination delay for the third dose of DTPa, by Aboriginal status, for 15 local health districts in NSW, and for Network with Victoria, compared with NSW, for the cohort of children born in NSW in 2008

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																	
Aboriginal	29.12	34.55	26.50	21.82	33.83	26.38	32.06	18.18	31.52	10.53	32.95	28.37	32.20	22.34	30.43	26.67	28.32
Non-Aboriginal	19.89	16.95	14.70	18.29	18.17	15.36	18.30	17.20	20.25	14.19	13.54	16.49	15.73	13.86	15.38	13.93	15.53
>6 months																	
Aboriginal	1.65	0.00	6.91	4.55	4.51	5.96	3.82	9.09	5.43	5.26	5.68	7.21	6.78	5.32	7.73	3.89	5.87
Non-Aboriginal	2.16	1.36	1.67	1.88	2.45	1.82	1.82	1.85	3.43	1.03	1.20	1.78	1.77	1.12	1.58	1.47	1.61

[a]CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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
*NV: Network with Victoria (2 postcodes in Albury NSW)
Source: Australian Childhood Immunisation Register.

Table 9. Vaccination delay for the second dose of measles-mumps-rubella by Aboriginal status for 15 local health districts in NSW, and for Network with Victoria, compared with NSW, for the cohort of children born in NSW in 2005

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																	
Aboriginal	37.93	38.64	38.51	35.26	33.78	38.78	30.95	34.78	29.94	42.37	34.72	35.66	39.56	39.71	36.59	38.40	36.55
Non-Aboriginal	41.00	39.47	42.26	40.43	36.75	40.86	38.77	42.30	38.74	42.15	41.67	39.06	42.16	41.55	40.02	39.06	40.50
>6 months																	
Aboriginal	28.45	31.82	32.77	38.15	44.59	27.89	36.90	47.83	32.20	27.12	31.94	34.97	40.66	22.06	37.54	32.00	34.25
Non-Aboriginal	26.08	30.53	24.74	33.41	34.39	23.57	30.28	19.32	31.81	25.29	24.22	30.20	27.76	22.77	27.83	26.40	27.04

[a]CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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
*NV: Network with Victoria (2 postcodes in Albury NSW)
Source: Australian Childhood Immunisation Register.

areas, especially outside Sydney, with 'fully immunised' coverage above national benchmark levels.

Discussion

These data reveal that 90% coverage benchmarks have been reached for children at both 12 and 24 months of age for NSW and for all LHDs except for Northern NSW and the Mid North Coast. During 2009 and 2010, there was a substantial increase in coverage at the 5-year milestone, to just below the 90% level.

Coverage at 24 months of age exceeds that at 12 months in NSW and for 10 LHDs. This is likely related to the greater period of time between due date and assessment time (12 and 6 months respectively), and potentially the maternity incentive payment assessed at 18–24 months. The increase in coverage at 5 years is due to improved timeliness of vaccination, and is probably related to the change to the overdue rules in January 2009, where children became overdue for their pre-school boosters at 4 years and 1 month of age instead of the previous 5 years (Box 1). This change had an impact on eligibility for child-care benefits for parents and outcome payments for providers. It was accompanied by a letter from Medicare Australia advising parents of the change, and the follow-up of overdue children by local health authorities. It is unlikely that the splitting of the Maternity Immunisation Allowance at that time could have had an impact on these data, as it applies only to children turning 4 years from 2011 onwards. Older children would have received the full Maternity Immunisation Allowance payment at 24 months of age and were therefore not eligible for another payment at 4 years.

While there was little difference in the coverage for most individual vaccines given at particular schedule points, the exceptions were rotavirus and varicella, for which coverage was substantially lower. The reasons for lower varicella coverage may relate to the age of vaccination (18 months), a schedule point where no other vaccines are due, and where coverage has been lower in the past for other vaccines (i.e. DTPa).[1] For rotavirus, upper age limits that apply only to this vaccine are likely to reduce vaccinations with this vaccine but not others when children present late.

It should be noted that several vaccines are not included in the assessment of 'fully immunised' (i.e. 7vPCV, meningococcal C, rotavirus and varicella). While this annual report provides coverage data on these vaccines, only data for the more longstanding and established vaccines are provided to General Practice Divisions and immunisation providers. Coverage estimates for the 7vPCV and meningococcal C vaccines are comparable with estimates for vaccines that are included in 'fully immunised' calculations, but estimates for

Table 10. Percentage of conscientious objectors and children with no vaccines recorded on the Australian Childhood Immunisation Register for the cohort born 2004–2009, for 15 local health districts in NSW, and for Network with Victoria, compared with NSW

Vaccine	Local health district															NSW
	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NV* %	NN %	NS %	SES %	SWS %	SN %	SYD %	WN %	WS %	%
Conscientious objectors	2.3	1.0	1.2	1.3	3.2	1.1	1.5	1.6	5.7	1.7	1.6	0.5	2.1	1.1	0.8	0.5	1.4
No vaccines recorded	2.7	1.8	2.0	2.7	4.6	2.0	2.7	2.1	7.7	4.4	4.2	2.4	3.7	4.1	1.7	3.3	3.3

CC: Central Coast; FW: Far West; HNE: Hunter New England; IS: Illawarra Shoalhaven; MN: Mid North Coast; MM: Murrumbidgee; NBM: Nepean Blue Mountains; 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
*NV: Network with Victoria (2 postcodes in Albury NSW)
Source: Australian Childhood Immunisation Register.

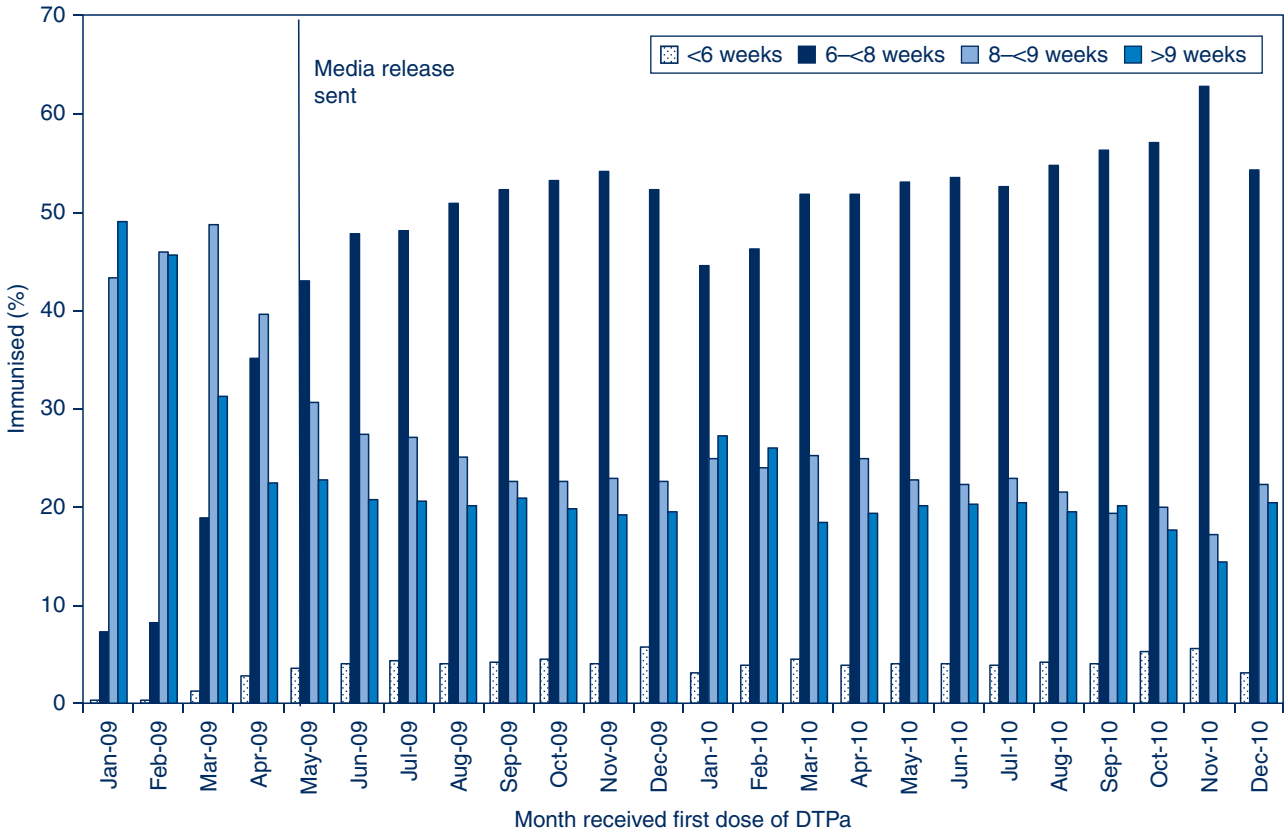

Figure 8. Age at which children in NSW received their first dose of hexavalent combination (DTPa/Hexa) vaccine by month of receipt, January 2009–December 2010

The media release was a message for providers and the public on 10 March 2009 which asked parents and providers to consider bringing the first dose of DTPa forward to 6 weeks of age to provide earlier protection
DTPa/Hexa: hexavalent combination of diphtheria, tetanus, pertussis (acellular), Hep B, Hib and inactivated poliovirus

Source: Australian Childhood Immunisation Register.

varicella and rotavirus are lower. As these vaccines have been routinely incorporated into the childhood immunisation schedule for some time, their inclusion in the official coverage assessments for 'fully immunised', and wider dissemination, should be considered. This would facilitate monitoring of program delivery, potentially boost coverage by allowing existing incentive payments to apply to them, and provide a more realistic assessment of 'fully immunised'.

Although most children eventually complete the scheduled series of vaccinations by the 24-month milestone, many still do not do so in a timely manner. This situation is more pronounced for Aboriginal children, which has been noted previously.[1,12] It is of particular concern for diseases where multiple vaccine doses are required for protection and the disease risk among young infants is significant (e.g. pertussis and pneumococcal disease), and for Aboriginal children who often suffer infection at an earlier age. 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. Of note was the improved timeliness of the second dose of MMR vaccine from 2009, and the rapid improvement in pertussis vaccination at 6–8 weeks of age following its promotion in NSW.

Coverage for elderly people has been consistently high for influenza vaccine, but less so for pneumococcal vaccine, perhaps due to greater awareness of the yearly influenza vaccination programs.

School-based vaccination in NSW has achieved relatively high coverage for most vaccines, which is similar to or better than that achieved in other Australian jurisdictions and higher than in settings where adolescent vaccines are implemented through primary care.[11]

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. The Australian Childhood Immunisation Register, the NSW Population Health Survey and monitoring through the NSW School Vaccination Program continue to be very useful tools for administering the National Immunisation Program and monitoring its implementation in NSW.

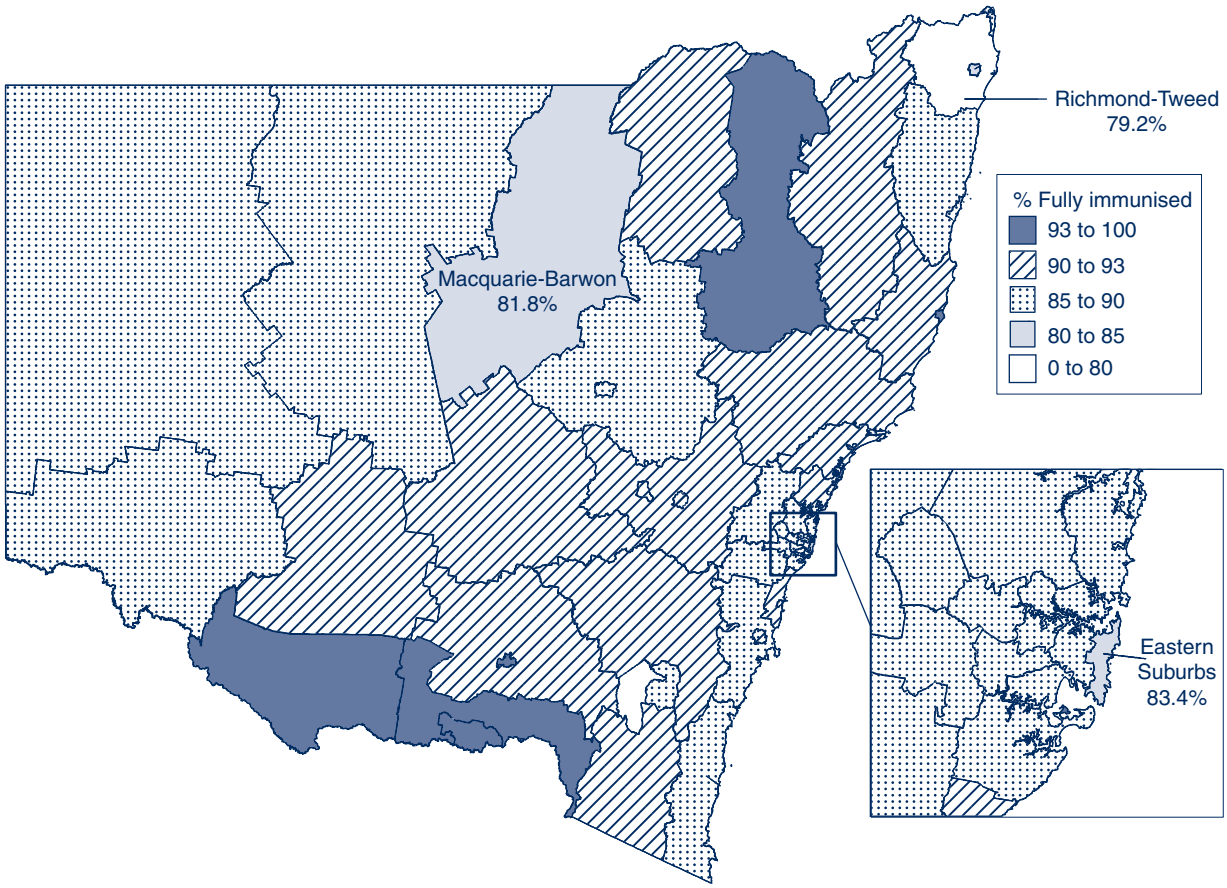

Figure 9. 'Fully immunised' coverage at 5 years of age, by statistical subdivision, NSW, for the cohort of children born in 2005
Source: Australian Childhood Immunisation Register.

