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Immunisation in NSW

Controlling measles in NSW: how are we doing in the context of other countries in the Western Pacific?

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Global measles control over the past decade has been very successful. Estimated deaths have fallen by 74% from 535 300 in 2000 to 139 300 in 2010.[1] While the goal of eradicating global measles transmission has not yet been formally adopted, five of six World Health Organization (WHO) regions have set deadlines for elimination of endemic measles transmission* (the exception being the South East Asian Region).[2] This was achieved in the Americas in 2002 and has been maintained since then.[3] However, after 8 years of decline, global case numbers have increased in the past 3 years due to substantial outbreaks in Africa and Europe.[4] In Europe in 2011 there were more than 30 000 cases of measles notified with at least eight deaths.[5] Significant outbreaks occurred in France (15 000 cases), Italy, Spain, Romania and Germany. More than 80% of cases occurred in unvaccinated persons – the main reason for these outbreaks is failure to vaccinate. It is likely that countries with major outbreaks will need to consider 'catch-up' programs, as well as improved primary vaccination coverage with two doses of measles-containing vaccine. In Africa large outbreaks have recently been experienced in 60% of countries.[6]

*Endemic transmission is defined as ongoing transmission of the same strain of virus for ≥12 months (see Annex 4 of: http://www.wpro.who.int/about/regional_committee/63/documents/RC63_07_Item_12_Measles_elimination_FINAL_COMPLETE.pdf)

In the WHO Western Pacific Region, major progress to control measles has been made in recent years. The Western Pacific Region focused on measles control during the 1990s before adopting the goal of elimination in 2003 and, in 2005, declaring the target year as 2012.[7] Control activities have accelerated in recent years: reported coverage with one dose of measles-containing vaccine increased from 85% in 2000 to 97% in 2011 (the highest of any WHO region), and coverage is 91% for the second routine dose of measles-containing vaccine. Supplemental immunisation activities, usually targeting children from the age of 9 months up to 14 years, have been conducted in 30 of 37 countries and areas in the region.[7] The largest supplemental immunisation activity in history was conducted in China in 2010, with over 103 million children vaccinated.[4] The fruits of these activities can be seen in a 91% reduction in reported measles cases between 2000 and 2011,[8] and an estimated 76% reduction in deaths between 2000 and 2010.[1] Although cessation of endemic measles virus circulation in every country in the region is unlikely to be achieved in 2012, elimination appears to have already been achieved in 25 of 37 countries and areas within the Western Pacific Region. These are: South Korea (the only Western Pacific Region country to formally announce elimination), all Pacific Island countries, Australia, Hong Kong and Macau.[9] Substantial progress has been made in recent years in the four countries with the largest populations – China, Japan, Philippines and Viet Nam.[7] This remarkable progress in the region has resulted in the Western Pacific Regional Director appointing a Regional Verification Commission to formally assess regional and individual country progress towards meeting the elimination goal.

Although not yet formally verified in Australia, measles elimination may have already been achieved, judging from our high two-dose coverage, limited transmission from imported cases, cessation of endemic genotype circulation, national serosurvey data and modelling studies.[10] Australia

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has been requested to appoint a National Verification Committee to provide evidence supporting elimination.

Recent increases in measles cases in New South Wales (NSW) described by Rosewell et al.[11] were associated with outbreaks in Sydney high schools that have particular populations with low vaccination coverage and transmission in hospital emergency departments. Although outbreaks have not occurred in other Australian states and territories this year, outbreaks linked to imported cases occurred in all jurisdictions in 2011, and the numbers of cases nationally has increased in recent years.[12,13] The source countries for NSW-imported cases were predominantly from the Western Pacific, European and South East Asian regions, probably reflecting a combination of travel patterns and source country disease incidence. Unlike in Europe,[14] outbreaks in NSW have not yet resulted in the re-establishment of endemic transmission.[11] However, to ensure this, continued high levels of vaccination coverage throughout the community are essential, as is continued vigilance through sensitive case surveillance and meticulous outbreak investigation and control (including genotyping to exclude common circulating types). Serosurveillance studies help to determine whether and when a catch-up campaign may be needed. In addition, we must pay particular attention to the vaccination status of travellers not only to endemic areas but also to high profile mass gatherings.

Supporting strengthened elimination efforts internationally will also benefit NSW and Australia by limiting the potential for the importation of cases. One relatively minor step could be reporting discarded measles case numbers to WHO; a discarded measles case is one originally suspected as being measles but subsequently confirmed as not measles. Currently, suspected measles cases are deleted once measles has been excluded as the cause in NSW and other Australian jurisdictions. The benchmark of ≥2 discarded measles cases per 100 000 population is a key indicator that a country's measles surveillance is adequate for verifying elimination. Australia is one of only four countries not providing these data to the Western Pacific Regional Office,[7] but studies in northern NSW and Victoria have confirmed Australia's ability to collect the data to meet this benchmark.[2,15] This information would provide a valuable reassurance to other countries in the region about our surveillance quality and commitment to regional elimination efforts.

While much progress has been made in measles control over the past decade, NSW and Australia must maintain vigilance at home as well as supporting active partnership with elimination efforts in the Western Pacific.

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NSW Annual Vaccine-Preventable Disease Report, 2011

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Abstract: Aim: To describe the epidemiology of selected vaccine-preventable diseases in NSW for 2011. **Methods:** Data from the NSW Notifiable Conditions Information Management System were analysed by: local health district of residence, age, Aboriginality, vaccination status, and organism, where available. Risk factor and vaccination status data were collected by public health units for case-patients following notification under the NSW *Public Health Act 1991**. **Results:** Outbreaks of measles and pertussis were reported in 2011, associated with unimmunised groups for measles, and a variety of factors for pertussis. Notification rates for other selected vaccine-preventable diseases remained stable. **Conclusion:** Vaccine-preventable diseases are generally well controlled in NSW. However, pertussis remains an important public health issue. To prevent measles high population vaccination coverage, including vaccination in risk groups, is essential.

The objectives of vaccine-preventable disease surveillance are, at an individual level, to identify events that may require immediate public health control measures, and at a population level, to identify risk factors such as age and geographic location that inform better targeted immunisation efforts.

This report describes notification data for measles, pertussis, rubella, *Haemophilus influenzae* serotype b invasive infection, invasive meningococcal disease, mumps, tetanus, and invasive pneumococcal disease in New South Wales (NSW) in 2011 and provides comparison with recent trends.

Methods

The notification requirements for medical practitioners, hospital general managers and laboratories under the state's public health legislation have been previously described.[1] On receipt of a notification, a public health unit surveillance officer determines whether or not the notification meets the definition of a case of vaccine-preventable disease according to national criteria,[2] and if so enters data gathered on each notified case into the NSW Notifiable Conditions Information Management System (NCIMS). In this report, a person with an illness that meets the case definition is called a case-patient.

Data describing cases in NCIMS were extracted for selected vaccine-preventable diseases with a date of onset in 2011. Rates were calculated using Australian Bureau of Statistics population estimates and are presented as annual rates per 100 000 total population or population in age groups. Risk factor and vaccination status data were collected for case-patients through public health unit follow-up with general practitioners (GPs) and other sources such as case-patient or carer reports. The incidence of cases were analysed by geographic area of residence.

Results

Haemophilus influenzae serotype b invasive infection

In 2011, four cases of *H. influenzae* serotype b infection were notified; this was the lowest annual incidence within the last decade. Three case-patients were aged less than 1 year and one was a 2-year old child; all were male. Of the three infants aged less than 1 year, one 10-month old and one 11-month old infant were fully vaccinated for age (3 doses), while one 9-month old infant was partially vaccinated for age (2 doses). The 2-year old case-patient was fully vaccinated (4 doses). No case-patients were identified as being Aboriginal. All lived in regional NSW.

Measles

In 2011, 90 cases of measles were notified in NSW, compared to 26 in 2010. The highest case notification rates were reported among children aged 0–4 years (21 cases, 4.4 per 100 000 population), of whom three were too young to be vaccinated, and in young people aged 10–14 years (17 cases, 3.7 per 100 000 population) (Table 1). Thirty-nine case-patients (43%) were male. Ten case-patients were identified as Aboriginal people,

Table 1. Number and rate per 100 000 population of case notifications for selected vaccine-preventable diseases, by 5-year age groups, NSW, 2011

Age group (years)	*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
0–4	4	0.8	21	4.4	25	5.2	1	0.2	2403	503.8	70	14.7	0	0	0	0
5–9	0	0	2	0.4	6	1.3	3	0.7	4120	923.1	14	3.1	0	0	0	0
10–14	0	0	17	3.7	1	0.2	1	0.2	2334	514.7	8	1.8	0	0	0	0
15–19	0	0	16	3.4	9	1.9	6	1.3	351	74	9	1.9	1	0.2	1	0.2
20–24	0	0	6	1.2	10	2	11	2.2	203	40.7	10	2	4	0.8	0	0
25–29	0	0	8	1.6	2	0.4	9	1.8	252	50.1	11	2.2	5	1	0	0
30–34	0	0	12	2.4	2	0.4	10	2	365	74.1	19	3.9	3	0.6	0	0
35–39	0	0	6	1.2	1	0.2	9	1.8	575	112.3	18	3.5	2	0.4	0	0
40–44	0	0	2	0.4	3	0.6	2	0.4	609	122.4	19	3.8	1	0.2	0	0
45–49	0	0	0	0	3	0.6	3	0.6	450	90.4	33	6.6	0	0	0	0
50–54	0	0	0	0	2	0.4	4	0.8	301	62.7	28	5.8	0	0	0	0
55–59	0	0	0	0	0	0	2	0.5	271	62.6	42	9.7	1	0.2	0	0
60–64	0	0	0	0	1	0.3	3	0.8	251	62.8	56	14	0	0	0	0
65–69	0	0	0	0	2	0.6	1	0.3	196	62.7	40	12.8	0	0	0	0
70–74	0	0	0	0	2	0.8	0	0	168	69	29	11.9	0	0	0	0
75–79	0	0	0	0	0	0	0	0	93	49.1	23	12.1	0	0	0	0
80–84	0	0	0	0	2	1.3	0	0	54	35.5	40	26.3	0	0	0	0
85+	0	0	0	0	1	0.7	0	0	49	33.7	55	37.9	0	0	0	0

Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

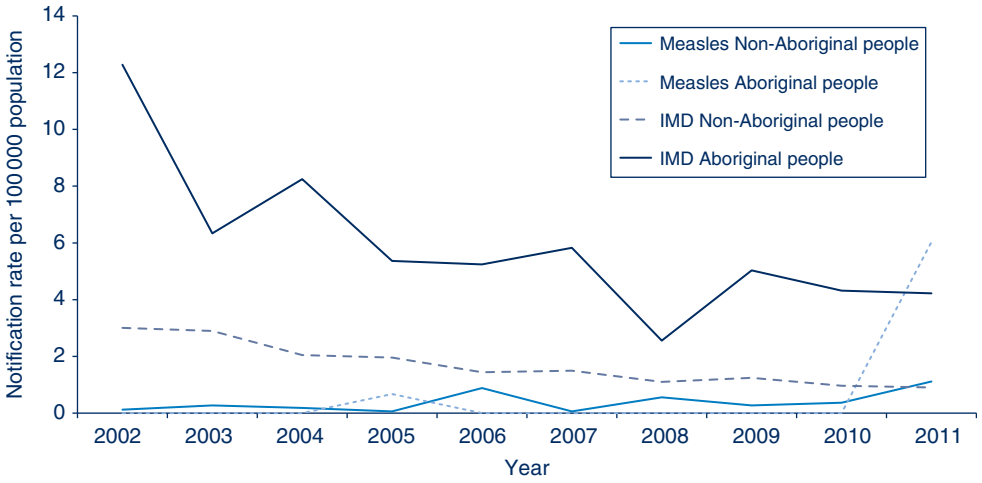

Figure 1. Case notifications of measles and invasive meningococcal disease (IMD) per 100 000 population in NSW, for Aboriginal and non-Aboriginal people, for each year of the period 2002–2011.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

amongst whom case notification rates were significantly higher than in non-Aboriginal people (6.0 and 1.1 per 100 000, respectively) (Figure 1). Measles cases were notified in 10 local health districts (LHDs); the highest rate was in the Greater Southern LHD (10 cases, 4.9 per 100 000 population) (Table 2).