References

1. Hull B, Deeks S, Menzies R, McIntyre P. Immunisation coverage annual report, 2007. *Commun Dis Intell* 2009; 33: 170–87.
2. 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
3. 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.
4. O'Brien ED, Sam GA, Mead C. Methodology for measuring Australia's childhood immunisation coverage. *Commun Dis Intell* 1998; 22(3): 36–7.
5. 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
6. 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.
7. 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.
8. Australian Bureau of Statistics (ABS). Australian Standard Geographical Classification (ASGC), 2001. Cat. no. 1216.0. Canberra: ABS; 2001.
9. Australian Bureau of Statistics (ABS). Statistical Subdivision from Postal Area 2006 Concordance. Canberra: ABS; 2007. Available from: www.abs.gov.au/AUSSTATS/abs@.nsf/39433889d406eeb9ca2570610019e9a5/5942283858e38743ca25730c00009f2e!OpenDocument (Cited 29 August 2011.)
10. Health NSW. New South Wales Population Health Survey. 2010. Available from: www.health.nsw.gov.au/resources/publichealth/surveys/pdf/hsa_10pub.pdf (Cited 29 August 2011.)
11. 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
12. Hull BP, McIntyre PB. Timeliness of childhood immunisation in Australia. *Vaccine* 2006; 24: 4403–8. doi:10.1016/J.VACCINE.2006.02.049

NSW Annual Report Describing Adverse Events Following Immunisation, 2010

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Abstract: Aim: This report summarises Australian passive surveillance data for adverse events following immunisation in NSW for 2010. **Methods:** Analysis of de-identified information on all adverse events following immunisation reported to the Therapeutic Goods Administration. **Results:** 424 adverse events following immunisation were reported for vaccines administered in 2010; this is 6% lower than 2009 but 24% higher than 2008 and the second highest number since 2003. A total of 274 (65%) adverse events involved seasonal or pandemic influenza vaccines. Reports were predominantly of mild transient events: the most commonly reported reactions were fever, allergic reaction, injection site reaction, malaise and headache. Only 9% of the reported adverse events were serious in nature, including eight reports of febrile convulsions in children following seasonal influenza vaccine. **Conclusion:** The large number of reports in 2010 is attributable to the high rates of fever and febrile convulsions in children after vaccination with 2010 seasonal trivalent influenza vaccine, as well as pandemic (H1N1) 2009 influenza vaccine.

Adverse events following immunisation are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s). They may be caused by a vaccine(s) or may be coincidental. Adverse events may also include conditions that occur following the incorrect handling and/or administration of a vaccine(s). Post-licensure surveillance – the practice of monitoring the safety of a vaccine after it has been licensed and released in the market – is important to detect rare, late onset and unexpected events which are difficult to detect in pre-licensure vaccine trials.

This is the second annual report for adverse events following immunisation in New South Wales (NSW). It summarises passive surveillance data reported from NSW in 2010 and describes reporting trends over the 11-year period 2000–2010. To assist readers, a glossary of the abbreviations of the vaccines referred to in this report is provided in Box 1.

Trends in reported adverse events following immunisation are influenced by changes to vaccines provided through the National Immunisation Program. Changes in previous years have been reported elsewhere.[1–12] Two recent changes to vaccine funding and availability influenced the adverse events surveillance data presented in this report:

(i) For the first time, in 2010 annual vaccination with seasonal trivalent influenza vaccine (containing three influenza strains A/H1N1, A/H3N2 and B) was funded under the National Immunisation Program for people aged 6 months and over with medical risk factors (previously subsidised Pharmaceutical Benefits Scheme) and for all Aboriginal people aged 15 years and over (previously all Aboriginal adults aged 50 years and over and 15–49 years with medical risk factors).[13]

(ii) Pandemic H1N1 (pH1N1) influenza vaccine (Panvax®) was introduced in Australia from 30 September 2009 for people aged 10 years and over, and from December 2009 for children aged 6 months to 10 years.[14]

Methods

Adverse events following immunisation are notifiable to public health units by medical practitioners and hospital CEOs under the NSW *Public Health Act 1991*. Cases with outstanding information and all serious adverse events are followed up by public health units and NSW Health, and all notifications are forwarded to the Therapeutic Goods Administration. The Therapeutic Goods Administration also receives reports directly from vaccine manufacturers, members of the public and other sources.[15,16] During the pH1N1 vaccine program, reports of adverse events following the administration of this vaccine were required to be notified directly to the

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Box 1. List of abbreviations of vaccine types used in this report

BCG	Bacillus of Calmette and Guérin (i.e. tuberculosis bacillus)
dT	diphtheria–tetanus, adolescent and adult formulation
DTPa	diphtheria–tetanus–pertussis (acellular), paediatric formulation
dTpa	diphtheria–tetanus–pertussis (acellular), adolescent and adult formulation
dTpa-IPV	combined dTpa and inactivated poliovirus
DTPa-HepB	combined diphtheria–tetanus–pertussis (acellular) and hepatitis B
DTPa-IPV	combined diphtheria–tetanus–pertussis (acellular) and inactivated poliovirus (quadrivalent)
DTPa-IPV-HepB	combined diphtheria–tetanus–pertussis (acellular), inactivated poliovirus and hepatitis B (pentavalent)
DTPa-IPV-HepB-Hib	combined diphtheria–tetanus–pertussis (acellular), inactivated poliovirus, hepatitis B and *Haemophilus influenzae* type b vaccine (hexavalent)
HepB	hepatitis B
Hib	*Haemophilus influenzae* type b
Hib-HepB	combined *Haemophilus influenzae* type b and hepatitis B
HPV	human papillomavirus
IPV	inactivated poliovirus vaccine
Men4PV	meningococcal polysaccharide tetravalent vaccine
MenCCV	meningococcal C conjugate vaccine
MMR	measles-mumps-rubella
7vPCV	7-valent pneumococcal conjugate vaccine
23vPPV	23-valent pneumococcal polysaccharide vaccine

Therapeutic Goods Administration rather than to a public health unit and reporting by the general public to the Therapeutic Goods Administration was actively promoted. All reports are assessed by the Therapeutic Goods Administration (TGA) using internationally-consistent criteria[17] and entered into the Australian Adverse Drug Reactions System database.

Adverse events following immunisation data

De-identified information on adverse events following immunisation (AEFI) reports from the Australian Adverse Drug Reactions System database was released to the National Centre for Immunisation Research and Surveillance for analysis and reporting. AEFI records contained in the Australian Adverse Drug Reactions System database were eligible for inclusion in the analysis if: a vaccine was recorded as 'suspected' of involvement in the reported adverse event; the vaccination occurred between 1 January 2000 and 31 December 2010; and the residential address of the individual was recorded as NSW. If the vaccination date was not recorded the date of onset of symptoms or signs was taken as the date of vaccination.

The term 'AEFI record' is used throughout this report because a single adverse event notification to the TGA can generate more than one record in the Australian Adverse Drug Reactions System database. This may occur if there is a time sequence of separate adverse reactions in a single patient.

AEFI records are classified as 'suspected' by the TGA. An AEFI record is classified as 'not suspected' and excluded from the Adverse Drug Reactions System database if: there is no reasonable temporal association between the use of a drug and the clinical event (generally defined as onset of symptoms within 28 days following vaccination); the record does not contain enough information for an adequate assessment or the information is contradictory; or if a clinical event is explained as likely to have arisen from other causes.

Study definitions of AEFI outcomes and reactions

AEFIs were defined as 'serious' or 'non-serious' based on information recorded in the Australian Adverse Drug Reactions System database and using criteria similar to those used elsewhere.[17,18] In this report, an AEFI is defined as 'serious' if the record indicated that the person had recovered with sequelae, been admitted to a hospital, experienced a life-threatening event, or died.

Because children generally receive several vaccines at the same time, all administered vaccines are usually listed as 'suspected' of involvement in a systemic adverse event as it is usually not possible to attribute the event to a single vaccine.

Typically, each AEFI record listed several symptoms, signs and diagnoses that had been re-coded by TGA staff from the description provided by the reporter into standardised terms using the Medical Dictionary for Regulatory Activities (MedDRA®).[19] AEFI reports of suspected anaphylaxis and hypotonic-hyporesponsive episodes were classified by the TGA using the Brighton Collaboration case definitions.[20,21]

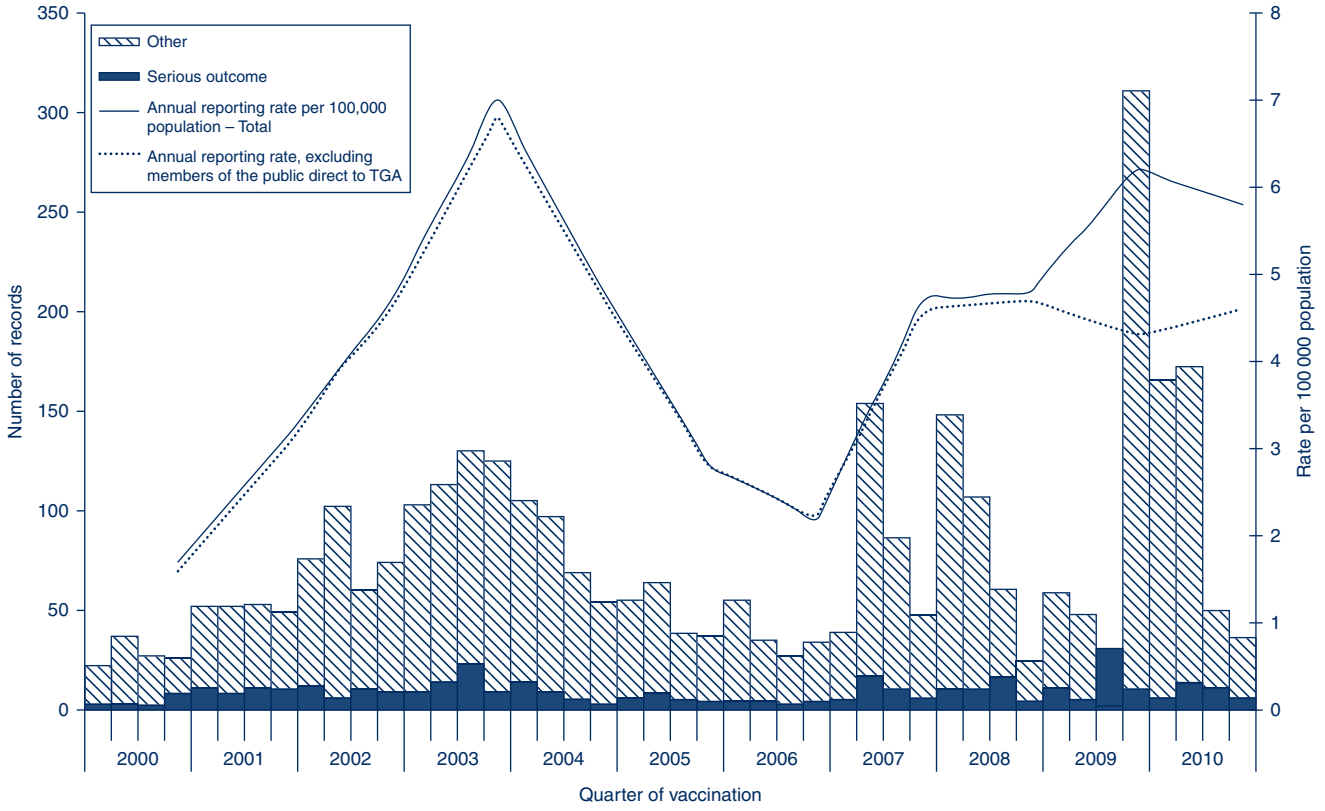

Figure 1. Reports of adverse events following immunisation, NSW, 2000–2010, by quarter of vaccination.