Of the 90 cases, 50 (56%) were unvaccinated, 18 (20%) were vaccinated, and 22 (24%) had missing vaccination status. Of the 18 vaccinated cases, five (all aged 15–35 years) had two documented doses, three one dose only and 10 did not have information on the number of doses of vaccine that they had received. Of the five fully vaccinated case-patients, vaccination history was validated by written records in three (one through the Australian Childhood Immunisation Register and two their personal health record), and for two based on self-report only. None of the nine case-patients who acquired their infection overseas had documented evidence of measles vaccination.

During the past decade, measles has been rare in NSW compared with the period before the 1998 Measles Control Campaign, with outbreaks primarily occurring in under-immunised populations and international travellers. Of the 90 cases notified in 2011, 12 (13%) were acquired overseas, 11 (12%) were epidemiologically linked to these cases, while in 67 (74%) no link to an overseas-acquired case could be established. Among clusters in metropolitan Sydney, repeat presentations of case-patients to health settings prior to diagnosis were common. Source case-patients were retrospectively identified in emergency departments in several clusters. In two clusters, case-patients were children overdue for immunisation.[3,4]

In Western Sydney LHD, 26 cases (23 locally acquired) were notified from one local government area. Twelve of these were children from Pacific Islander communities, seven of whom attended the same high school. In Southern NSW LHD there were seven cases notified in an outbreak centred on a high school with low vaccination coverage in the Australian Capital Territory.

Internationally, there are eight different clades and 24 subclades of measles viruses referred to as genotypes.[5] In 2011, 34 (38%) cases had measles genotyping results. Of these, five (15%) were measles genotype D8, seven (21%) were measles genotype D4 and 22 (65%) were measles genotype D9. Travel to France and Italy was associated with measles genotype D4 while travel to the Philippines was associated with measles genotype D9. In recent years, the measles virus D9 genotype has been identified in Europe and as endemic in selected countries of the Asia-Pacific region, while measles virus D4 and D8 genotypes have been identified more widely.[1]

Meningococcal disease (invasive)

In 2011, 72 cases of invasive meningococcal disease were notified in NSW (62 confirmed and 10 probable), compared with 76 cases notified in 2010. Four deaths among case-patients were notified in 2011 across a wide age range, including: one infant aged less than 1 year, one 45–49-year old, one 70–75-year old and one 80–85-year old (all caused by serogroup B). This compares to five deaths in 2010 (three caused by serogroup B, one serogroup W135, and one with an unknown serogroup).

The highest case notification rates of invasive meningococcal disease were among children aged less than 5 years at onset of illness (25 cases, 5.2 per 100 000 population) and young people aged 20–24 years (10 cases, 2.0 per 100 000 population) (Figure 2). Of the case notifications among children aged less than 5 years, the highest rates

Table 2. Number and rate per 100 000 population of case notifications for selected vaccine-preventable diseases, for all local health districts, NSW, 2011

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
Sydney	0	0	9	1.6	6	1	10	1.7	585	101.2	38	6.6	3	0.5	1	0.2
South Western Sydney	0	0	11	1.3	7	0.8	5	0.6	1231	139.9	51	5.8	2	0.2	0	0
South Eastern Sydney	0	0	12	1.4	5	0.6	16	1.9	1316	157	71	8.5	4	0.5	0	0
Illawarra Shoalhaven	0	0	12	3.1	6	1.5	1	0.3	1071	275.7	35	9	0	0	0	0
Western Sydney	0	0	26	3.1	7	0.8	12	1.4	1507	181	40	4.8	3	0.4	0	0
Nepean Blue Mountains	0	0	0	0	4	1.2	3	0.9	1150	332.7	36	10.4	0	0	0	0
Northern Sydney	0	0	2	0.2	9	1.1	9	1.1	1554	185.1	51	6.1	3	0.4	0	0
Central Coast	0	0	3	0.9	2	0.6	0	0	347	109	25	7.9	1	0.3	0	0
Hunter New England	2	0.2	2	0.2	15	1.7	0	0	776	88.2	70	8	1	0.1	0	0
Northern NSW	2	0.7	3	1	1	0.3	4	1.3	698	234.3	19	6.4	0	0	0	0
Mid North Coast	0	0	0	0	0	0	1	0.5	316	147.8	9	4.2	0	0	0	0
Southern NSW	0	0	10	4.9	1	0.5	2	1	435	214.7	16	7.9	0	0	0	0
Murrumbidgee (including Albury)	0	0	0	0	3	1	1	0.3	1286	440.2	18	6.2	0	0	0	0
Western NSW	0	0	0	0	6	2.2	0	0	707	263.2	41	15.3	0	0	0	0
Far West	0	0	0	0	0	0	0	0	53	170.1	2	6.4	0	0	0	0

Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

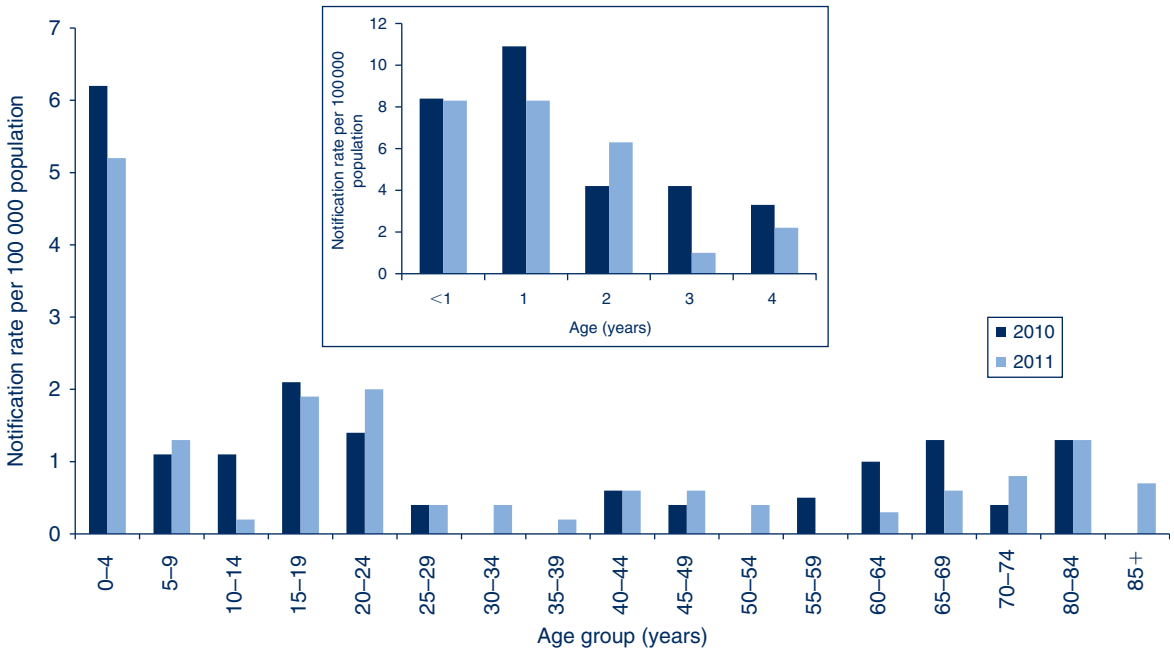

Figure 2. Comparison of annual case notification rates per 100 000 population for invasive meningococcal disease by 5-year age groups, NSW, 2010 and 2011. Comparison of annual case notification rates per 100 000 population for children aged less than 5 years for each year of age, NSW, 2010 and 2011, presented inset.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

were reported from children aged 13–24 months (eight cases, 8.3 per 100 000 population) and infants aged less than 12 months (eight cases, 8.3 per 100 000 population).

In 2011, 36 case-patients (50%) with invasive meningococcal disease were male. Seven case-patients were Aboriginal people, amongst whom notification rates were 4.6 times higher (95% CI 2.1, 10.0) than in non-Aboriginal people (4.2 and 0.9 per 100 000, respectively) (Figure 1). Geographically in NSW, the highest case notification rates were from Western NSW LHD (2.2 per 100 000 population).

Of the 72 cases notified in NSW in 2011, serogroup information was recorded for 54 (75%). Of these 54 case-patients, for 44 (81%) disease was caused by serogroup B infection (for which there is no vaccine); 32% of these case-patients were aged less than 5 years, 57% were >5 years and <65 years of age, and 11% were >65 years of age. For four case-patients (7%), disease was caused by serogroup Y infection; of these people three were aged less than 25 years of age and one was aged between 25 and 80 years. For four case-patients (7%), disease was caused by serogroup W135 infection (of these people three were less than 2 years of age and one was aged between 2 and 40 years). Only two case-patients (4%) had disease caused by serogroup C infection, one aged 32 years, the other 69 years – both were ineligible for vaccination and were not vaccinated. Of the 18 cases (25%) of unknown serogroup, two were unable to be typed and eight had clinical findings consistent with meningococcal disease but no laboratory confirmation. Of the seven case-patients who were Aboriginal people, for four disease was due to serogroup B infection, two W135 infection and one due to serogroup Y. Information describing vaccination status was complete for 54 case-patients (75%); there were no cases caused by serogroup C among people who had been vaccinated against serogroup C.

Mumps

In 2011, 65 cases of mumps were notified in NSW compared to 39 in 2010. The highest case notification rates of mumps were among young adults aged 20–24 years at onset of illness (11 cases, 2.2 per 100 000 population). In 2011, 35 case-patients (54%) were male.

In NSW, notified cases of mumps are not routinely followed up by public health units. No outbreaks of mumps were reported in 2011.