Adverse events following immunisation are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
For reports where the date of vaccination was not recorded, the date of onset was used as a proxy for the vaccination date.

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

Data analysis

All data analyses were performed using SAS (version 9.1.3, SAS Institute, Cary, NC, USA). Average annual population-based reporting rates were calculated using population estimates obtained from the Australian Bureau of Statistics.[22]

AEFI reporting rates per 100 000 administered doses were estimated where information on dose numbers was available from: the Australian Childhood Immunisation Register for National Immunisation Program vaccines for children aged less than 7 years; NSW Health data on vaccines administered in schools for 12–17-year-olds; and the 2009 NSW Population Health Survey for influenza vaccines and the 23-valent pneumococcal polysaccharide vaccine (23vPPV) for adults aged 65 years and over.[23] For the 23vPPV vaccine, as a single booster is recommended 5 years after the first dose, the number of respondents who declared being vaccinated within 5 years was divided by five to get an estimate of the average number of doses for a single year.

Notes on interpretation

The data reported here are provisional only, particularly for the fourth quarter of 2010, because of reporting delays and the late onset of some AEFIs. The information collated in the Australian Adverse Drug Reactions System database is intended primarily to detect signals of adverse events and to inform hypothesis generation. While AEFI reporting rates can be estimated using appropriate denominators, they cannot be interpreted as incidence rates due to under-reporting and biased reporting of suspected events, and the variable quality and completeness of information provided in individual notification reports.[1–12,23]

It is important to note that this annual report is based on vaccine and reaction term information collated in the Australian Adverse Drug Reactions System database and not on comprehensive clinical notes. Individual records in the database list symptoms, signs and diagnoses that were used to define a set of reaction categories based on the case definitions provided in the 9th edition of *The Australian Immunisation Handbook*.[16] These reaction categories are similar, but not identical, to the AEFI case definitions.

The reported symptoms, signs and diagnoses in each AEFI record in the Australian Adverse Drug Reactions System database are temporally associated with vaccination but are not necessarily causally associated with one or more vaccines.

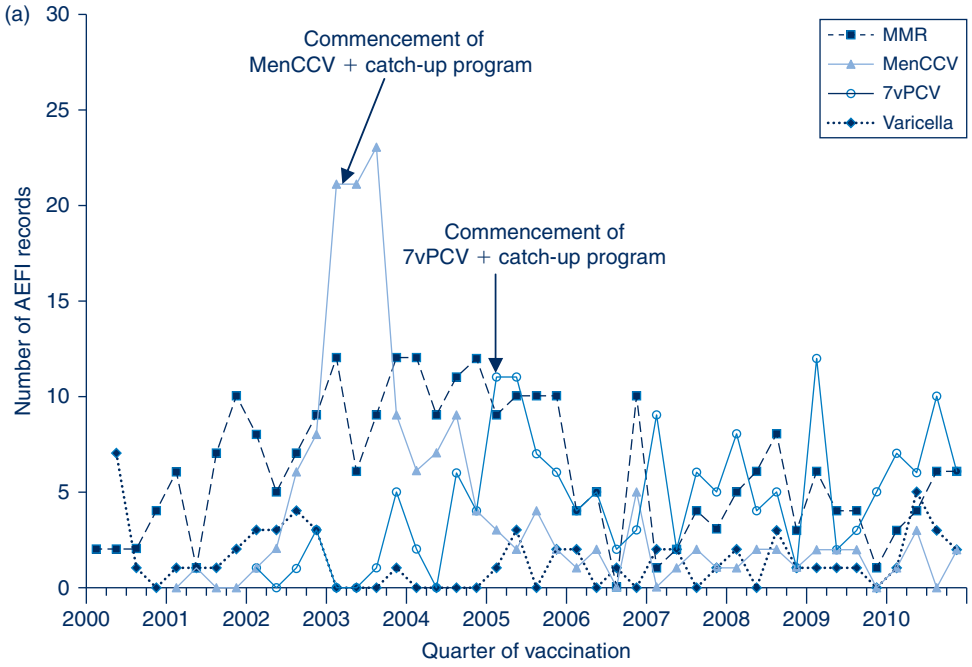

Figure 2a. Adverse events following immunisation for children aged <7 years in frequently suspected vaccines (including MMR, MenCCV, 7vPCV and varicella), NSW, 2000-2010, by quarter of vaccination.

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
Meningococcal C conjugate vaccine (MenCCV) was introduced into the National Immunisation Program schedule on 1 January 2003; and 7-valent pneumococcal conjugate vaccine (7vPCV) on 1 January 2005.
MMR: measles-mumps-rubella

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

Results

There was a total of 424 AEFI records for NSW in the Australian Adverse Drug Reactions System database with a date of vaccination (or onset of an adverse event if vaccination date was not reported) in 2010. This was a 6% decrease on the 450 records in 2009 and a 24% increase on the 340 records in 2008. Eighty percent ($n = 338$) of the AEFI records during 2010 were reported in the first two quarters of the year, a substantial increase (68%) from the corresponding period in 2009 (24%, $n = 107$). Fifty-seven percent ($n = 243$) were for children aged less than 7 years. Thirty-six percent ($n = 154$) were reported to the TGA by NSW Health and the remainder were reported directly to the TGA; 21% ($n = 88$) by members of the public, 38% ($n = 161$) by doctors/other health care providers, and 5% ($n = 21$) by hospitals. The number of AEFI reports by members of the public was much greater in 2009 and 2010 than in 2008 (2%, $n = 7$) with 95% of reports by members of the public relating to seasonal influenza and pH1N1 influenza vaccines.

Reporting trends

The AEFI reporting rate for 2010 was 5.8 per 100 000 population, compared with 6.2 per 100 000 population in 2009 (Figure 1). This is the third highest reporting rate for the period 2000–2010, after the first peak in 2003 that coincided with the national program for meningococcal C conjugate vaccine and high rates of reporting from the 18-month dose of DTPa; and the second peak in 2009 following the commencement of the pH1N1 program (Figure 1). Figure 1 shows the increase in reporting by the general public directly to the TGA in 2009 and 2010, and that the majority of reported events (from all reporter types) were of a non-serious nature. Figures 2b and 3 show that the rise in the reporting rate in 2009 and 2010 was due to reports following receipt of pH1N1 vaccine and seasonal influenza vaccines, and that in 2010 this was predominantly in children. Figures 2 and 3 also demonstrate marked variations of reporting levels in association with previous changes to the National Immunisation Program from 2000 onwards.

The usual seasonal pattern of AEFI reporting from older Australians receiving 23vPPV and influenza vaccines during the autumn months (March–June) is evident in Figure 3, with a higher reporting rate for influenza in 2010.

Age distribution

In 2010, the highest population-based AEFI reporting rate occurred in infants aged less than 1 year, the age group that received the highest number of vaccines (Figure 4). Compared with 2009, there was a four-fold increase in AEFI

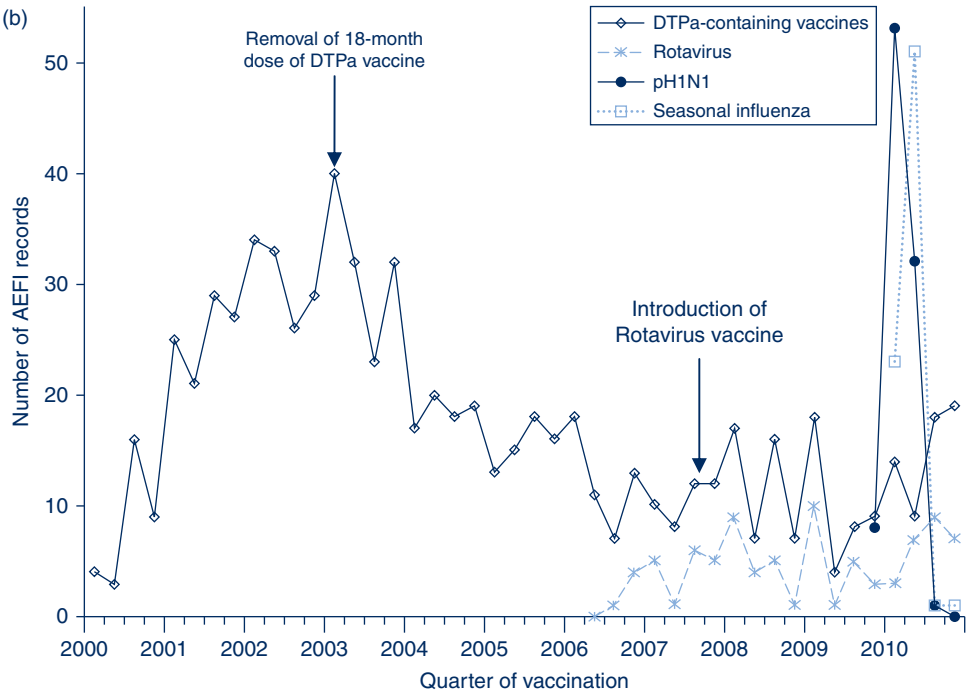

Figure 2b. Adverse events following immunisation for children aged <7 years in frequently suspected vaccines (including DTPa-containing vaccines, seasonal influenza, pH1N1 and rotavirus), NSW, 2000–2010, by quarter of vaccination.

Adverse events following immunisation are (AEFI) generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
DTPa-IPV and DTPa-IPV-HepB-Hib (hexavalent) vaccines in November 2005; rotavirus (RotaTeq® and Rotarix®) vaccines 1 July 2007; pH1N1 influenza vaccine was introduced in September 2009; and seasonal influenza vaccine in 2010.
DTPa: diphtheria–tetanus–pertussis (acellular), paediatric formulation
pH1N1: pandemic (H1N1) 2009 influenza

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

reporting rates among children aged 7 years and under (9.9 to 37.9 per 100 000 population), related to the increase in reports following the administration of seasonal and pH1N1 influenza vaccines. There were also increases in the reporting rates of most other individual vaccines given to this age group in 2010 (Table 1) compared to 2009.[24] In adults there were also substantial increases in the number of reports following seasonal influenza vaccines, but about a three-fold decrease in AEFI reporting rates in this age group overall (6.3 to 2.4 per 100 000 population), due to the decline in reports following pH1N1 influenza vaccine in this age group.

Vaccines

Of the 424 records, 150 (35%) included receipt of seasonal influenza vaccine and 126 records (30%) included pH1N1 influenza vaccine. Vaccines containing diphtheria, tetanus and acellular pertussis antigens were reported in 80 records (19%), with dTpa (20 records, 4.7%) and hexavalent DTPa-IPV-HepB-Hib (28 records, 6.6%) being the most frequently reported among DTPa-containing vaccines. The other frequently reported vaccines were 23vPPV (30 records, 7%), 7vPCV (29 records, 7%) and rotavirus (26 records, 6%) (Table 1). Of vaccines with reliable data on doses administered, those with the highest AEFI rates per 100 000 doses were DTP-IPV (33.0), 23vPPV (23.4), rotavirus (15.4) and HPV (15.2). Few AEFIs ($n = 24$) occurred following the co-administration of influenza and non-influenza vaccines (14% of 174 reports of non-influenza vaccines).

Reactions

The distribution and frequency of reactions listed in AEFI records for 2010 are shown in Table 2. The most frequently reported adverse events were fever (49%), allergic reaction (31%), injection site reaction (19%), malaise (16%), headache (12%), myalgia (9%), rash (8%) and nausea (7%) (Table 2).

Severity of outcomes

Nine percent ($n = 37$) of events were defined as 'serious' (i.e. recovery with sequelae, requiring hospitalisation, experiencing a life-threatening event or death); higher than observed in 2009. Numbers of reported events and events with outcomes defined as 'serious' are shown in Table 1.

Fifteen percent of records were recorded as 'not fully recovered' at the time of reporting (Table 3); 59% of these were following receipt of pH1N1 and seasonal influenza

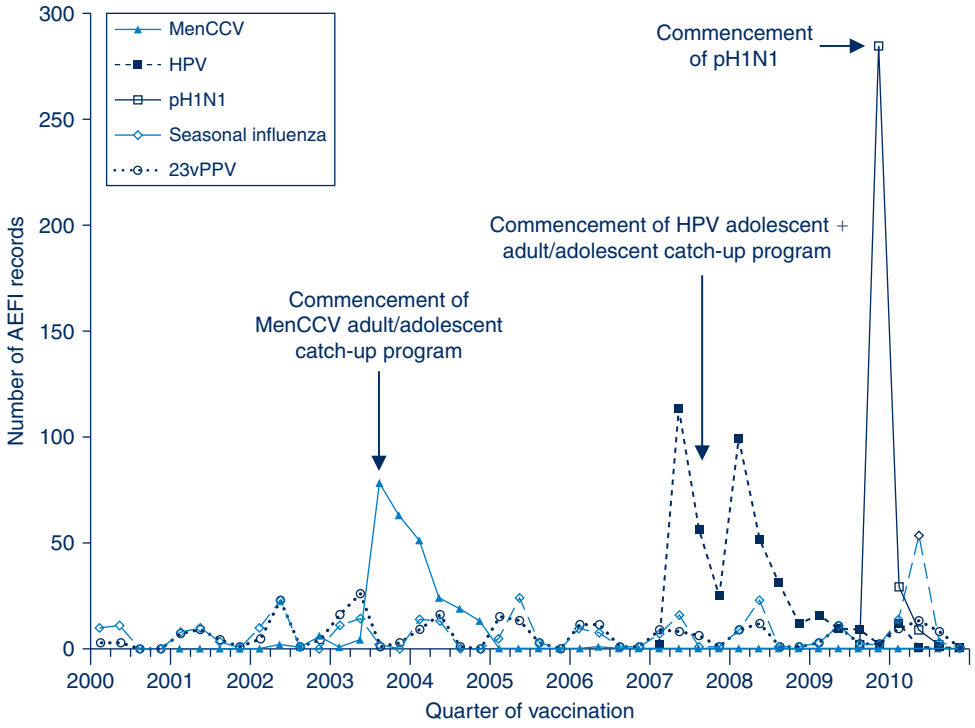

Figure 3. Adverse events following immunisation for children aged >7 years in frequently suspected vaccines (including MenCCV, seasonal influenza, 23vPPV, HPV and pH1N1), NSW, 2000–2010, by quarter of vaccination.

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
23vPPV: 23-valent pneumococcal polysaccharide vaccine
MenCCV: meningococcal C conjugate vaccine
HPV: human papillomavirus
pH1N1: pandemic (H1N1) 2009 influenza

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

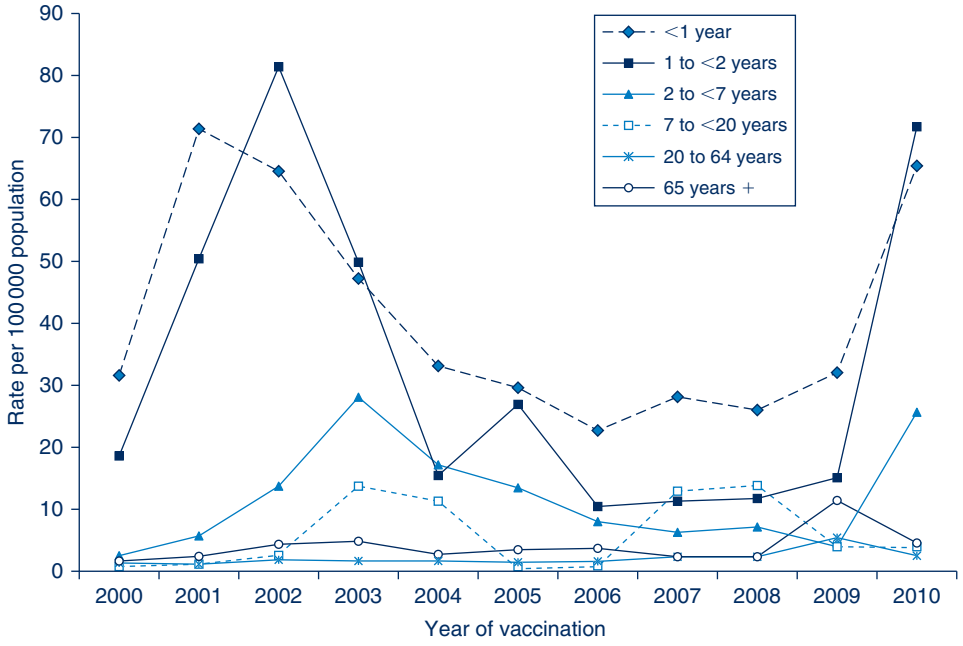

Figure 4. Reporting rates of adverse events following immunisation for NSW per 100 000 population, 2000–2010, for six age groups and by year of vaccination.

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

Table 1. Vaccine types listed as 'suspected' in records of adverse events following immunisation for four age groups (<7, 12–17, 18–64 and ≥65 years), NSW, 2010

Vaccines[a]	AEFI records[b]	'Serious' outcome[c]	Vaccine doses[d]	Reporting rate per 100 000 doses[e] (95% CI)
	n	*n*	*n*	2010
<7 years				
DTPa-IPV	32	2	90 999	35.2 (24.1–49.7)
Hexavalent (DTPa-IPV-HepB-Hib)	28	9	268 847	10.4 (6.9–15.1)
Haemophilus influenzae type b	6	0	90 863	6.6 (2.4–14.4)
Measles-mumps-rubella	19	2	183 385	10.4 (6.2–16.2)
Rotavirus	26	10	168 669	15.4 (10.1–22.6)
7vPCV	29	9	269 682	10.8 (7.2–15.4)
Varicella	11	3	88 131	12.5 (6.2–22.4)
MenCCV	6	0	93 689	6.4 (2.3–14.0)
pH1N1	86	9	n/a	n/a
Seasonal influenza	76	3	n/a	n/a
12–17 years				
HPV	13	0	92 305	14.1 (7.5–24.1)
dTpa	5	0	117 646	4.3 (1.4–9.9)
Hepatitis B	12	0	104 208	11.5 (15.9–20.1)
Varicella	2	0	27 775	7.2 (0.7–25.9)
pH1N1	2	0	n/a	n/a
Seasonal influenza	1	0	n/a	n/a
18–64 years				
Seasonal influenza	38	0	n/a	n/a
pH1N1	27	0	n/a	n/a
dTpa	13	1	n/a	n/a
23vPPV	4	0	n/a	n/a
≥65 years				
Influenza	24	7	718 863	3.3 (2.1–5.0)
23vPPV	26	2	110 899	23.4 (15.3–34.4)
dTpa	2	0	n/a	n/a
pH1N1	1	0	n/a	n/a
Age group (years)				
<1 year[f]	41	12	725 631	5.7 (4.1–7.7)
1 to <2 years[f]	18	4	331 208	5.4 (3.2–8.6)
2 to <7 years[f]	32	2	197 426	16.2 (11.1–22.9)
12–17 years[f]	23	0	341 934	6.7 (4.3–10.1)[g]
18–64 years	88	1	n/a	n/a
65+ years	43	7	829 762	5.2 (3.7–7.0)[h]

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
dTpa: diphtheria–tetanus–pertussis (acellular), adolescent and adult formulation
DTPa-IPV: combined dTpa and inactivated poliovirus
DTPa-IPV-HepB-Hib: combined diphtheria–tetanus–pertussis (acellular), inactivated poliovirus, hepatitis B and *Haemophilus influenzae* type b vaccine (hexavalent)
MenCCV: meningococcal C conjugate vaccine
pH1N1: pandemic (H1N1) 2009 influenza
7vPCV: 7-valent pneumococcal conjugate vaccine
23vPPV: 23-valent pneumococcal polysaccharide vaccine
[a]Records where at least one of the vaccines shown in the table was suspected of involvement in the reported adverse event. A 'serious' outcome is defined as recovery with sequelae, hospitalisation, life-threatening event or death.[17]
[b]Number of AEFI records in which the vaccine was coded as 'suspected' of involvement in the reported adverse event and the vaccination was administered between 1 January and 31 December 2010. More than one vaccine may be coded as 'suspected' if several were administered at the same time.
[c]'Serious' outcomes are defined in the Methods section.
[d]Number of vaccine doses recorded and administered between 1 January and 31 December 2010.
[e]The estimated AEFI reporting rate per 100 000 vaccine doses recorded.
[f]Number of AEFI records excluding influenza vaccines administered alone. Most reports include more than one vaccine.
[g]School-based only.
[h]Seasonal influenza and 23vPPV only.
Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

Table 2. Reaction categories of interest mentioned in records of adverse events following immunisation for two age groups (<7 and ≥7 years), NSW, 2010

Reaction category[a,b,c]	AEFI records	'Serious' outcome[d]		Only reaction reported[e]		Age group[d]			
						<7 years		≥7 years	
	n	*n*	%	*n*	%	*n*	%	*n*	%
Fever	211	6	3	18	9	58	75	50	24
Allergic reaction[f]	131	5	4	10	8	91	69	36	27
Injection site reaction	82	3	4	17	21	29	35	52	64
Rash[g]	36	2	6	11	31	24	67	12	33
Convulsions	29	9	31	12	41	27	93	2	7
Abnormal crying	20	3	15	1	5	20	100	0	0
Arthralgia	13	0	0	0	0	1	8	12	92
Somnolence	10	1	10	0	0	8	80	2	20
Hypotonic-hyporesponsive episode	8	6	75	4	50	8	100	0	0
Lymphadenopathy/itis[h]	8	0	0	0	0	0	0	8	100
Arthritis	6	1	17	3	50	1	17	5	83
Guillain-Barrè syndrome	4	3	75	4	100	0	0	4	100
Syncope	4	0	0	1	25	1	25	3	75
Anaphylactic reaction	1	1	100	1	100	0	0	1	100
Idiopathic Thrombocytopenic Purpura	1	1	100	1	100	1	100	0	0
Malaise	66	1	2	0	0	36	55	29	44
Headache	49	0	0	2	4	15	31	34	69
Myalgia	39	2	5	0	0	9	23	30	77
Nausea	30	0	0	0	0	3	10	27	90
Abdominal pain	21	2	10	0	0	12	57	8	38
Pain	21	0	0	0	0	6	29	15	71
Dizziness	15	0	0	0	0	0	0	15	100
Erythema	9	0	0	0	0	7	78	2	22
Respiratory rate/rhythm change	8	1	13	0	0	8	100	0	0
Reduced sensation	4	0	0	2	50	0	0	3	75
Weakness	3	0	0	0	0	1	33	2	67

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).

[a]Reaction categories were created for the AEFI of interest listed and defined in *The Australian Immunisation Handbook* (9th edition, pp. 58–65 and 360–3)[14] as described in Methods section. The bottom part of the table shows reaction terms not listed in *The Australian Immunisation Handbook*[10] but included in AEFI records in the Adverse Drug Reactions System database.

[b]Reaction categories like gastrointestinal related to rotavirus and heart rate/rhythm change had 11 reports each; tremor had 10 reports; oedema had eight reports; increased sweating and pallor each had seven reports; flushing had three reports and parotitis had one report.

[c]There were no reports for reaction categories like acute flaccid paralysis, irritability, meningitis, orchitis, osteitis, osteomyelitis, sepsis, toxic shock syndrome and abscess.

[d]Not shown if neither age nor date of birth were recorded.

[e]AEFI records where only one reaction was reported.

[f]Includes skin reactions including pruritus, urticaria, periorbital oedema, facial oedema, erythema multiforme etc. and/or gastrointestinal (e.g. diarrhoea, vomiting) symptoms and signs but does not include other abdominal symptoms like abdominal pain, nausea, flatulence, abnormal faeces, hematochezia etc. Does not include anaphylaxis.[10]

[g]Includes general terms of rash but does not include rash pruritic.

[h]Includes lymphadenitis following Bacillus of Calmette and Guérin vaccination and the more general term of 'lymphadenopathy'.

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

vaccines. Eighty-six percent of cases recorded as 'not fully recovered' had missing information on hospitalisation. Of these, 62% were reported by health care providers, 18% by NSW Health and 20% by members of the public. Information on severity could not be determined for 26% of records ($n = 109$); 86% of these were following receipt of influenza vaccines and 56% of these reports came from members of public with little information provided. Of those without information describing severity, the most commonly reported adverse reactions were: fever (59%); allergic reactions (39%); malaise (13%); injection site reaction (12%); headache (11%); convulsion, nausea and rash (6% each); myalgia (5%); and syncope and dizziness (3% each).