Pertussis

In 2011, 13 053 cases of pertussis were notified in NSW (the highest level on record), compared with 9332 in 2010. The highest age-specific pertussis case notification rates were in children aged 5–9 years (4120 cases, 923.1 per 100 000 population) and 10–14 years (2334 cases, 514.7 per 100 000 population), an increase from 2010 when 2744 cases (620.0 per 100 000 population) and 1627 cases (359.4 per 100 000 population) were notified in the 5–9 and 10–14-year age groups respectively (Figure 3). The greatest increase from 2010 to 2011 was among children aged 6 years (958.0 per 100 000 population in 2011

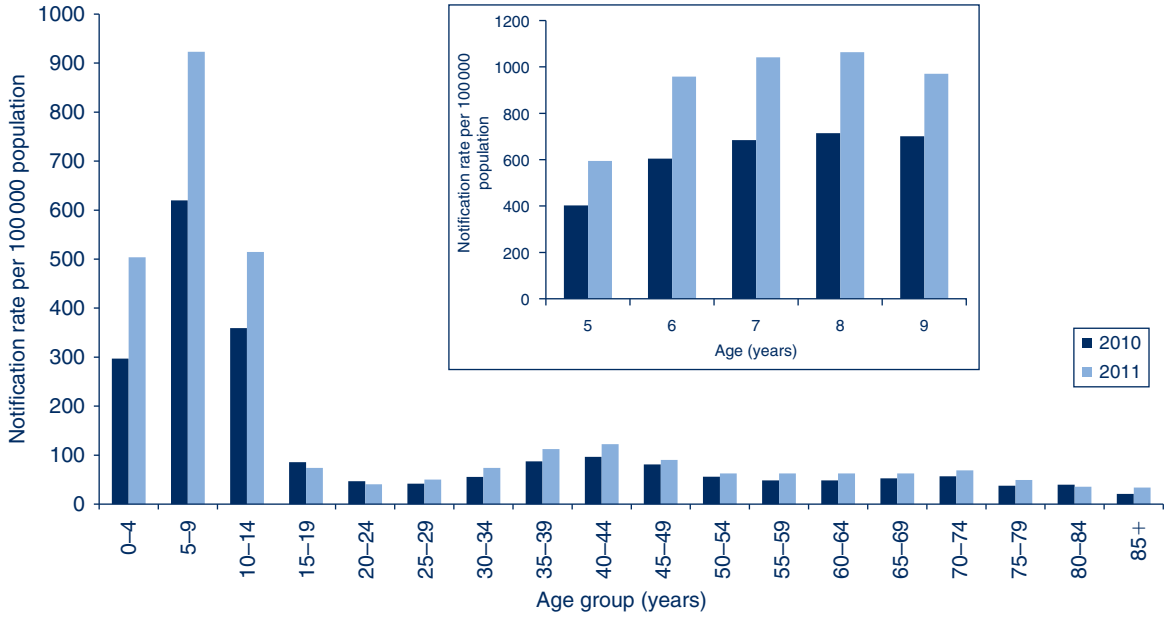

Figure 3. Comparison of annual case notification rates per 100 000 population for pertussis by 5-year age groups, NSW, 2010 and 2011. Annual case notification rates for children aged 5–9 years for each year of age, NSW, 2009 and 2010, presented inset.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

compared to 604.0 per 100 000 population in 2010) and 7 years (1041.8 per 100 000 population in 2011 compared to 683.9 per 100 000 population in 2010). Of the case-patients aged less than 5 years, the highest notification rates were in children aged 3 years (588 cases, 601.8 per 100 000 population) and 2 years (529 cases, 554.1 per 100 000 population). One death was reported in a 1-month old infant, who was too young to be vaccinated.

In 2011, 5939 case-patients (45%) were male. Of the 2403 case-patients aged 0–4 years (who are followed up by public health units), 132 (5%) were Aboriginal children. Geographically, the highest case notification rates were reported in Murrumbidgee (including Albury) (440.2.0 per 100 000 population) and Nepean Blue Mountains (332.7 per 100 000 population) LHDs.

In total, 520 case-patients were aged less than 12 months. Of these, 309 (59%) were infants too young to have received three doses of vaccine (i.e. aged 6 months or less at onset of illness). Of the 1885 case-patients who were children aged 1–4 years, 247 (7%) were reported to be not immunised, 31 (2%) reported less than three doses of vaccine, and 1618 (86%) reported three or more doses. For the remainder of case-patients (5%) data on vaccine doses was not reported.

Pneumococcal disease (invasive)

In 2011, 524 cases of invasive pneumococcal disease were notified compared to 500 in 2010. Fifty-seven deaths were identified in 2011: one case-patient who died was a child aged less than 2 years who was fully vaccinated (due to disease caused by a serotype that was not included in the vaccine), nine case-patients who died were aged between 80 and 84 years and 15 were aged 85 years and over.

The highest case notification rates of invasive pneumococcal disease were in adults aged older than 85 years (55 cases, 37.9 per 100 000 population) and 80–85 years (40 cases, 26.3 per 100 000 population), and in children aged less than 5 years (70 cases, 14.7 per 100 000 population) (Table 1). Of the case-patients less than 5 years of age, the highest notification rates were in infants aged less than 12 months (21 cases, 21.8 per 100 000 population) and children aged 12–23 months (20 cases, 20.8 per 100 000 population).

Fifty-two percent of case-patients were male. Of the 383 case-patients aged 0–4 years or older than 50 years (who are followed up by public health units), 12 (3%) were Aboriginal people. Geographically, the highest notification rates were reported in Western NSW (41 cases, 15.3 per 100 000 population), Nepean Blue Mountains (36 cases, 10.4 per 100 000 population) and Illawarra Shoalhaven (35 cases, 9.0 per 100 000 population) LHDs (Table 2).

From 1 July 2011, 13-valent conjugate pneumococcal vaccine (PCV-13) replaced 7-valent conjugate pneumococcal vaccine (PCV-7) on the NSW Immunisation Program. The PCV-13 vaccine includes the additional serotypes 1, 3, 5, 6A, 7F and 19A.

Rubella

In 2011, 17 cases of rubella were notified in NSW compared to 13 in 2010. All case-patients were people aged between 15 and 60 years. Seven case-patients (41%)

were male. Geographically, the highest notification rates were in the Sydney LHD (0.5 per 100 000 population). Notifications have not changed over the previous 5 years. There were no case notifications of congenital rubella.

Tetanus

In 2011, one case of tetanus was notified in NSW. This case-patient resided in Sydney LHD and was an 18-year old male who reported being vaccinated 12 years ago.

The number of notified cases of tetanus has remained relatively stable over the past 5 years, ranging from 1 to 2 cases annually. Most tetanus cases occur in older adults who are not adequately immunised. This was the youngest case-patient notified in the last decade in NSW.

Discussion

While there are limitations to the data,[1] vaccine-preventable disease surveillance in NSW enables the implementation of timely public health measures, permits a better understanding of disease trends and helps inform policy. Notifications of some vaccine-preventable diseases (such as *H. influenzae* serotype b, invasive meningococcal disease, pneumococcal disease, mumps and rubella) have remained stable or declined over recent years.

Outbreaks of measles continue to occur, mostly as a result of people who are unvaccinated or have incomplete vaccinations travelling to countries where measles transmission is common and then returning home whilst infectious or during their incubation period. As measles is a highly infectious disease, local transmission can occur among the susceptible members of the contact network of these travellers, including infants too young to be protected through vaccination. In addition, there were 67 cases (including 11 clusters affecting 32 people) with no direct links to overseas travel. These cases were therefore thought to be locally acquired from infectious measles patients that may not have been diagnosed or sought medical attention. This highlights the challenges to comprehensive identification and notification of cases of measles where many clinicians may not have previously seen or diagnosed measles.

Pertussis remains an important public health problem in NSW. Public health activities should focus on the prevention of severe disease (which frequently occurs in young infants) and death (which mostly occurs in infants less than 2 months of age). One important recommendation (according to the Australian Immunisation Handbook) is that new parents, grandparents and adult carers of infants are vaccinated.[6] While vaccine-induced selection pressure on pertussis strains has been suggested as a possible explanation for the significant increases in notifications in Australia in recent years,[7] this is unconfirmed. The greater contribution is likely to have been increased (and more sensitive) testing for pertussis.[8] Vaccination remains the key prevention and control tool, especially in the prevention of severe pertussis and death.

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 45 cases (29% of those with known serogroup) in 2003, to less than 10 cases annually over the last 5 years, and two cases (4% of those with known serogroup) in 2011. The number of cases of meningococcal disease associated with serogroup B has also decreased over time, but remains the most commonly identified serotype. The notifications of other serogroups (W135 and Y) have remained relatively stable over time.

Vaccine-related invasive pneumococcal disease (IPD) has diminished since the introduction of the 7-valent conjugate pneumococcal vaccine (PCV-7) in 2005, whilst serotypes not covered by the PCV-7 have been steadily increasing. Serotypes 1, 3, 6A, 7F and 19A (included in the 13-valent pneumococcal vaccine (PCV-13)) have been responsible for up to 59% (predominantly serotype 19A: 36%) of IPD in children aged less than 5 years since 2005. Following the introduction of PCV-13 in 2011, further reduction in IPD is expected in children. It remains to be seen whether similar reductions in IPD due to serotypes covered by PCV-13 in people aged >5 years will be equivalent to those seen with PCV-7.

Conclusion

This review demonstrates the value in ongoing systematic collection of vaccine-preventable disease data to highlight the challenges as well as significant improvements in disease control over time. While vaccine-preventable diseases remain generally well controlled in NSW, challenges remain to ensure ongoing population health protection. High vaccination coverage and timely vaccination for infants and children is important to maintain low rates of disease. Improving vaccination coverage among people from culturally and linguistically diverse communities as well as Aboriginal communities is crucial for successful disease prevention strategies. In addition, individuals planning international travel who are susceptible to measles or other vaccine-preventable diseases should be encouraged to receive relevant vaccinations prior to their departure. As cases of some diseases like measles have become rare, it is increasingly important to raise awareness among clinicians, and those training to be clinicians, of the diagnostic features and to have routine infection control practices in place to minimise transmission in health care settings.

Acknowledgments

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*The *Public Health Act 2010* (NSW) (http://www.health.nsw.gov.au/phact/)
The *Public Health Act 2010* (NSW) was passed by the NSW Parliament in December 2010 and commenced on 1 September 2012. The Public Health Regulation 2012 was approved in July 2012 and commenced, along with the *Public Health Act 2010* (NSW), on 1 September 2012. The objectives of the Regulation are to support the smooth operation of the Act. The Act carries over many of the provisions of the *Public Health Act 1991* (NSW) while also including a range of new provisions.

NSW Annual Immunisation Coverage Report, 2011

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Abstract: This annual report, the third in the series, documents trends in immunisation coverage in NSW for children, adolescents and the elderly, to the end of 2011. **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. **Results:** During 2011, greater than 90% coverage was maintained for children at 12 and 24 months of age. For children at 5 years of age the improvement seen in 2010 was sustained, with coverage at or near 90%. For adolescents, there was improved coverage for all doses of human papillomavirus vaccine, both doses of hepatitis B vaccine, varicella vaccine and the dose of diphtheria, tetanus and acellular pertussis given to school attendees in Years 7 and 10. Pneumococcal vaccination coverage in the elderly has been steadily rising, although it has remained lower than the influenza coverage estimates. **Conclusion:** This report provides trends in immunisation coverage in NSW across the age spectrum. The inclusion of coverage estimates for the pneumococcal conjugate, varicella and meningococcal C vaccines in the official coverage assessments for 'fully immunised' in 2013 is a welcome initiative.

This is the third *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 2008.[1]

The Australian Childhood Immunisation Register was established on 1 January 1996 by incorporating demographic data from Medicare on all Medicare-registered children aged less than 7 years.[2] The operations of the Australian Childhood Immunisation Register have been discussed in detail elsewhere.[3]

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.[3] 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.

Table 1 presents the vaccines delivered through the NSW Immunisation Program for children in 2011. The only new vaccine to be introduced into the NSW Immunisation Program in 2011 was the 13-valent pneumococcal conjugate vaccine, Prevenar 13®, which replaced Prevenar®, the 7-valent vaccine, on 1 July.

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 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

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

October 2011 – Children aged between 12 and 35 months who have completed a primary pneumococcal vaccination course with Prevenar® (7-valent pneumococcal conjugate vaccine, 7vPCV) were eligible to receive a free supplementary dose of Prevenar 13® (13-valent pneumococcal conjugate vaccine, 13vPCV) from 1 October 2011 to 30 September 2012.

July 2011 – Prevenar 13® (13-valent pneumococcal conjugate vaccine, 13vPCV) replaced Prevenar® (7-valent pneumococcal conjugate vaccine, 7vPCV) on the National Immunisation Program for children at 2, 4 and 6 months of age in all states and territories except the Northern Territory (which replaced 10vPCV with 13vPCV from 1 October 2011).