Table 3. Outcomes of adverse events following immunisation for two age groups (<7 and ≥7 years), NSW, 2010

Outcome	AEFI records		Age group			
			<7 years		≥7 years	
	n	%[a]	*n*	%[b]	*n*	%[b]
Non-serious	214	50	135	63	78	36
Not recovered at time of report	64	15	23	36	40	63
Unknown[c]	109	26	58	53	47	43
Serious:	37	9	27	73	10	27
recovered with sequelae	1		1	100	–	
hospital treatment – admission	32		24	75	8	25
life-threatening event	4		2	50	2	50
death (maybe drug)	–		–	–	–	–
Total	**424**	**100**	**243**	**57**	**175**	**41**

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
[a]Percentages relate to the total number of AEFI records ($N = 424$).
[b]Percentages relate to the number of AEFI records with the specific outcome (e.g. of 214 AEFI records with a 'non-serious' outcome, 63% were for children aged less than 7 years).
[c]'Unknown' outcome relates to the number of AEFI records which are not serious and with unknown outcome.
Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

The reactions recorded as 'serious' were: convulsions ($n = 9$), including six febrile convulsions; fever ($n = 6$); hypotonic-hyporesponsive episodes ($n = 6$); diarrhoea/vomiting ($n = 6$); allergic reactions ($n = 5$); Guillain-Barrè syndrome ($n = 3$); injection site reactions ($n = 3$); and one case each of intussusception, anaphylaxis and Idiopathic Thrombocytopenic Purpura. Other severe reactions not recorded as 'serious' were: convulsions ($n = 20$), including 11 febrile convulsions; hypotonic-hyporesponsive episodes ($n = 2$); and Guillain-Barrè syndrome ($n = 1$).

Of the 29 cases of convulsion, 27 were children aged less than 7 years. The most commonly suspected vaccines were pH1N1 vaccine ($n = 18$) and seasonal influenza vaccine ($n = 11$), either given alone or co-administered with other vaccines.

All the reports of hypotonic-hyporesponsive episodes were from children aged less than 7 years. Seven reports were following administration of hexavalent/pneumococcal and rotavirus vaccines while one case report was following administration of hexavalent and pneumococcal vaccines only.

All four cases of Guillain-Barrè syndrome were in adults aged 65 years and over and following seasonal flu vaccine (Fluvax®) (CSL Biotherapies) with onset within 24 hours of vaccination.

AEFI reports not including influenza vaccines

There were 150 AEFI records in 2010 which did not include influenza vaccines, either alone or co-administered with other vaccines. Only one (0.7%) was reported by a member of the public.

Eleven percent ($n = 17$) of the 150 AEFI records had outcomes defined as 'serious' (i.e. recovery with sequelae, hospitalisation, life-threatening event or death). Serious AEFIs reported included hypotonic-hyporesponsive episodes ($n = 6$), diarrhoea ($n = 4$), allergic reactions ($n = 3$), injection site reactions ($n = 2$), Idiopathic Thrombocytopenic Purpura ($n = 1$) and intussusception ($n = 1$). There were no reports of life-threatening events and all but one of the children coded as 'serious' was admitted to hospital. The report of intussusception followed administration of hexavalent (DTPa-IPV-HepB-Hib), pneumococcal (PCV7) and rotavirus vaccines in an infant and occurred 2 months post-vaccination. However, due to the length of latency, causality is unlikely to be related to the vaccine. The case of Idiopathic Thrombocytopenic Purpura followed administration of varicella vaccine. However, due to an alternate cause (febrile intercurrent viral infection), the causality is less likely to be related to the vaccine. The distribution of more commonly reported AEFIs is listed in Figure 5.

2010 seasonal influenza vaccine

The majority of reports for seasonal influenza vaccine were for Fluvax® (CSL Biotherapies) ($n = 101$, 67%) while another 20% did not specify the vaccine brand and were coded only as influenza vaccine. There were 13 adverse event reports following vaccination with Influvac® (Solvay Biosciences) and six with Vaxigrip® (Sanofi Pasteur). All reports following seasonal influenza

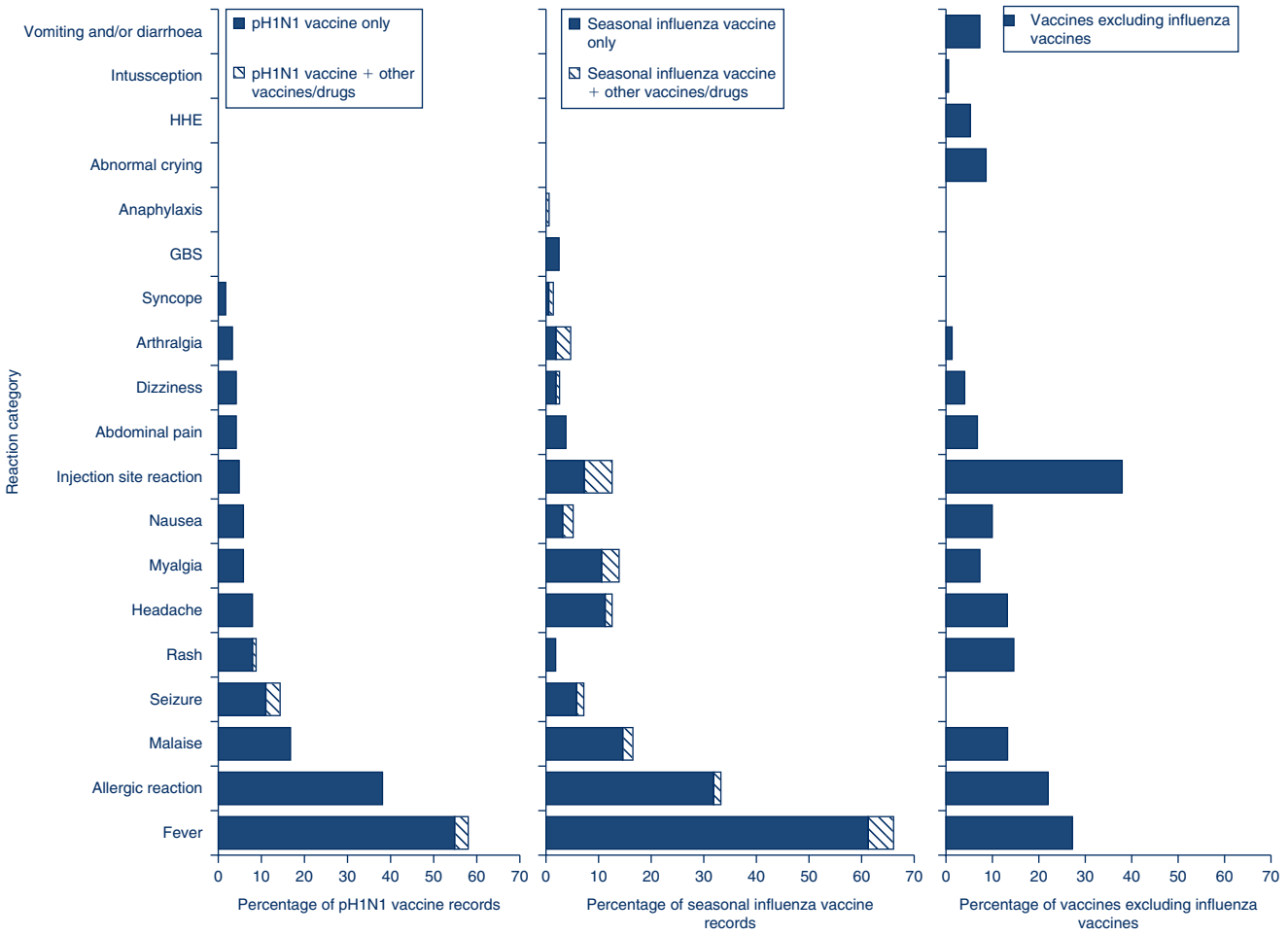

Figure 5. Most frequently reported adverse events following pH1N1 and seasonal influenza immunisation, 2010, by number of vaccines suspected of involvement in the reported adverse event.

Adverse events following immunisation are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
pH1N1 (percentage of 126 AEFI records); seasonal influenza vaccine (percentage of 150 AEFI records); and vaccines excluding influenza vaccines (percentage of 150 AEFI records) where the corresponding vaccines were listed as suspected of involvement in the reported adverse event following immunisation.
GBS: Guillain-Barré syndrome
HHE: hypertonic-hyporesponsive episodes
pH1N1: pandemic (H1N1) 2009 influenza

Source: Adverse Drug Reactions System database, Therapeutic Goods Administration.

vaccination in 2010 were received by the TGA on or after the date of announcement of the withdrawal of seasonal influenza vaccine from use in children (23 April 2010).

A large proportion of the AEFIs following seasonal influenza vaccine were reported directly to the TGA by general practitioners and specialists (41%) and members of the public (20%), while 29% were reported to the TGA by NSW Health. Fifty-nine percent ($n = 89$) of the reports following seasonal influenza vaccine were defined as 'non-serious', 7% ($n = 11$) were defined as 'serious', 15% ($n = 22$) were defined as not recovered, and an additional 19% were not categorised because of the non-availability of data on hospitalisation and outcome. The distribution of reaction types for seasonal influenza vaccine is presented in Figure 5. The spectrum of reactions for seasonal influenza vaccine was different to that for non-influenza vaccines with a substantially higher proportion of fever (66% compared with 27% for non-influenza vaccines) and allergic reaction (33% vs. 22%) and a lower proportion of injection site reactions (13% vs. 38%). There were 11 reports (7%) of convulsions including eight febrile convulsions, four (3%) of Guillain-Barrè syndrome and two (1%) of syncope following seasonal influenza vaccine. A higher proportion of reports following seasonal influenza vaccine came from members of the public (20% compared with 0.7% for non-influenza vaccines).

Monovalent pH1N1 vaccine

For pH1N1 pandemic influenza vaccine events, 68% ($n = 86$) were for children aged 7 years and under.

Forty-seven percent ($n = 59$) were reported by members of the public directly to the TGA and only 17% were reported by NSW Health to the TGA. Seven percent of the reports following pH1N1 influenza vaccine were coded as serious. The distribution of reaction types for pH1N1 influenza vaccine is presented in Figure 5. The spectrum of reactions for the pH1N1 influenza vaccine was similar to that for seasonal influenza vaccine, showing higher rates for fever (58%), allergic reaction (38%), malaise (17%) and convulsion (14%).

Discussion

There has been an increase in both the number of AEFI reports and population-based reporting rates in both 2009 and 2010. This is due to the substantial increase in reports in children following vaccination with the two available influenza vaccines: the 2010 seasonal trivalent influenza and pandemic (pH1N1) influenza vaccines.

The pH1N1 program for adults that commenced in September 2009 resulted in a large peak in reports for that age group in the last quarter of that year, followed by substantially lower levels in adults in 2010. Reports in children peaked in 2010 following the roll-out of vaccination to children aged 6 months to 10 years from December 2009. The safety of the pH1N1 vaccine has been examined closely both nationally and internationally. The World Health Organization reports that approximately 30 different pH1N1 vaccines have been developed using a range of methods.[25] All progressed successfully through vaccine trials to licensure, showing satisfactory safety profiles, with the most common reactions being severe to moderate fever (1.2%; 95% CI, 0.2%–6.6%) and irritability in infants and younger children following the first dose of pH1N1 vaccine.[26] However, these clinical trials were not large enough to detect rare adverse vaccine reactions which occur with a frequency of less than one in 1000. In general, the safety profile, including that for the Australian vaccine, has been similar to those of other vaccines, with predominantly mild transient events and a small number of serious reactions reported.[27] In Australia, reports of febrile convulsions following Panvax administration were found to be between 10 and 100 per 100 000 doses; this is consistent with the definition of a rare event, and substantially less than that for Fluvax®.[28] Active surveillance for Guillain-Barrè syndrome has resulted in no evidence of an increased incidence, and reports of anaphylaxis are also rare and within expectations.[29]

The large number of reports following the administration of the pH1N1 vaccine may be attributable to the active promotion of reporting by the TGA and may reflect the fact that immunisation providers are more likely to report milder, less serious AEFIs for vaccines they are not familiar with. This tendency to report an AEFI for newer vaccines increases the sensitivity of the system to detect signals of serious, rare or previously unknown events, but also complicates the interpretation of trends.

While seasonal influenza vaccines have been used in Australia for decades, a vaccine safety concern emerged in children in 2010. Epidemiological studies determined that the 2010 seasonal influenza vaccine produced by CSL Biotherapies (Fluvax® and Fluvax junior®) was associated with a rate of febrile convulsions within 24 hours of administration of 500–700 per 100 000 doses,[28] or between 5 and 20 times higher than in other seasonal influenza vaccines and pH1N1 vaccine. Very high rates of fever were also found in a follow-up study: 46% following administration of Fluvax compared to 16% following pH1N1, and 7% following Influvac.[30] The use of the 2010 seasonal trivalent influenza vaccine in children aged under 5 years was suspended in April 2010,[31] after which reporting of AEFIs from seasonal influenza vaccine declined. The recommendation to resume the use of seasonal influenza vaccine in children aged 6 months to 5 years, using brands other than Fluvax® and Fluvax junior®, was subsequently made in August 2010.[32] This issue was initially detected in Western Australia, where vaccine was provided for a larger proportion of children aged 6 months to 5 years through a state-based influenza vaccination program. In other jurisdictions including NSW, only children with medical risk factors were provided with free vaccine. Therefore, the ability of surveillance systems to detect an AEFI 'signal' was limited in these other jurisdictions. However, when results from these jurisdictions were subsequently combined, analyses found a similar rate of febrile convulsions following Fluvax® compared to that in Western Australia.[30]

Stimulated reporting associated with a new vaccine (pH1N1 influenza vaccine) and a vaccine safety issue (Fluvax) is likely to have resulted in increased reporting of milder AEFIs and for other vaccines. AEFI reporting rates for non-influenza vaccines in children were higher in 2010 compared with 2009. After excluding reports of influenza vaccines, the population-based AEFI reporting rate in children aged less than 7 years was three times lower (2.1 per 100 000 population) than the overall reporting rate per 100 000 population for 2010 in that age group (5.8). This is consistent with levels of reporting in 2004–2008 after the removal of the 18-month dose of DTPa that resulted in a reduction of injection site reactions. The majority of these (60%) were reported by the NSW Department of Health and only 0.7% were reported by members of the public.

The recent increase in reports from members of the public (seven in 2008 compared with 88 in 2010) indicates a high level of public interest in both the pH1N1 and seasonal influenza vaccines. This is likely to be due at least in part to the active promotion of the reporting of events following pH1N1 vaccination directly to the TGA,[27] as well as the issues mentioned above.

Conclusion

There was a 24% higher rate of AEFIs per 100 000 population reported from NSW in 2010 compared with 2008, and a 6% decrease compared with 2009. The high rate in 2010 was attributable to a large number of reports following receipt of the pH1N1 and seasonal influenza vaccines in children. A higher proportion of these events were reported directly to the TGA by members of the public following promotion of this for pH1N1. The majority of reports were of mild transient events. Increases in reporting following the introduction of a new vaccine (pH1N1) are expected. However, high rates of febrile convulsions and fever following seasonal influenza vaccine, predominantly in Western Australia where the vaccine was offered to all children aged 6 months to 5 years, ultimately resulted in the removal of the indication for the use of Fluvax® and Fluvax junior® in children of that age, nationally.[31] In NSW, where the influenza vaccine was provided only for children in this age group with medical risk factors, there were eight cases of febrile convulsions. These cases contributed to the finding that febrile convulsion reporting rates following Fluvax® were elevated across Australia.

Acknowledgments

The National Centre for Immunisation Research and Surveillance is supported by the Department of Health and Ageing, the NSW Department of Health and The Children's Hospital at Westmead.

References

1. Lawrence G, Boyd I, McIntyre P, Isaacs D. Surveillance of adverse events following immunisation: Australia 2002 to 2003. *Commun Dis Intell* 2004; 28(3): 324–38.
2. Lawrence G, Boyd I. Surveillance of adverse events following immunisation for children aged less than 7 years, 1 January to 30 June 2004. *Commun Dis Intell* 2004; 28(4): 490–2.
3. Lawrence G, Boyd I. Supplementary report: surveillance of adverse events following immunisation among children aged less than 7 years in Australia, 1 January to 30 June 2005. *Commun Dis Intell* 2005; 29(4): 413–6.
4. Lawrence G, Boyd I, McIntyre P, Isaacs D. Annual report: surveillance of adverse events following immunisation in Australia, 2005. *Commun Dis Intell* 2006; 30(3): 319–33.
5. Lawrence G, Boyd I. Supplementary report: surveillance of adverse events following immunisation among children aged <7 years in Australia, 1 January to 30 June 2006. *Commun Dis Intell* 2006; 30(4): 438–42.
6. Lawrence G, Gold MS, Hill R, Deeks S, Glasswell A, McIntyre PB. Annual report: surveillance of adverse events following immunisation in Australia, 2007. *Commun Dis Intell* 2008; 32(4): 371–87.
7. Lawrence GL, Boyd I, McIntyre PB, Isaacs D. Annual report: surveillance of adverse events following immunisation in Australia, 2004. *Commun Dis Intell* 2005; 29(3): 248–62.
8. Lawrence GL, Aratchige PE, Boyd I, McIntyre PB, Gold MS. Annual report on surveillance of adverse events following immunisation in Australia, 2006. *Commun Dis Intell* 2007; 31(3): 269–82.
9. Lawrence GL, Aratchige PE, Hill R. Supplementary report: surveillance of adverse events following immunisation among children aged less than 7 years in Australia, 1 January to 30 June 2007. *Commun Dis Intell* 2007; 31(4): 379–82.
10. Lawrence GL, Mahajan D, Roomiani I. Supplementary report: surveillance of adverse events following immunisation among children aged <7 years in Australia, 1 January to 30 June 2008. *Commun Dis Intell* 2009; 33(1): 27–31.
11. Mahajan D, Menzies R, Roomiani I, Lawrence GL. Supplementary report: surveillance of adverse events following immunisation among children aged <7 years in Australia, 1 January to 30 June 2009. *Commun Dis Intell* 2010; 34(1): 49–53.
12. Menzies R, Mahajan D, Gold MS, Roomiani I, McIntyre P, Lawrence G. Annual report: surveillance of adverse events following immunisation in Australia, 2008. *Commun Dis Intell* 2009; 33(4): 365–81.
13. Victorian State Government, Department of Health. National immunisation program schedule. Available from: http://health.vic.gov.au/immunisation/fact-sheets/factsheets/schedule_victoria (Cited 1 December 2010.)
14. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. TGA approves vaccine against pandemic (H1N1) 2009 influenza. 18 September 2009. Available from: http://www.tga.gov.au/media/mr2009.htm (Cited 2 December 2010.)
15. National Health and Medical Research Council. The Australian Immunisation Handbook. 8th ed. Canberra: Australian Government Department of Health and Ageing; 2003.
16. National Health and Medical Research Council. The Australian Immunisation Handbook. 9th ed. Canberra: Australian Government Department of Health and Ageing; 2008.
17. Uppsala Monitoring Centre. WHO Collaborating Centre for International Drug Monitoring. 2009. Available from: http://www.who-umc.org/ (Cited 1 February 2009.)
18. Zhou W, Pool V, Iskander JK, English-Bullard R, Ball R, Wise RP et al. Surveillance for safety after immunization: Vaccine Adverse Event Reporting System (VAERS)–United States, 1991–2001. *MMWR Surveill Summ* 2003; 52(1): 1–24.
19. Brown EG, Wood L, Wood S. The medical dictionary for regulatory activities (MedDRA). *Drug Saf* 1999; 20(2): 109–17. doi:10.2165/00002018-199920020-00002
20. Bonhoeffer J, Gold MS, Heijbel H, Vermeer P, Blumberg D, Braun M et al. Hypotonic-hyporesponsive episode (HHE) as an adverse event following immunization: case definition and guidelines for data collection, analysis, and presentation. *Vaccine* 2004; 22(5–6): 563–8. doi:10.1016/j.vaccine.2003.09.009
21. Rüggeberg JU, Gold MS, Bayas JM, Blum MD, Bonhoeffer J, Friedlander S et al. Anaphylaxis: case definition and guidelines for data collection, analysis, and presentation of immunization safety data. *Vaccine* 2007; 25(31): 5675–84. doi:10.1016/j.vaccine.2007.02.064
22. Australian Bureau of Statistics. 31010DO002_201006 Population by Age and Sex, Australian States and Territories, Jun 2010. Australian Bureau of Statistics; 2010. Released at 11:30 am (Canberra time) 21 December 2010.

23. Centre for Epidemiology and Research. Summary report on adult health from the NSW Population Health Survey, 2009. Sydney: NSW Department of Health; 2010.

24. Mahajan D, Campbell-Lloyd S, Roomiani I, Menzies R. NSW Annual Adverse Events Following Immunisation Report, 2009. *N S W Public Health Bull* 2010; 21(9–10): 224–33. doi:10.1071/NB10048

25. World Health Organization. Safety of pandemic A (H1N1) influenza vaccines. *Wkly Epidemiol Rec* 2010; 85(5): 29–36.

26. Nolan T, McVernon J, Skeljo M, Richmond P, Wadia U, Lambert S et al. Immunogenicity of a monovalent 2009 influenza A (H1N1) vaccine in infants and children: a randomized trial. *JAMA* 2010; 303(1): 37–46. doi:10.1001/jama.2009.1911

27. Australian Government Department of Health and Ageing. Therapeutic Goods Administration, Cook J. Australian experience with non-adjuvant H1N1 vaccine (Panvax and Panvax Junior). Medicines Safety Update No. 4, 2010. Available from: http://www.tga.gov.au/adr/msu/msu1008.htm#austexper (Cited 30 August 2010.)

28. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. Australian Technical Advisory Group on Immunisation (ATAGI) and Therapeutic Goods Administration (TGA) Joint Working Group. Analysis of febrile convulsions following immunisation in children following monovalent pandemic H1N1 vaccine (Panvax/Panvax Junior, CSL). Available from: http://www.tga.gov.au/safety/alerts-medicine-seasonal-flu-100928.htm (Cited 30 May 2011.)

29. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. Suspected adverse reactions to Panvax® reported to the TGA. 30 September 2009 to 17 September 2010. Available from: http://www.tga.gov.au/safety/alerts-medicine-panvax-091120.htm (Cited 30 May 2011.)

30. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. Investigation into febrile reactions in young children following 2010 seasonal trivalent influenza vaccination. Status report as at 2 July 2010 (updated 24 September 2010). Available from: http://www.tga.gov.au/safety/alerts-medicine-seasonal-flu-100702.htm (Cited 30 May 2011.)

31. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. Departmental Media Releases 23 April 2010. Seasonal Flu Vaccine and young children. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/mr-yr10-dept-dept230410.htm (Cited 30 May 2011.)

32. Australian Government Department of Health and Ageing, Therapeutic Goods Administration. Departmental Media Releases 30 July 2010. Seasonal flu vaccination for young children can be resumed – Updated advice from the Chief Medical Officer. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/mr-yr10-dept-dept300710.htm (Cited 30 May 2011.)

New Senior Hospitalist Initiative: a new medical career pathway for NSW Health

New South Wales (NSW) is developing a new medical career pathway for hospitalists. Hospitalists will provide a range of clinical services and promote coordinated patient care across disciplines. The establishment of the hospitalist role and development of an education program for experienced non-specialist doctors was recommended by the Garling Special Commission of Inquiry into Acute Care Services in NSW public hospitals. The report recognised that "Hospitalists have an important role in coordinating the care of a patient who has needs which cross boundaries of individual specialities".

The hospitalist pathway offers a flexible, interesting and attractive career to non-specialists keen to remain involved in acute patient care, while leading improvements in the coordination of hospital services. The pathway will be supported by the Masters of Clinical Medicine (Leadership and Management) which will focus on the range of skills required for senior hospitalist roles within NSW Health. The Masters, or equivalent, will be a requirement for eligibility for NSW Health Senior Hospitalist positions as an alternative to the Senior Career Medical Officer Grading Committee.

The 2-year part-time Masters, endorsed by NSW Health, will begin in 2012. The program is open to non-specialist doctors with 3 years full-time postgraduate medical experience. It will be accessible statewide through flexible delivery options and will have a substantial workplace component. To support eligible NSW Health doctors to participate in the Masters, the Department will sponsor 15 places in 2012.

Those interested in finding out more about the Senior Hospitalist Initiative, including sponsorship and enrolment information, should check the NSW Health website at: http://www.health.nsw.gov.au/training/hospitalist/

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Trachoma

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Trachoma is an infectious eye disease caused by strains of the bacteria *Chlamydia trachomatis* (which causes an infective conjunctivitis) Repeated episodes of infection can result in loss of vision and blindness if not treated.[1] Trachoma has disappeared in developed countries as living standards have improved, however it remains an issue in some developing countries, and still occurs in the Aboriginal population in Australia.

C. trachomatis is an obligate, intracellular, gram-negative bacterium.[1] It attaches to the epithelial cells in the eye and is internalised, forming a metabolically active reticulate body, which triggers a delayed type hypersensitivity reaction. Inflammation occurs in all layers of the conjunctiva, with infiltration of lymphocytes, and the development of lymphoid follicles in the tarsal conjunctiva. Repeated infection and prolonged inflammatory processes results in fibrosis and thickening of the conjunctiva, causing scarring.[1] The scarring pulls the eyelid margin inward, causing trichiasis, where one or more eyelashes are pulled in to rub on the eye. Trichiasis causes pain and trauma to the corneal surface, and will result in opacification of the cornea and irreversible vision loss if left untreated.