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

October 2009 – The recommendation by the Australian Technical Advisory Group on Immunisation 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 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 2011

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

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; PCV: pneumococcal conjugate vaccine (7vPCV till 30 June 2011, 13vPCV from 1 July 2011 onwards); Men C: meningococcal C vaccine; HPV: human papilloma virus vaccine (females only); Flu: influenza vaccine; 23vPCV: 23-valent pneumococcal polysaccharide vaccine.
[a]Catch-up only.
[b]For Aboriginal people only.
[c]Aboriginal adults with medical risk factors.
[d]Annual vaccination, all aged ≥6 months with medical risk factors, non-Aboriginal adults ≥65 years.
Source: National Immunisation Program Schedule.

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. Vaccines included were those used nationally for the purposes of incentive payments. '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, 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. 'Fully immunised' at 24 months of age was defined as three or four doses of a DTP-containing vaccine, three doses of polio vaccine, three or four doses of PRP-OMP containing Hib vaccine or four doses of any other Hib vaccine, three or four doses of Comvax® hepatitis B vaccine or four doses of all other hepatitis B vaccines, and one dose of a measles- mumps- and rubella (MMR)-containing 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.

Previous reports included analysis by local health district (LHD), data on other National Immunisation Program vaccines not included in 'fully immunised' calculations (pneumococcal conjugate vaccine, rotavirus vaccine, varicella vaccine and meningococcal C vaccine), vaccination timeliness and data comparing Aboriginal and non-Aboriginal children. However, it was not possible to include these analyses in this report due to a review by the Department of Health and Ageing of processes for releasing data from the Australian Childhood Immunisation Register.

Coverage in adolescents and the elderly

Information describing coverage for vaccines given to adolescents was collected from the NSW School Immunisation Program. Vaccination status is recorded by school immunisation teams and counts are collated by LHDs and NSW Health. The denominator is the number of school enrolments at the start of the year. 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.[7] For varicella and hepatitis B vaccines, students who were not vaccinated due to previous vaccination or varicella infection are included in the denominator. The proportion of these students is unknown.

Influenza and pneumococcal vaccination coverage estimates in the elderly 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 4732 and 4395 respondents in NSW, respectively. Methods and results are presented in more detail elsewhere.[8]

Table 2. Percentage of children immunised at 12 months, 24 months and 5 years of age, by vaccine, in NSW compared with Australia, 2011

Vaccine	Milestone age (months)	NSW %	Australia %
Diphtheria, tetanus, pertussis	12[a]	92.1	92.1
	24[b]	94.5	94.6
	60[c]	90.1	90.0
Poliomyelitis	12[a]	92.1	92.1
	24[b]	94.4	94.5
	60[c]	90.1	90.0
Haemophilus influenza type b	12[a]	91.7	91.8
	24[b]	94.7	94.6
	60[c]	NI	NI
Hepatitis B	12[a]	91.7	91.6
	24[b]	94.0	94.0
	60[c]	NI	NI
Measles-mumps-rubella	12[a]	NI	NI
	24[b]	93.7	93.9
	60[c]	90.0	89.9
Fully immunised	12[a]	91.3	91.4
	24[b]	92.0	92.2
	60[c]	89.6	89.5

[a]Birth cohort born 1 January 2010–31 December 2010: Three doses of a diphtheria, tetanus and pertussis (DTP)-containing 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]Birth cohort born 1 January 2009–31 December 2009: Three or four doses of a diphtheria, tetanus and acellular pertussis-containing vaccine, 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.
[c]Birth cohort born 1 January 2006–31 December 2006: Four or five doses of a diphtheria, tetanus and acellular pertussis-containing vaccine, four doses of polio vaccine, and two doses of a measles-mumps- and rubella-containing vaccine.
NI: this vaccine at this age milestone is not included in the calculation of coverage estimates.
Source: Australian Childhood Immunisation Register.

Results

Overall coverage estimates

In NSW, coverage for all individual vaccines for the 12-month age group is greater than 91%. Similarly, for

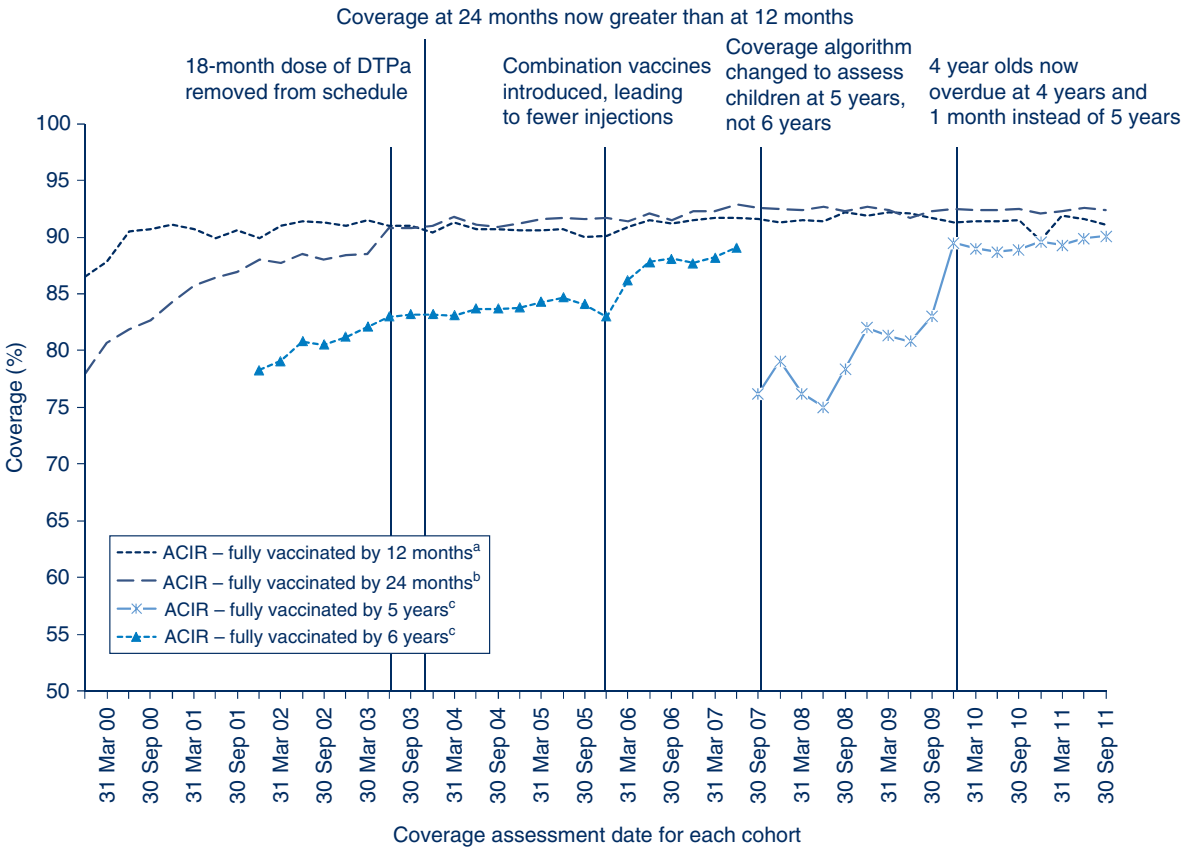

Figure 1. Trends in 'fully immunised'[a,b,c] vaccination coverage, NSW, 2000–2011, for four age cohorts of children.

[a]Three doses of a diphtheria, tetanus and acellular petussis-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.

the 24-month age group, coverage for all individual vaccines is also higher than 90%. Recorded coverage for the 5-year age group is higher than 90% for all vaccines (Table 2). 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 during 2010 and remained at that level during 2011.

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 92% (Figure 2) for the 12-month age group and approximately 95% (Figure 3) for the 24-month age group. These newer estimates more accurately reflect the true proportion of children fully vaccinated for these vaccines. Also in 2011, coverage for the MMR vaccine for the 24-month age group was around 94% (Table 2).

Coverage estimates for children aged 5–6 years

The trends in childhood vaccination coverage in NSW for individual vaccines (DTPa, polio and MMR) at 5 years of age (6 years of age prior to 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

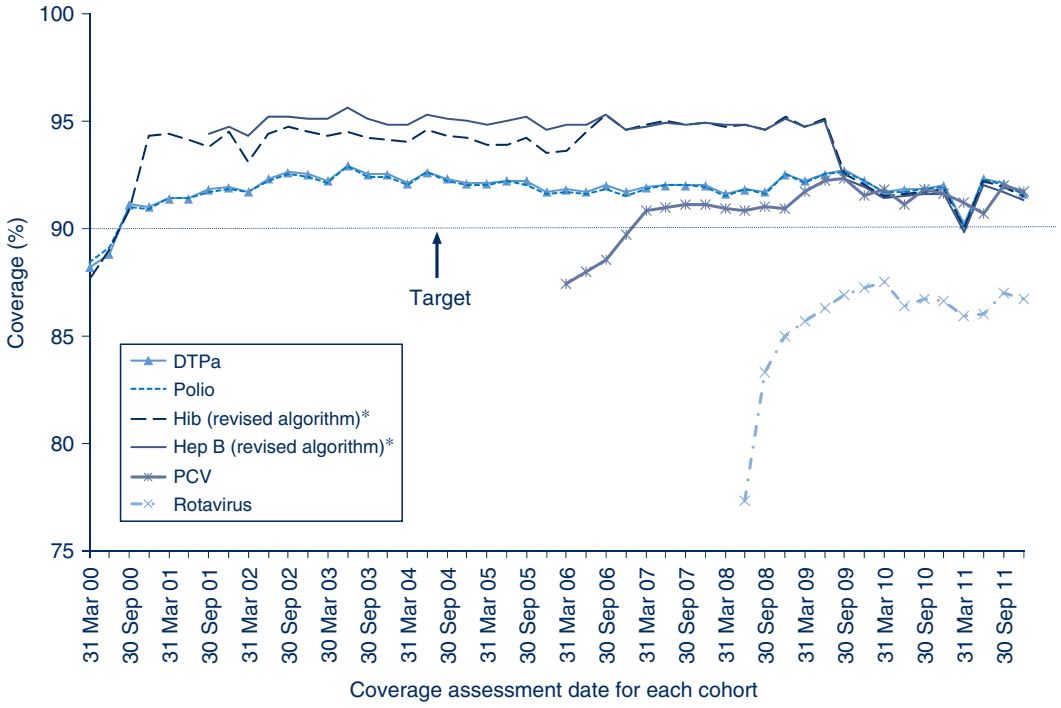

Figure 2. Trends in 'fully immunised' coverage estimates for individual vaccines at 12 months of age (third dose of DTPa, polio, hepatitis B and Hib), NSW, 2000–2011.

By 3-month birth cohorts born between 1 January 1999 and 31 December 2010. Coverage assessment date was 12 months after the last birth date of each cohort.
*Prior to December 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 December 2009, changes to the algorithm were made to tighten the rules regarding 'fully immunised' for Hib and hepatitis B vaccines.
DTPa: diphtheria, tetanus, pertussis (acellular) – paediatric formulation
Hep B: hepatitis B
PCV: pneumococcal conjugate vaccine

Source: Australian Childhood Immunisation Register.

recording of delayed vaccinations. However, in 2011, the 5-year coverage for DTPa, polio and MMR increased markedly to be slightly above 90% following a change to due and overdue rules. The overall 'fully immunised' rate for 5-year coverage was 89.6% in NSW, which was similar to the national 5-year coverage rate of 89.5% (Table 2). However, at 5 years of age, the proportion recorded as being 'fully immunised' was lower than that at earlier age milestones.