The clinical signs of trachoma can be considered in two distinct phases.[2] 'Active trachoma' involves active infection with *C. trachomatis,* characterised by inflammatory thickening of the conjunctiva and the development of follicles. 'Cicitricial disease' is characterised by scarring, with later trichiasis and corneal opacity. Trachoma can be easily diagnosed and the World Health Organization (WHO) Simplified Grading System allows for rapid clinical assessment of the prevalence and severity of the disease in a population.

Trachoma is a disease of poor hygiene related to poverty and proximity. Primary transmission involves transmission from person to person through infected ocular secretions or nasal discharge; secondary transmission by flies also occurs. Specific risk factors for trachoma include household crowding, an insufficient or unclean water supply, the absence of a toilet in the household, and an increased presence of flies. The most important risk factor is poor facial hygiene, characterised by a dirty face.

The control strategy recommended by the WHO is SAFE: Surgery, Antibiotics, Facial cleanliness and Environmental improvement.[3] Surgery for trichiasis involves reversing the in-turned eyelashes. Antibiotics reduce the level of chlamydial infection in the active trachoma phase through a single oral dose repeated every 6–12 months and may be administered at a family or community-wide level. Facial cleanliness involves behavioural change in communities and families, addressed through health promotion programs, while environmental strategies address water, sanitation and household hygiene.

The National Indigenous Eye Health Survey[4] (2009) determined the overall rate of active trachoma to be 3.8% in all Aboriginal and Torres Strait Islander children aged 5–15 years (ranging from 0.6% in major cities to 7.3% in very remote areas). In Aboriginal and Torres Strait Islander adults the rate of scarring was 15.7%, trichiasis 1.4% and corneal opacity 0.3%.

In New South Wales (NSW), 8.1% of adults surveyed had trachomatous scarring. Trachoma was very common in Aboriginal communities in western NSW until the 1970s and therefore trichiasis may be found in older Aboriginal people in these areas. To detect trichiasis in these people one can follow the 'Ts for Trichiasis'; Think of looking for it; use your Thumb to lift the upper lid off the eyeball; and use a Torch to see in-turned lashes. Outreach eye services in NSW do not keep data on the number of clients with trichiasis, but anecdotally report the numbers as low.

The Survey found 2% of children surveyed in NSW (3 of 155 children) showed signs of active trachoma (two from inner regional areas and one from a major city). The current prevalence of trachoma in western NSW is unclear, but anecdotal evidence suggests it is rare. Further work is required to determine the best surveillance methods for detecting and managing this disease, in keeping with a global commitment to the elimination of trachoma by 2020.

References

1. Wright HR, Turner A, Taylor HR. Trachoma. *Lancet* 2008; 371: 1945–54. doi:10.1016/S0140-6736(08)60836-3
2. Taylor HR. Trachoma. Haddington Press: Australia; 2008.
3. Mathew AA, Turner A, Taylor HR. Strategies to Control Trachoma. *Drugs* 2009; 69(8): 953–70. doi:10.2165/00003495-200969080-00002
4. Taylor HR, Fox SS, Xie J, Dunn RA, Arnold AMR, Keeffe JE. The prevalence of trachoma in Australia: the National Indigenous Eye Health Survey. *Med J Aust* 2010; 192(5): 248–53.

Communicable Diseases Report, NSW, July and August 2011

Communicable Diseases Branch
NSW Department of Health

For updated information, including data and facts on specific diseases, visit www.health.nsw.gov.au and click on **Public Health** and then **Infectious Diseases.** The communicable diseases site is available at: http://www.health.nsw.gov.au/publichealth/infectious/index.asp.

Figure 1 and Tables 1 and 2 show notifications of communicable diseases received in July and August 2011 in New South Wales (NSW).

Enteric infections

Outbreaks of foodborne disease

Sixteen outbreaks of gastrointestinal disease thought to be due to consumption of contaminated food were reported in July and August 2011. One outbreak was identified through surveillance of laboratory notifications, 14 outbreaks were identified through complaints to the NSW Food Authority and one outbreak through the local public health unit. Nine of these outbreaks were further investigated and enough evidence was gathered on three to suggest that they were outbreaks related to food. In two of these outbreaks, the causative organism was identified as *Salmonella enterica* serotype Typhimurium; in the third, no causative organism could be identified.

The first outbreak linked to *S. enterica* serotype Typhimurium was identified through a complaint to the NSW Food Authority about a restaurant. Interviews found that three of four ill people had consumed a tiramisu made with raw egg. Interviews with other cases whose illness was caused by *S. enterica* serotype Typhimurium with the same molecular subtyping (multiple-locus variable number tandem repeat analysis [MLVA] pattern) identified in the initial complaint case, found an additional ten people who had become ill following the consumption of tiramisu at this restaurant. This brought the total of known ill from this outbreak to thirteen people.

The second outbreak caused by *S. enterica* serotype Typhimurium was identified through routine surveillance of laboratory notifications which detected four cases of *S. enterica* serotype Typhimurium with the same MLVA pattern clustered in a regional city over the same 4-day collection period. It was revealed through interview that the four people all developed gastrointestinal illness after eating sandwiches prepared with raw egg mayonnaise from the same local café.

Both of these outbreaks appear likely to have been caused by the consumption of products containing contaminated raw eggs. Due to the risk associated with potential contamination of raw eggs with *Salmonella*,[1] the businesses in both outbreaks agreed not to serve raw egg goods unless they used pasteurised egg product. Thorough cooking of food kills *Salmonella* and it is therefore advisable to avoid consumption of raw or undercooked eggs, especially young children, elderly people and people with an immunosuppressive condition.

The third outbreak was identified through two complaints about the same restaurant to the NSW Food Authority. The complaints were from two separate groups of six people who ate at the restaurant on different days (eight days apart). Eleven of these twelve people reported gastrointestinal illness. Interviews with the twelve people revealed that the most common foods eaten by the eleven ill people were schnitzels, potato salad and gravy however no one food item was clearly linked with illness. Gravy was one of the most common foods eaten by the ill people, so samples of the gravy were analysed. The NSW Food Authority inspected the premises and found cleaning standards and temperatures to be satisfactory. No causative agent was identified in the food samples taken from the restaurant. Based on the incubation period of 12 hours and symptoms of nausea and diarrhoea, the likely organism was considered to be a preformed bacterial toxin such as *Clostridium perfringens* or *Bacillus cereus*.

Outbreaks of gastroenteritis in institutional settings

In July and August 2011, 117 outbreaks of gastroenteritis in institutions were reported, affecting a total of 2145 people. Sixty-four outbreaks occurred in aged-care facilities, 25 in child-care centres, 25 in hospitals, and three in other residential and family-care centres. All these outbreaks appear to have been caused by person-to-person spread of a viral illness. In 80 (68%) outbreaks, one or more stool specimens were collected. In 49 (61%) of these

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specimens, norovirus was detected. Rotavirus was detected in nine (11%) outbreaks (norovirus was also identified in two of these). Adenovirus was detected in one outbreak. In 15 outbreaks all stool specimens were negative for pathogens. Stool specimens for laboratory testing were not available for the remaining 37 (32%) outbreaks.

Viral gastroenteritis increases in winter months. Public health units encourage institutions to submit stool specimens from cases for testing during an outbreak to help determine the cause of the outbreak. For more information on control guidelines for gastrointestinal outbreaks in institutions, see: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-cdna-norovirus.htm/$File/norovirus-guidelines.pdf

Zoonotic infections

Hendra virus

In July and August, Hendra virus was confirmed in ten horses on eight properties on the NSW North Coast. All horses died or were euthanised. Twenty-six potential human contacts of these horses were assessed by public health staff. Contacts were considered to be people who have had direct or indirect exposure of skin or mucous membranes to body fluids of a horse determined to be a confirmed case of Hendra virus infection, (or of a horse where heightened suspicion of infection exists on clinical and epidemiological grounds). Potential contacts were interviewed by public health staff about their exposures to the horse while it had symptoms and for the 3 days prior to onset of illness in the horse. None of the contacts were considered to have had high level exposure to infected horses. Queensland authorities also investigated outbreaks in this period.

Hendra virus infection is carried by all four species of flying foxes (fruit bats) in Australia. Occasionally the infection is passed to horses, presumably through exposure to virus excreted by flying foxes. There have been seven human infections with Hendra virus (including 4 deaths) identified in Australia to date, all following high level exposure to infected horses.[2] No human infections have followed direct exposure to a flying fox or to another person with the infection.

Queensland and NSW government representatives have formed a Joint Government Hendra Virus Task Force which has met on several occasions. The Taskforce will recommend research into Hendra virus and transmission of the virus.

Respiratory infections

Influenza

The number of people who presented to 56 selected Emergency Departments with influenza-like-illness, and the number of notifications of laboratory-confirmed influenza remained stable in NSW during July and August 2011. There were 467 presentations (rate 2.6 per 1000 presentations) for July and 443 presentations (rate 2.3 per 1000 presentations) for August to selected Emergency Departments with influenza-like-illness. There were 1351 notifications of laboratory-confirmed influenza in July, and 1650 notifications in August.

A sample of 184 influenza A specimens collected from influenza patients from the Hunter New England area since May 2011 was tested for antiviral resistance. Of these, 25 influenza A (H1N1) 2009 specimens were identified with a mutation (H275Y neuraminidase) associated with resistance to two antiviral medications used to treat influenza, oseltamivir (Tamiflu™) and peramivir. Seven affected patients were hospitalised; there were no deaths. No patients had received oseltamivir or peramivir before the specimens were collected. None of these specimens showed resistance to the antiviral medication zanamivir (Relenza™).

For a more detailed report on respiratory activity in NSW see: http://www.health.nsw.gov.au/PublicHealth/Infectious/influenza_reports.asp

Vaccine-preventable diseases

Meningococcal disease

Fifteen confirmed cases of meningococcal disease were notified in July and August 2011. Ten cases were due to serogroup B, one serogroup W135, one serogroup Y, and, for three cases, the serogroup was unknown. Unusually, two serogroup B cases occurred one month apart in the same child-care centre in south western Sydney. The public health response after the notification of the first case followed national guidelines. Clearance antibiotics were provided to staff and children who were in the same child-care group as the case and information about meningococcal disease was provided to all parents of children at the centre. Following the second case, all children at the centre were offered information and clearance antibiotics.

A free vaccine for serogroup C meningococcal disease is available for infants at 12 months of age.[3] Consequently, serogroup C disease is now mainly seen in adults and in unimmunised children. In NSW this year, 75% of cases of meningococcal disease where serogroup of the bacterium was known were caused by serogroup B, for which there is no vaccine. No cases of serogroup C disease have been notified to date this year.

Measles

Fifteen cases of measles were notified in NSW in July and August 2011. All cases lived in the Sydney metropolitan area and all recent cases have been acquired locally.

As measles has not been endemic in NSW in recent years the original source case is presumed to have been an unidentified traveller who acquired measles overseas and who was infectious on their return to NSW. Four cases were children and eleven were adults aged between 19 and 37 years.

Many Australian-born people who are aged between 20 and 40 years may not have received any, let alone the two doses of measles vaccination that is required for best protection, and do not have immunity from past infection. Measles, mumps and rubella (MMR) vaccine is now routinely given at 12 months of age and again at 4 years (although it can be given from 3½ years); two MMR vaccines give long-lasting immunity.

An accurate immunisation history is often difficult to determine from adults who may be unsure of the exact details of the vaccines they received in childhood and do not have written records. There is no whole-of-life immunisation register that can be used to verify the vaccination record of adults. General practitioners are able to provide MMR vaccine free to anyone born after 1966 who has not received two doses of vaccine or who are unsure of their vaccination history.

References

1. Heymann DL, ed. Control of Communicable Diseases Manual. 19th edition. Washington: American Public Health Association; 2008.
2. Selvey LA, Wells RM, McCormack JG, Ansford AJ, Murray K, Rogers RJ et al. Infection of humans and horses by a newly described morbillivirus. *Med J Aust* 1995; 162: 642–5.
3. National Health and Medical Research Council. The Australian Immunisation Handbook. 9th edition. Canberra: Australian Government Department of Health and Ageing; 2008.

Figure 1. Reports of selected communicable diseases, NSW, Jan 2004 to August 2011, by month of onset.
Preliminary data: case counts in recent months may increase because of reporting delays.
Laboratory-confirmed cases only, except for measles, meningococcal disease and pertussis.
BFV: Barmah Forest virus infections, RRV: Ross River virus infections.
Lab Conf: laboratory confirmed.
Men Gp C and Gp B: Meningococcal disease due to serogroup C and serogroup B infection; other/unk: other or unknown serogroups.
NB: Multiple series in graphs are stacked, except gastroenteritis outbreaks.
NB: Outbreaks are more likely to be reported by nursing homes and hospitals than by other institutions.

NSW population	
Male	50%
<5 y	7%
5–24 y	27%
25–64 y	53%
65+ y	13%
Rural	46%

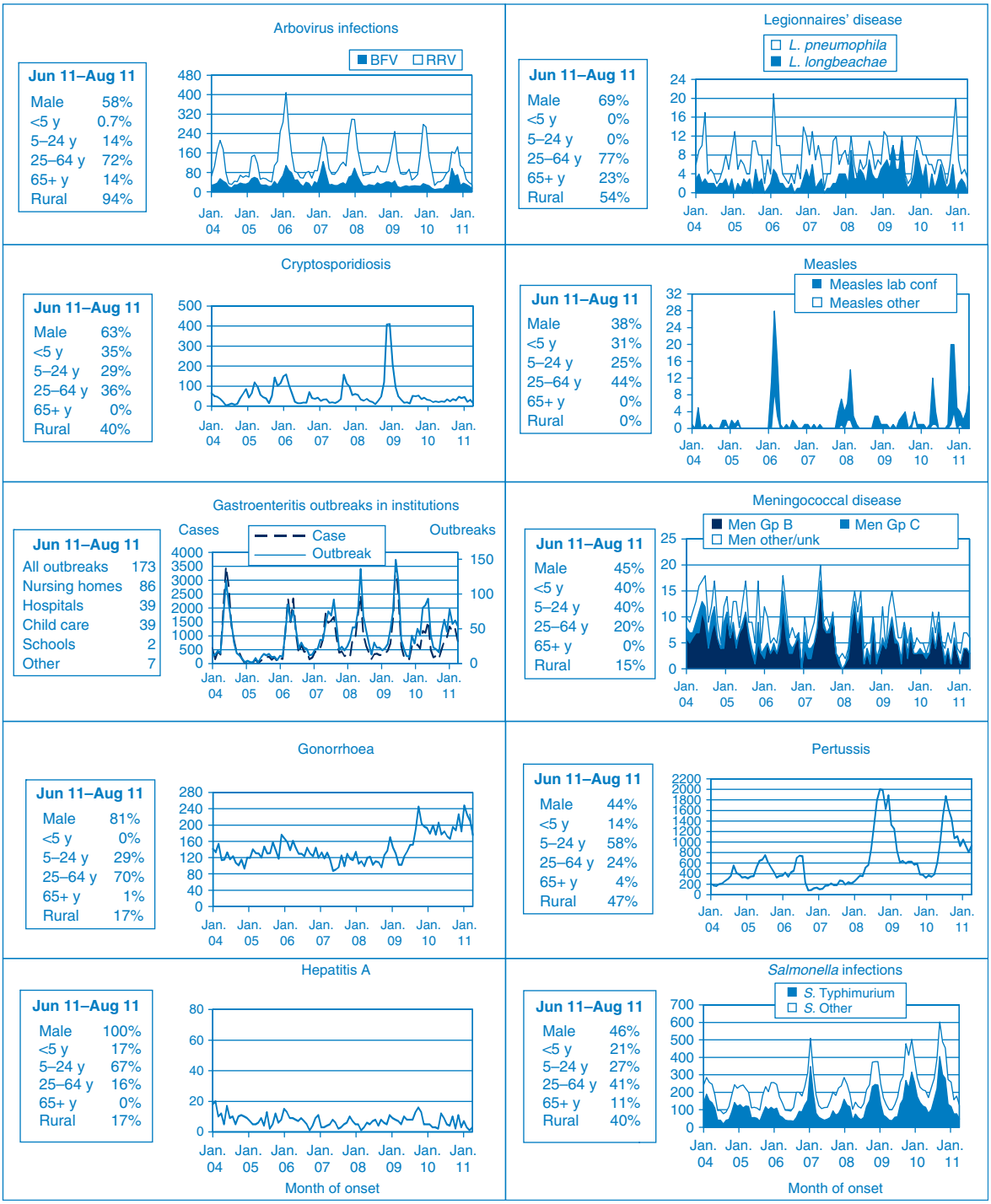

Table 1. Reports of notifiable conditions received in July 2011 by local health districts

Condition	Local health district (2011)																Total	
	Murrumbidgee	Southern NSW	Western NSW	Far West	Hunter New England	Northern NSW	Mid North Coast	Central Coast	Northern Sydney	South Eastern Sydney	Illawarra Shoalhaven	Sydney	South Western Sydney	Western Sydney	Nepean Blue Mountains	Justice Health	For Jul[b]	Year to date[b]
Bloodborne and sexually transmitted																		
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	55	43	88	20	256	67	47	85	125	272	81	179	161	133	68	24	1709	11 960
Gonorrhoea[a]	2	1	2	1	17	4	1	1	22	66	7	42	11	24	2	–	203	1474
Hepatitis B – acute viral[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	17
Hepatitis B – other[a]	4	1	4	3	7	1	4	–	22	28	5	29	42	53	6	1	210	1507
Hepatitis C – acute viral[a]	–	–	2	–	–	1	1	–	–	–	–	–	–	–	–	–	4	26
Hepatitis C – other[a]	15	4	14	1	24	23	6	13	11	32	21	19	29	34	14	–	260	1922
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	4
Lymphogranuloma vanereum	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	2	27
Syphilis	–	–	3	1	1	–	–	–	2	16	2	7	4	8	–	–	44	388
Vectorborne																		
Barmah Forest virus[a]	–	1	3	–	1	13	1	–	–	–	–	–	–	–	–	–	19	360
Ross River virus[a]	5	–	4	–	2	2	1	–	–	–	–	–	–	–	–	–	14	472
Arboviral infection (other)[a]	–	1	1	–	1	–	–	1	–	1	1	–	1	–	–	–	7	80
Malaria[a]	–	–	–	–	1	–	–	–	–	1	–	1	1	2	1	–	7	45
Zoonoses																		
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brucellosis[a]	–	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	2	4
Leptospirosis[a]	3	–	1	–	2	–	–	–	–	–	1	–	–	–	–	–	7	29
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	9
Q fever[a]	2	–	–	–	–	2	1	–	–	–	1	–	–	–	–	–	6	60
Respiratory and other																		
Blood lead level[a]	3	–	6	–	1	–	–	1	–	1	2	–	3	–	3	–	20	173
Influenza[a]	11	33	43	3	331	121	44	8	141	102	17	89	134	194	79	–	1351	2778
Invasive pneumococcal infection[a]	–	2	3	–	11	7	3	1	6	8	6	6	4	3	4	–	64	275
Legionella longbeachae infection[a]	–	–	–	–	1	–	–	–	–	–	–	1	–	2	–	–	4	19
Legionella pneumophila infection[a]	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	–	3	40
Legionnaires' disease (other)[a]	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	7
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Meningococcal infection (invasive)[a]	1	–	–	–	1	–	–	–	1	1	–	–	1	1	1	–	7	41
Tuberculosis	1	–	–	–	1	1	–	–	–	9	1	2	1	9	–	1	26	201
Vaccine–preventable																		
Adverse event after immunisation	1	3	1	–	–	1	–	–	5	1	–	–	–	2	–	–	14	137
H. *Influenzae b* infection (invasive)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Measles	–	–	–	–	–	–	–	–	1	3	–	–	–	–	–	–	4	54
Mumps[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	28
Pertussis	120	48	50	5	27	43	23	17	52	65	70	50	66	87	85	–	808	7482
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	13
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Enteric																		
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cryptosporidiosis[a]	–	–	–	–	3	5	1	–	2	2	1	2	3	4	–	–	23	236
Giardiasis[a]	3	8	8	–	26	–	4	4	26	22	5	17	19	17	11	–	170	1597
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Hepatitis A[a]	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	2	38
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	14
Listeriosis[a]	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1	12
Rotavirus[a]	–	–	–	–	7	4	1	2	8	5	3	7	1	8	–	–	46	434
Salmnellosis[a]	10	2	4	–	15	6	4	6	20	24	1	21	17	16	3	–	149	2557
Shigellosis[a]	–	–	–	–	–	–	–	2	1	1	–	–	1	1	–	–	6	78
Typhoid[a]	–	–	–	–	–	–	–	–	–	2	–	–	–	2	–	–	4	34
Verotoxin producing *E. coli*[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Miscellaneous																		
Creutzfeldt–Jakob disease	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.
N.B: Data are current and accurate as at the preparation date. The number of cases reported is, however, subject to change, as cases may be entered at a later date or retracted upon further investigation. Historical data configurations are included for continuity/comparison purposes and to highlight regional differences.
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Bloodborne and sexually transmitted																		
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	54	42	78	18	222	83	48	90	148	241	84	158	153	94	60	10	1583	13 489
Gonorrhoea[a]	1	1	1	1	11	4	2	5	22	88	10	42	27	16	4	–	235	1709
Hepatitis B – acute viral[a]	1	–	–	2	–	–	–	–	1	–	–	–	–	1	–	–	5	22
Hepatitis B – other[a]	6	2	1	–	1	1	5	2	21	44	8	37	62	37	6	–	233	1740
Hepatitis C – acute viral[a]	–	–	–	3	–	–	–	–	–	1	–	–	–	–	–	–	4	30
Hepatitis C – other[a]	21	16	16	3	27	11	14	14	10	26	9	36	40	27	17	3	290	2212
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	28
Syphilis	–	–	2	–	3	2	1	4	2	2	2	1	–	3	–	–	22	410
Vectorborne																		
Barmah Forest virus[a]	1	1	4	1	6	9	2	–	–	–	1	–	–	1	–	–	26	386
Ross River virus[a]	3	1	4	1	5	4	1	–	–	–	–	–	–	–	–	–	19	491
Arboviral infection (other)[a]	–	–	–	–	2	–	–	–	2	1	–	–	1	–	–	–	6	86
Malaria[a]	–	–	2	–	2	–	–	–	–	–	1	1	1	2	1	–	10	55
Zoonoses																		
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brucellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Leptospirosis[a]	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	30
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	10
Q fever[a]	–	2	1	–	–	2	1	–	–	–	1	–	–	–	–	–	7	67
Respiratory and other																		
Blood lead level[a]	4	–	5	1	1	–	–	1	2	–	–	1	1	–	–	–	16	189
Influenza[a]	49	34	72	5	309	198	36	33	134	138	21	135	117	255	114	–	1650	4428
Invasive pneumococcal infection[a]	1	2	3	1	9	5	1	5	3	7	6	4	6	5	8	–	66	341
Legionella longbeachae infection[a]	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	20
Legionella pneumophila infection[a]	–	–	1	–	–	–	–	1	–	1	1	–	–	–	–	–	4	44
Legionnaires' disease (other)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Meningococcal infection (invasive)[a]	–	–	–	–	1	–	–	–	2	1	–	–	2	1	1	–	8	49
Tuberculosis	2	–	–	–	2	–	1	–	1	1	–	–	–	–	2	–	9	210
Vaccine–preventable																		
Adverse event after immunisation	1	1	1	–	–	1	–	–	4	1	1	–	–	3	–	–	13	150
H. *Influenzae b* infection (invasive)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Measles	–	–	–	–	–	–	–	–	–	2	–	4	5	–	–	–	11	65
Mumps[a]	–	–	–	–	–	–	–	–	–	1	–	–	–	3	–	–	4	32
Pertussis	112	46	84	10	45	43	24	30	127	116	97	46	79	137	134	1	1131	8613
Rubella[a]	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	14
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Enteric																		
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cryptosporidiosis[a]	1	1	1	–	1	4	2	–	3	3	2	4	1	4	2	–	29	265
Giardiasis[a]	3	5	7	1	11	1	3	11	28	21	8	17	7	7	3	–	134	1731
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Hepatitis A[a]	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	2	40
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	2	16
Listeriosis[a]	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	13
Rotavirus[a]	–	2	2	–	7	8	2	4	17	8	4	8	4	5	7	–	78	512
Salmnellosis[a]	16	6	5	1	24	4	8	6	25	15	13	12	14	24	7	–	180	2737
Shigellosis[a]	–	–	–	–	–	–	–	1	2	1	–	–	–	2	–	–	6	84
Typhoid[a]	–	–	–	–	–	–	–	–	–	2	–	3	1	1	–	–	7	41
Verotoxin producing *E. coli*[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Miscellaneous																		
Creutzfeldt–Jakob disease	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	4
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.
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Contents

Immunisation in NSW

NSW PUBLIC HEALTH BULLETIN

The *NSW Public Health Bulletin* is a peer-reviewed journal produced by the NSW Department of Health and indexed in Medline. It has a NSW focus, however, it aims to support the practice of public health more broadly.

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eISSN 1834-8610

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