Coverage in adolescents

NSW Adolescent Vaccination Program coverage data for high school students for 2011 by LHD are shown in Table 3. For NSW, coverage varied 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. In 2011, coverage in adolescents increased for all vaccine types and doses compared to the previous year.[9] The greatest improvement was seen with varicella vaccine, with coverage increasing 13 percentage points from 32% to 45%. Vaccine coverage in adolescents varied by LHD (Table 3).

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 at over 70% in NSW during the period 2002–2011. However, pneumococcal vaccination (23-valent pneumococcal polysaccharide vaccine, 23vPPV) in the previous 5 years remained lower than the influenza coverage estimates. The highest coverage estimate for pneumococcal vaccination in the elderly was observed in 2006 at 61%, the year after its inclusion on the National Immunisation Program (Figure 5). Coverage in 2011 was 60%. Vaccine coverage in the elderly varied by LHD (Table 4).

Discussion

These data reveal that 90% coverage benchmarks have been reached for children at both 12 and 24 months of age for NSW. During 2011, there was an increase in coverage at the 5-year milestone, to approximately 90%.

Coverage at 24 months of age exceeds that at 12 months in NSW. This is likely related to the greater period of time

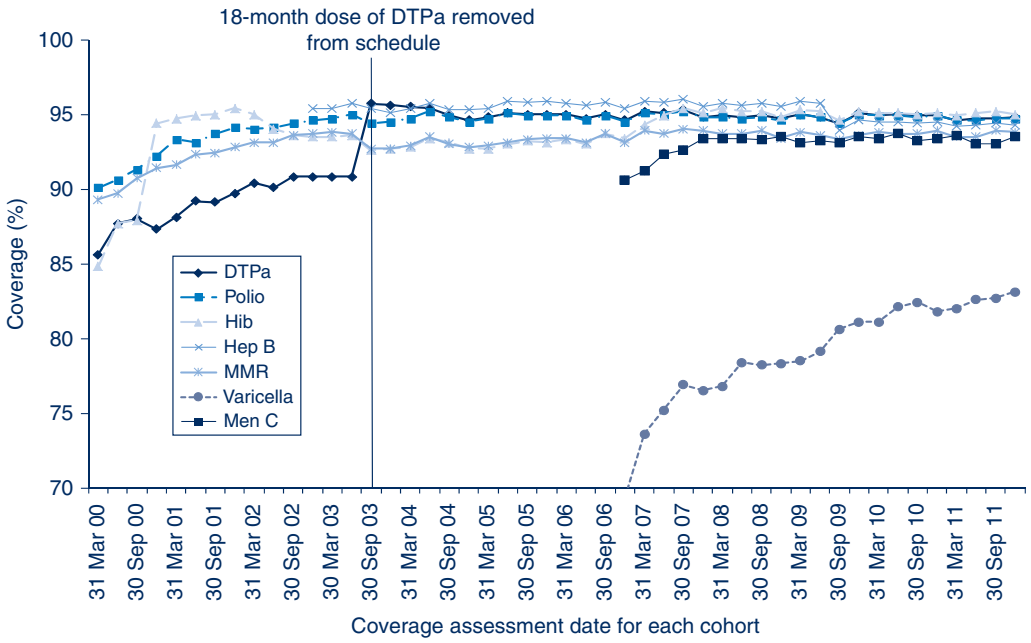

Figure 3. Trends in 'fully immunised' coverage estimates for individual vaccines at 24 months of age (DTPa, polio, hepatitis B, Hib, MMR, varicella, Men C),[a] for NSW 3-month birth cohorts between 2000 and 2011.

By 3-month birth cohorts born between 1 January 1999 and 31 December 2009. 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; one dose of MMR).
DTPa: diphtheria, tetanus, pertussis (acellular) – paediatric formulation
Hep B: hepatitis B
Hib: *Haemophilus influenzae* type b
Men C: Meningococcal C
MMR: measles-mumps-rubella

Source: Australian Childhood Immunisation Register.

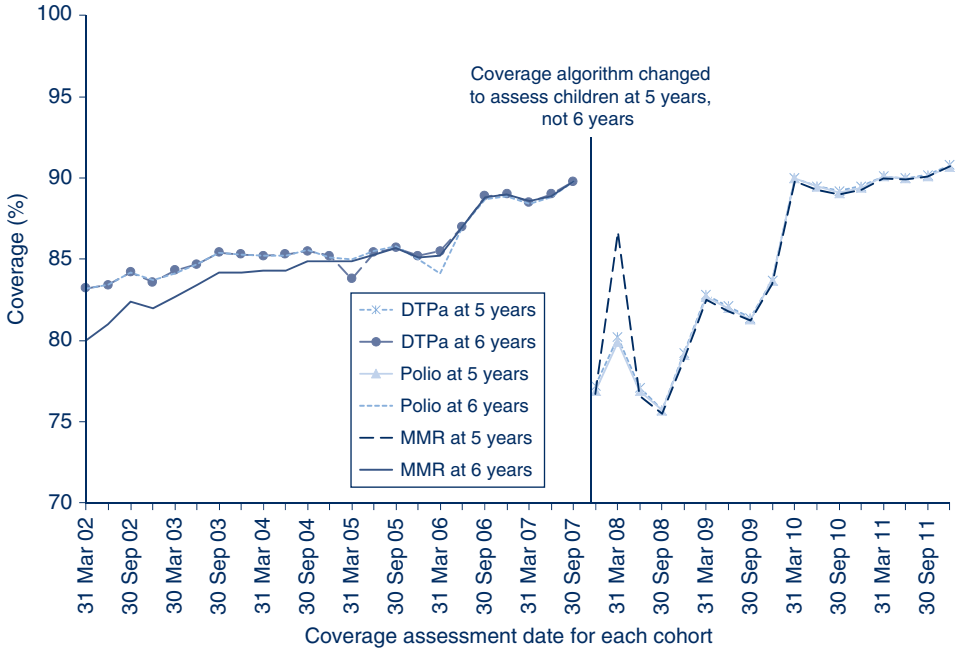

Figure 4. Trends in 'fully immunised' coverage estimates for individual vaccines (DTPa, polio and MMR)[a] at 5 years of age (6 years up to December 2007) in NSW.

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.

Table 3. Vaccination coverage estimates for individual vaccines, NSW adolescent school attendees in NSW, 2011

Vaccine	Local Health District[a]																Total doses administered
	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NN %	NS %	SES %	SN %	SWS %	SYD %	WN %	WS %	NSW %	*N*
HPV dose 1[b]	88	68	81	77	80	85	78	73	82	80	78	83	81	83	81	81	34 524
HPV dose 2[b]	82	61	75	70	74	82	72	67	77	75	72	82	80	81	76	76	32 582
HPV dose 3[b]	77	56	68	63	65	75	68	59	75	70	68	78	77	73	71	71	30 426
Hepatitis B dose 1[b]	71	59	66	67	75	73	64	70	60	86	69	69	66	73	64	68	30 426
Hepatitis B dose 2[b]	66	47	59	59	64	66	58	61	57	81	60	66	63	66	59	63	53 517
dTpa[b]	89	70	80	70	76	77	74	70	79	87	70	72	76	74	77	77	65 756
Varicella[b]	52	51	52	36	49	48	44	45	37	48	34	43	43	43	48	45	38 409
dTpa[c]	77	61	70	60	65	66	61	73	67	61	64	62	71	68	66	66	57 633

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

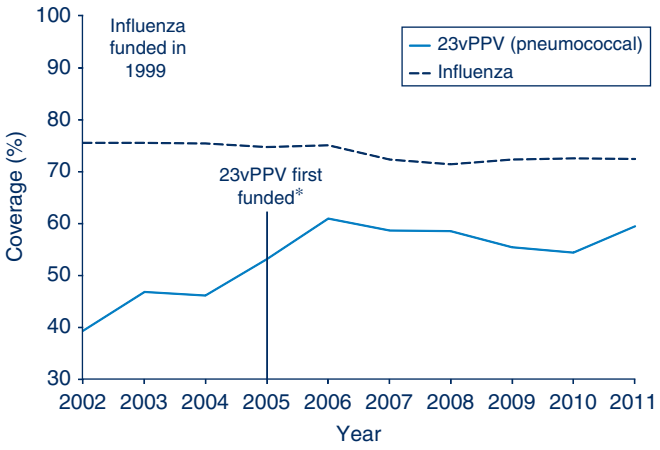

Figure 5. Trends in vaccination coverage estimates for individual vaccines (23vPPV and influenza) for adults aged 65 years and over[a] in NSW, vaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months, 2002–2011.

[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 2011 (HOIST). Centre for Epidemiology and Evidence, NSW Ministry of Health.

between due date and assessment time (12 and 6 months respectively), and potentially the maternity incentive payment assessed at 18–24 months. The continued improvement in coverage at 5 years of age is due to further 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 is also possible that the splitting of the Maternity Immunisation Allowance in 2011 could have affected these data, as it applied to children turning 4 years from 2011 onwards.

It should be noted that at present several vaccines on the National Immunisation Program schedule are not included in the assessment of 'fully immunised' (i.e. PCV, meningococcal C, rotavirus and varicella). This annual report does not provide coverage data on these vaccines. Only data for the more longstanding and established vaccines are provided to Medicare Locals, public health units and immunisation providers. As these non-assessable vaccines have been routinely incorporated into the childhood immunisation schedule for some time, their inclusion in the official coverage assessments for 'fully immunised' (except for rotavirus vaccine) has been made policy by the Department of Health and Ageing and is effective from 1 July 2013. This will facilitate more complete 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'.

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.[7] Coverage for

Table 4. Vaccination coverage estimates for individual vaccines (23vPPV and influenza) for adults aged 65 years and over in NSW, vaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months, 2011

Population surveyed and vaccine	Local Health District[a]																Total doses administered *N*
	CC %	FW %	HNE %	IS %	MN %	MM %	NBM %	NN %	NS %	SES %	SN %	SWS %	SYD %	WN %	WS %	NSW %	
Influenza (males)	76	67	74	67	75	73	70	69	76	71	75	71	66	66	70	72	4732
Influenza (females)	76	70	78	78	74	73	73	74	69	74	75	71	73	79	68	74	
Pneumococcal (males)	60	48	61	55	59	60	46	53	57	49	57	47	47	54	50	54	4395
Pneumococcal (females)	64	52	66	64	60	57	58	65	56	58	63	54	56	63	56	60	

[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.
Source: NSW Population Health Survey 2011.

varicella is lower than other vaccines in all other jurisdictions as well as NSW. This is likely due to a combination of students not vaccinated due to previous clinical history of chickenpox, students with previous receipt of varicella vaccine, and perceived less serious clinical outcomes. The change in advice given to parents about the need for a dose at 12 years of age that occurred in 2011 may also have had an impact. Coverage for all adolescent vaccines increased from 2010 to 2011.

Coverage for the elderly has been consistently high for influenza vaccine, but less so for pneumococcal vaccine, perhaps due to greater awareness of the yearly influenza vaccination programs. Uptake of pneumococcal vaccine in 2011 is likely to have been negatively affected by reported adverse events in that year and the associated temporary suspension of any doses of pneumococcal vaccine in NSW. These results may also be partly explained by an Australian study in the elderly that found, in comparison to written records held by immunisation providers, a telephone survey over-estimated influenza coverage in the elderly by 3%, and under-estimated pneumococcal coverage by 8%.[10]

Conclusion

Data provided in this report by the Australian Childhood Immunisation Register 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.

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NSW Annual Report Describing Adverse Events Following Immunisation, 2011

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Abstract: Aim: This report summarises Australian passive surveillance data for adverse events following immunisation in NSW for 2011. **Methods:** Analysis of de-identified information on all adverse events following immunisation reported to the Therapeutic Goods Administration. **Results:** 449 adverse events following immunisation were reported for vaccines administered in 2011; this is slightly higher than in 2010 ($n = 439$) and the second highest number since 2003. The most commonly reported reactions were injection site reaction, fever, allergic reaction and malaise. A large number of injection site reactions were reported following administration of the 23-valent pneumococcal polysaccharide vaccine in adults aged 65 years and over (97.4/100 000 doses) and in children aged less than 7 years following administration of the 13-valent pneumococcal conjugate vaccine (29.4/100 000 doses) and combined diphtheria, tetanus, pertussis (acellular) and inactivated poliovirus (quadrivalent)-containing vaccines (47.1/100 000 doses). Only 10% of the reported adverse events were categorised as serious. There were two reports of death however both were attributed to causes other than vaccination. **Conclusion:** The increased number of reports in 2011 is attributable to the high rates of injection site reactions in children associated with the administration of combined diphtheria, tetanus, pertussis (acellular) and inactivated poliovirus (quadrivalent)-containing vaccines and the 13-valent pneumococcal conjugate vaccine, as well as in adults following receipt of the 23-valent pneumococcal polysaccharide vaccine.

An adverse event following immunisation is defined as any untoward medical occurrence which follows immunisation and which does not necessarily have a causal relationship with the usage of the vaccine.[1] The adverse event may be any unfavourable or unintended sign, abnormal laboratory finding, symptom or disease.[1]

Thus, adverse events 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 particularly important to detect rare, late onset and unexpected events which are difficult to detect in pre-licensure vaccine trials.

This is the third annual report for adverse events following immunisation in New South Wales (NSW). It summarises passive surveillance data reported from NSW in 2011 and describes reporting trends over the 12-year period 2000–2011. 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.[2–10] Two recent changes influenced the adverse events surveillance data presented in this report:

(i) From 1 July 2011, Prevenar 13® (13-valent pneumococcal conjugate vaccine, 13vPCV) replaced Prevenar® (7-valent pneumococcal conjugate vaccine, 7vPCV) on the National Immunisation Program for children at 2, 4 and 6 months of age in all states and territories except the Northern Territory (which adopted 13vPCV from 1 October 2011).[11] Children aged 12–35 months who had completed a primary pneumococcal vaccination course with 7vPCV are eligible to receive a free supplementary dose of Prevenar 13® from 1 October 2011 to 30 September 2012.

(ii) On 25 March 2011, the Therapeutic Goods Administration issued a recall of Batch N3336 of Pneumovax® 23 (23-valent pneumococcal polysaccharide vaccine, 23vPPV) as a precautionary measure following an increased number of reports of adverse reactions in patients who had received the vaccine.[12] Further

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

advice to health professionals not to administer a second or subsequent dose of Pneumovax® 23 vaccine was provided in April 2011.[13] Revised recommendations regarding which patients should be re-vaccinated under the National Immunisation Program was provided in December 2011.[14]

Methods

Adverse events following immunisation (AEFI) are notifiable to public health units by medical practitioners and hospital Chief Executive Officers under the NSW *Public Health Act 1991*.* Case-patients with outstanding information and all serious adverse events are followed up by public health units and the NSW Ministry of 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]

AEFI data

All reports are assessed by the Therapeutic Goods Administration (TGA) using internationally-consistent criteria[17] and entered into the Australian Adverse Drug Reaction Reporting System database. 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 Reaction Reporting System database. This may occur if there is a time sequence of separate adverse reactions in a single patient.

Typically, each AEFI record lists several symptoms, signs and diagnoses that have been coded by TGA staff from the description provided by the reporter into standardised terms using the Medical Dictionary for Regulatory Activities (MedDRA®).[18]

Study definitions of AEFI outcomes and reactions

AEFI records are classified by medical officers within the TGA as 'suspected' to be causally related to immunisation. An AEFI record is classified as 'not suspected' and excluded from the Adverse Drug Reaction Reporting System database if: there is no reasonable temporal association between the use of a drug and the clinical event (generally described 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.

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.

AEFIs were defined as 'serious' or 'non-serious' based on information recorded in the Australian Adverse Drug Reaction Reporting System database and using criteria similar to those used elsewhere.[17,19] 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.

Data analysis

De-identified information on AEFI reports from the Australian Adverse Drug Reaction Reporting System database was released to the National Centre for Immunisation Research and Surveillance for analysis and reporting. AEFI records contained in the Adverse Drug Reaction Reporting 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 2011; and the residential address of the individual was recorded as NSW.

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.[20]

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.[21] 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, particularly for the fourth quarter of 2011, because of reporting delays and the late onset of some reported AEFIs. Numbers are updated for previous years. The information collated in the Adverse Drug Reaction Reporting 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.[2–10]

It is important to note that this annual report is based on vaccine and reaction term information collated in the Adverse Drug Reaction Reporting 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 broadly corresponding to those listed in the 9th edition of *The Australian Immunisation Handbook*.[16]

Results

There was a total of 449 AEFI records for NSW in the Adverse Drug Reaction Reporting System database with a date of vaccination (or onset of an adverse event if vaccination date was not reported) in 2011. This was slightly higher than in 2010 ($n = 439$) but the same as the number reported in 2009 ($n = 449$). Seventy-two percent ($n = 325$) of the AEFI records during 2011 were reported in the first two quarters of the year and 42% ($n = 138$) were following the administration of 23vPPV. Of all reports, 33% ($n = 149$) were for children aged less than 7 years and 66% ($n = 297$) were for people aged 7 years and over. Seventy-nine percent of AEFIs ($n = 354$) were reported to the TGA by NSW Health and the remainder were reported directly to the TGA; 19% ($n = 87$) by doctors/other health care providers, 1% ($n = 6$) by hospitals and 0.5% ($n = 2$) by members of the public. The number of AEFI reports by members of the public was much lower in 2011 than in 2010 (21%, $n = 88$) and 2009 (33%, $n = 149$).

Reporting trends

The AEFI reporting rate for 2011 was 6.2 per 100 000 population. This is the third highest reporting rate for the period 2000–2011, after the first peak in 2003 that coincided with the implementation of the national program for meningococcal C conjugate vaccine and catch-up program and high reporting rates from the 18-month dose of DTPa; and the second peak in 2009 following the commencement of the pandemic influenza vaccine (pH1N1) program (Figure 1). Figure 1 shows the increase in reporting by the general public directly to the TGA in 2009 and 2010 which subsided in 2011, and that the majority of reported events (from all reporter types) were of a non-serious nature in all years. Figures 2 and 3 demonstrate marked variations in reporting levels in association with previous changes to the National Immunisation Program from 2000 onwards. Figures 2a and 2b show that the rise in the reporting rate in 2011 was predominantly due to reports following receipt of 7vPCV, 13vPCV (Figure 2a), and DTPa-containing vaccines (Figure 2b) in children aged less than 7 years. There was a spike in AEFI reports following adminisration of 23vPPV in adults (Figure 3).

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.

Age-specific rates

There was a decrease in the reporting rate in children aged less than 7 years in 2011 compared with 2010 (from 37.9 to 23.4 per 100 000 population). However, the reporting rates were still about 2.5 times higher than in 2009 (9.9 per 100 000 population). In 2011, the highest population-based AEFI reporting rate occurred in infants aged less than

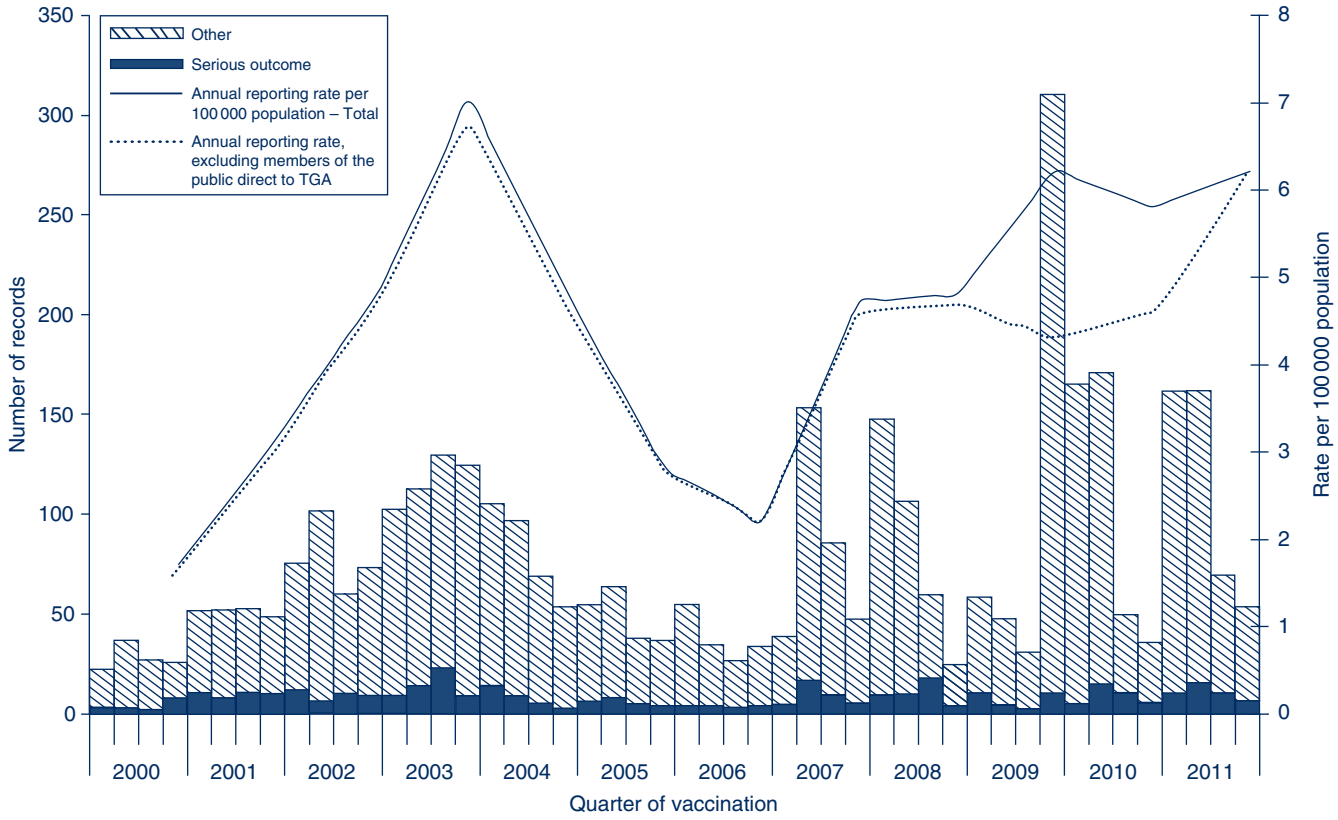

Figure 1. Reports of adverse events following immunisation, NSW, 2000–2011, by quarter of vaccination.

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 Reaction Reporting System database, Therapeutic Goods Administration.

1 year, the age group that received the highest number of vaccines (Figure 4). An increase was observed amongst those aged 7 years and over in 2011 compared to 2010 (4.5 vs 2.7 per 100 000 population respectively) and especially in adults aged 65 years and over (11.9 vs 4.2 per 100 000 population respectively).

There were increases in the reporting rates of most individual vaccines in children aged less than 7 years compared to 2010 (except Hib, varicella and MenCCV (Table 1)).[17] A significant increase was observed in adolescents (aged 12–17 years) in 2011 compared to 2010 (19.4 vs 6.7 per 100 000 doses), which was more pronounced for HPV (37.9 vs 14.1) and dTpa (24.3 vs 4.3). Reporting rates per 100 000 doses were also significantly higher for adults aged 65 years and over (14.6 vs 5.2), especially for 23vPPV (97.4 vs 23.4) (Table 1).

Vaccines

Of the 449 records, the most frequently reported individual vaccine was 23vPPV with 145 records (32%), predominantly in adults aged 65 years and over ($n = 108$) followed by 18–64 year-olds ($n = 32$). Five reports were received from those aged less than 18 years (three reports in children aged less than 7 years and two in the 12–17-year age group) (Table 1). Vaccines containing diphtheria, tetanus and acellular pertussis antigens were reported in 165 (37%) records, with dTpa (62 records, 14%), hexavalent DTPa-IPV-HepB-Hib (56 records, 12%) and DTPa-IPV (45 records, 10%) being the most frequently reported among DTPa-containing vaccines. The other frequently reported vaccines were: seasonal influenza vaccine (93 records, 21%), rotavirus (43 records, 10%), HPV and 13vPCV (42 records each, 9%), 7vPCV (32 records, 7%), MMR (29 records, 6%) and varicella (22 records, 5%) (Table 1). Of vaccines where data on doses administered could be estimated, those with the highest AEFI rates per 100 000 doses were 23vPPV for adults aged 65 years and over (97.4), DTP-IPV (47.1), HPV (37.9) and 13vPCV (29.4) (Table 1).

Reactions

The distribution and frequency of reactions listed in AEFI records for 2011 are shown in Table 2. The most frequently reported adverse events were injection site reaction (47%), fever (22%), allergic reaction (18%), malaise (11%),

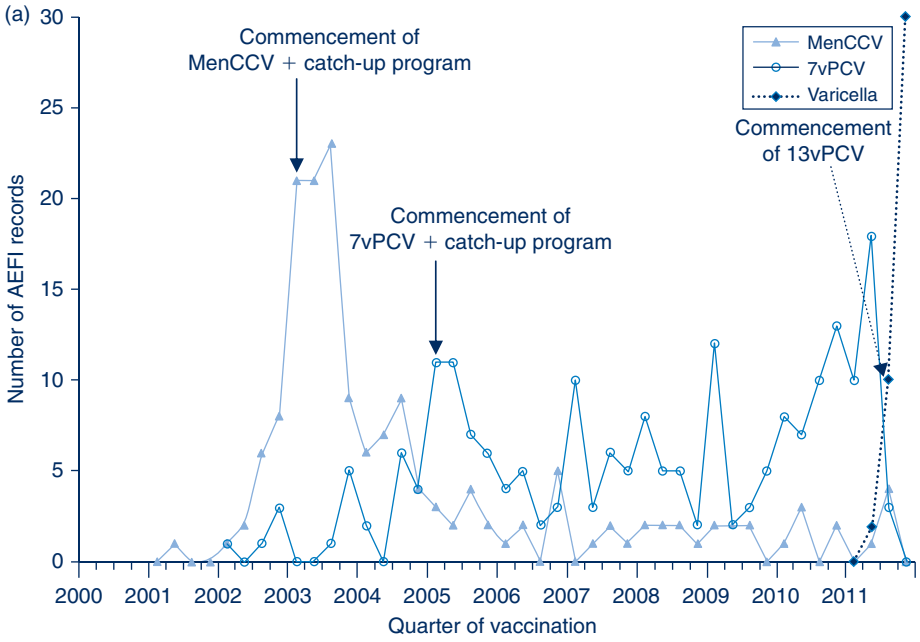

Figure 2a. Adverse events following immunisation in children aged <7 years for selected vaccines (MenCCV, 7vPCV and 13vPCV), NSW, 2000–2011, by quarter of vaccination.

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; 7-valent pneumococcal conjugate vaccine (7vPCV) on 1 January 2005; and 13-valent pneumococcal conjugate vaccine (13vPCV) on 1 July 2011.

Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

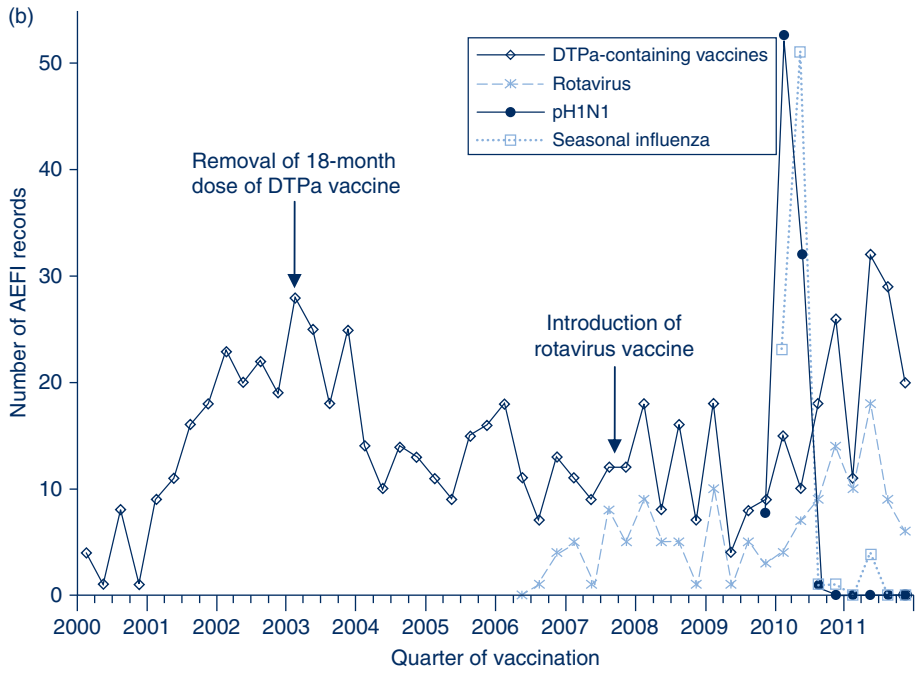

Figure 2b. Adverse events following immunisation for children aged <7 years for selected vaccines (DTPa-containing vaccines, seasonal influenza, pH1N1 and rotavirus), NSW, 2000–2011, by quarter of vaccination.

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
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 Reaction Reporting System database, Therapeutic Goods Administration.

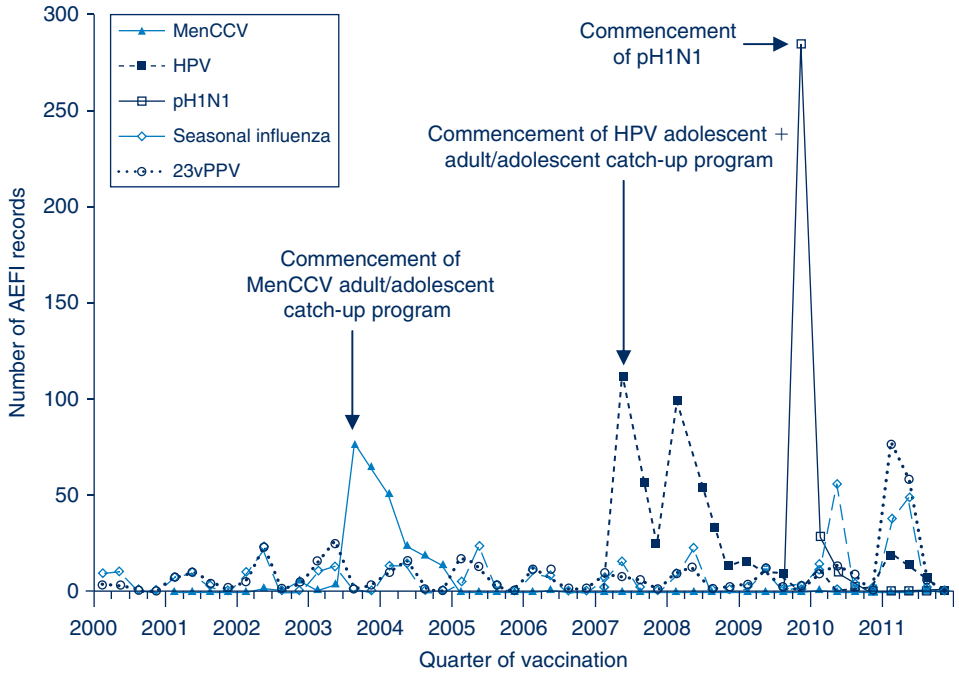

Figure 3. Adverse events following immunisation for people aged ≥7 years in frequently reported vaccines (including MenCCV, seasonal influenza, 23vPPV, HPV and pH1N1), NSW, 2000–2011, by quarter of vaccination.

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 Reaction Reporting System database, Therapeutic Goods Administration.

oedema and pain (10% each), and rash, erythema and nausea (8% each) (Table 2).

Of the total 209 cases of injection site reaction, 64 (31%) were children aged less than 7 years and 145 (69%) were in people aged 7 years and over. The most commonly suspected vaccines for children aged less than 7 years related to injection site reaction were: DTPa-IPV ($n = 36$), 13vPCV ($n = 19$), MMR ($n = 10$), hexavalent vaccine ($n = 5$) and 7vPCV ($n = 3$). For those aged 7 years and over, the most commonly suspected vaccines related to injection site reaction were: 23vPPV ($n = 99$; this included two reports in the 12–17-year age group, 26 reports in the 18–64-year age group and 71 reports in adults aged 65 years and over), seasonal influenza vaccine ($n = 36$; one report in the 12–17-year age group, 15 in the 18–64-year age group and 20 in adults aged 65 years and over) and dTpa ($n = 26$; seven reports in the 12–17-year age group, 14 in the 18–64-year age group and five in adults aged 65 years and over) either given alone or co-administered with other vaccines.

There were 25 reported cases of syncope during 2011 compared with only four cases reported in 2010. Five cases were reported in children aged less than 7 years following administration of DTPa-IPV-containing vaccines. Twenty cases were reported in people aged 7 years and over following receipt of dTpa vaccine ($n = 9$), HepB ($n = 3$), HPV ($n = 6$) and 23vPPV/seasonal influenza vaccine ($n = 2$): the majority were in 12–17-year olds ($n = 13$, 65%).

There were five reports of hypotonic-hyporesponsive episodes reported from children aged less than 7 years. Two reports were following co-administration of hexavalent/pneumococcal conjugated vaccine/rotavirus vaccines, one case was following co-administration of hexavalent and pneumococcal conjugate vaccine, and one case was following administration of hexavalent and pneumococcal conjugate vaccine each.

Severity of outcomes

Ten percent ($n = 44$) of events were defined as 'serious' (i.e. recovery with sequelae, requiring hospitalisation, experiencing a life-threatening event or death); similar to that observed in 2010. Numbers of reported events and events with outcomes defined as 'serious' are shown in Table 3.

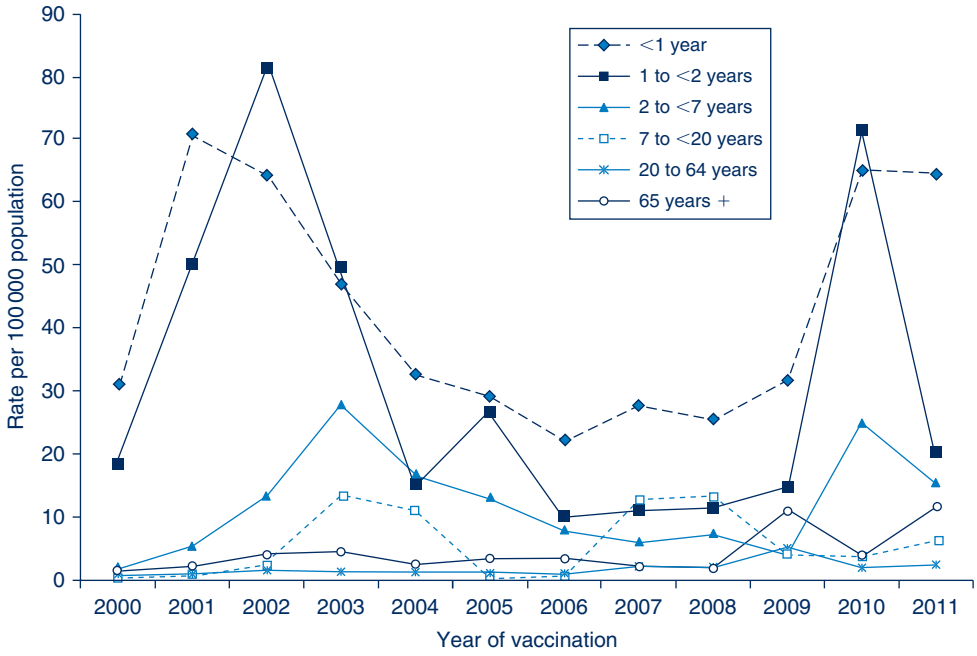

Figure 4. Reporting rates of adverse events following immunisation for NSW per 100 000 population, 2000–2011, for six age groups and by year of vaccination.

Adverse events following immunisation are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
23vPPV: 23-valent pneumococcal polysaccharide vaccine

Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

Eleven percent of records were recorded as 'not fully recovered' at the time of reporting (Table 3); 35% of these were following receipt of 23vPPV, 25% following DTPa-IPV-containing vaccines and 24% following seasonal influenza vaccines. Information on severity could not be determined for 8% of records ($n = 38$); 42% of these were following receipt of 23vPPV and 37% following DTPa-IPV-containing vaccines. Of those without information describing severity, the most commonly reported adverse reaction was injection site reaction (61%, $n = 23$).

The reactions recorded as 'serious' were: injection site reaction ($n = 13$), fever ($n = 8$), allergic reactions ($n = 7$), febrile convulsions ($n = 3$), diarrhoea/vomiting ($n = 2$), syncope ($n = 2$), one case each of Guillain-Barrè syndrome and anaphylaxis and two reported deaths.

There were two cases of anaphylaxis; one was coded as serious and occurred 5 minutes post first dose of seasonal influenza vaccine. The other case of anaphylaxis, not coded as serious, was following co-administration of dTpa and HepB vaccine.

The only reported case of Guillain-Barrè syndrome was in an adult following co-administration of seasonal influenza vaccine (Fluvax®) combined HepA/B formulation (Twinrix®). The onset date was approximately 6 weeks post-vaccination.

Two deaths were recorded as temporally associated with receipt of vaccines. One was a 4-month old infant who had received hexavalent, 13vPCV and rotavirus vaccine 3 days prior to death. The cause of death was recorded as sudden infant death syndrome. The other reported death was a 51-year old with motor neurone disease who died 4 days after receiving the seasonal influenza vaccine. He developed flu-like illness after vaccination and had a cardiac arrest. The cause of death was documented as complications of motor neurone disease.

Pneumococcal conjugate vaccine

In 2011, the pneumococcal conjugate vaccines (7vPCV and 13vPCV) were suspected of involvement in 73 AEFI records (42 for 13vPCV and 31 for 7vPCV) for people aged less than 7 years with 10 cases coded as serious (six for 7vPCV and four for 13vPCV). Ninety percent of the 7vPCV reports were from the first half of the year and all the 13vPCV cases were vaccinated between June 2011 and December 2011. The reporting rates were 29.4 per 100 000 doses for 13vPCV and 19.5 per 100 000 doses for 7vPCV (Table 1). The rate for 7vPCV was higher in 2011 than in 2010 (10.8) and 2009 (7.8). All the 7vPCV vaccines were co-administered with hexavalent and rotavirus vaccines while in the case of 13vPCV, 50% ($n = 21$) of cases were 13vPCV administered alone, under the

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, 2011

Vaccines[a]	AEFI records[b]	'Serious' outcome[c]	Vaccine doses[d]	Reporting rate per 100 000 doses[e] (95% CI)	
	n	*n*	*n*	2011	2010
<7 years					
Hexavalent (DTPa-IPV-HepB-Hib)	56	11	267 421	21.0 (15.8–27.2)	10.4 (6.9–15.1)
DTPa-IPV	45	5	95 562	47.1 (34.3–63.0)	35.2 (24.1–49.7)
Rotavirus	43	9	167 081	25.7 (18.6–34.7)	15.4 (10.1–22.6)
13vPCV	42	4	142 770	29.4 (21.2–39.8)	n/a
7vPCV	31	6	158 890	19.5 (13.3–27.7)	10.8 (7.2–15.4)
Measles-mumps-rubella	26	5	188 383	13.8 (9.0–20.2)	10.4 (6.2–16.2)
Varicella	9	1	89 083	10.1 (4.6–19.2)	12.5 (6.2–22.4)
MenCCV	5	2	94 093	5.3 (1.7–12.4)	6.4 (2.3–14.0)
Seasonal influenza	5	0	n/a	n/a	n/a
Haemophilus influenzae type b	4	2	91 336	4.4 (1.2–11.2)	6.6 (2.4–14.4)
12–17 years					
HPV	37	4	97 532	37.9 (26.8–52.3)	14.1 (7.5–24.1)
dTpa	30	3	123 389	24.3 (16.4–34.7)	4.3 (1.4–9.9)
Hepatitis B	24	1	111 948	21.4 (13.8–31.9)	11.5 (15.9–20.1)
Varicella	12	2	38 409	31.2 (16.1–54.6)	7.2 (0.7–25.9)
Seasonal influenza	4	2	n/a	n/a	n/a
18–64 years					
Seasonal influenza	40	5	n/a	n/a	n/a
23vPPV	32	1	n/a	n/a	n/a
dTpa	24	2	n/a	n/a	n/a
Hepatitis B	7	0	n/a	n/a	n/a
Yellow fever	3	1	n/a	n/a	n/a
Q fever	2	0	n/a	n/a	n/a
Rabies	1	0	n/a	n/a	n/a
≥65 years					
23vPPV	108	3	110 899	97.4 (79.9–117.6)	23.4 (15.3–34.4)
Seasonal influenza	43	0	718 863	6.0 (4.3–8.1)	3.3 (2.1–5.0)
dTpa	6	0	n/a	n/a	n/a
Age group (years)					
<1 year	60	13	719 873	8.3 (6.4–10.7)	5.7 (4.1–7.7)
1 to <2 years	19	4	352 274	5.4 (3.2–8.4)	5.4 (3.2–8.6)
2 to <7 years	70	7	222 472	31.5 (24.5–39.7)	16.2 (11.1–22.9)
12–17 years	72	9	371 278	19.4 (15.2–24.4)[g]	6.7 (4.3–10.1)
18–64 years	101	8	n/a	n/a	n/a
65+ years	121	3	829 762	14.6 (12.1–17.4)[h]	5.2 (3.7–7.0)

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
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.[22]
[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 2011. 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 2011.
[e]The estimated AEFI reporting rate per 100 000 vaccine doses recorded.
[f]School-based doses data only.
[g]Seasonal influenza and 23vPPV only.
Source: Adverse Drug Reaction Reporting 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, 2011

Reaction category[a,b]	AEFI records	'Serious' outcome[c]		Only reaction reported[d]		Age group[c]			
						<7 years		≥7 years	
	n	*n*	%	*n*	%	*n*	%	*n*	%
Injection site reaction	209	13	6	49	23	64	31	145	69
Fever	98	8	8	4	4	44	45	54	55
Allergic reaction[e]	81	7	9	12	15	22	27	58	72
Rash[f]	38	3	8	10	26	22	58	15	39
Syncope	25	2	8	10	40	5	20	19	76
Lymphadenopathy/itis[g]	16	1	6	1	6	1	6	15	94
Arthralgia	10	0	0	0	0	0	0	10	100
Convulsions	8	3	38	2	25	6	75	2	25
Somnolence	7	2	29	0	0	4	57	3	43
Abnormal crying	6	0	0	0	0	5	83	1	17
Hypotonic-hyporesponsive episode	5	0	0	4	80	5	100	0	0
Arthritis	4	2	50	0	0	2	50	2	50
Anaphylactic reaction	2	1	50	1	50	0	0	2	100
Death	2	2	100	1	50	1	50	1	50
Brachial neuritis	1	0	0	1	100	0	0	1	100
Guillain-Barrè syndrome	1	1	100	1	100	0	0	1	100
Malaise	50	6	12	0	0	10	20	40	80
Oedema	47	0	0	4	9	3	6	44	94
Pain	43	2	5	0	0	0	0	43	100
Erythema	35	3	9	2	6	6	17	29	83
Nausea	34	3	9	0	0	2	6	32	94
Headache	33	2	6	0	0	2	6	31	94
Myalgia	26	3	12	1	4	0	0	26	100
Dizziness	17	0	0	0	0	0	0	17	100
Gastrointestinal-RVV	14	2	14	2	14	14	100	0	0
Abdominal pain	12	1	8	1	8	5	42	7	58
Reduced sensation	12	1	8	0	0	1	8	11	92
Respiratory rate/rhythm change	8	1	13	1	13	1	13	7	88
Pallor	7	2	29	0	0	3	43	4	57
Weakness	5	0	0	0	0	0	0	5	100

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)[21] as described in the Methods section. The bottom part of the table shows reaction terms not listed in *The Australian Immunisation Handbook*[21] but included in AEFI records in the Adverse Drug Reaction Reporting System database.

[b]There were no reports for the reaction categories acute flaccid paralysis, intussusception, encephalopathy, encephalitis, meningitis, orchitis, osteitis, osteomyelitis, parotitis, sepsis and toxic shock syndrome.

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

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

[e]Allergic reaction 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.[21]

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

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

Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

catch-up program offered to children aged between 12 months and 35 months.

The distribution of reaction types for both 7vPCV and 13vPCV are presented in Figure 5. 7vPCV was not recorded as the only suspected vaccine for any reported reaction category. The most frequently reported reactions for 7vPCV were fever and vomiting/diarrhoea ($n = 10$, 32% each) and allergic reactions and rash ($n = 7$, 23% each).

Table 3. Outcomes of adverse events following immunisation for two age groups (<7 and ≥7 years), NSW, 2011

Outcome	AEFI records		Age group			
			<7 years		≥7 years	
	n	%[a]	*n*	%[b]	*n*	%[b]
Non-serious	316	70	100	32	215	68
Not recovered at time of report	51	11	14	27	35	69
Unknown[c]	38	8	11	29	27	71
Serious:	44	10	24	55	20	45
recovered with sequelae	1		0	0	1	100
hospital treatment – admission	39		23	59	16	41
life-threatening event	2		0	0	2	100
death	2		1	50	1	50
Total	**449**	100	**149**	33	**297**	66

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 ($N = 449$).
[b]Percentages relate to the number of AEFI records with the specific outcome (e.g. of 316 AEFI records with a 'non-serious' outcome, 32% were for children aged under 7 years).
[c]'Unknown' outcome relates to the number of AEFI records which are not serious and with unknown outcome.
Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

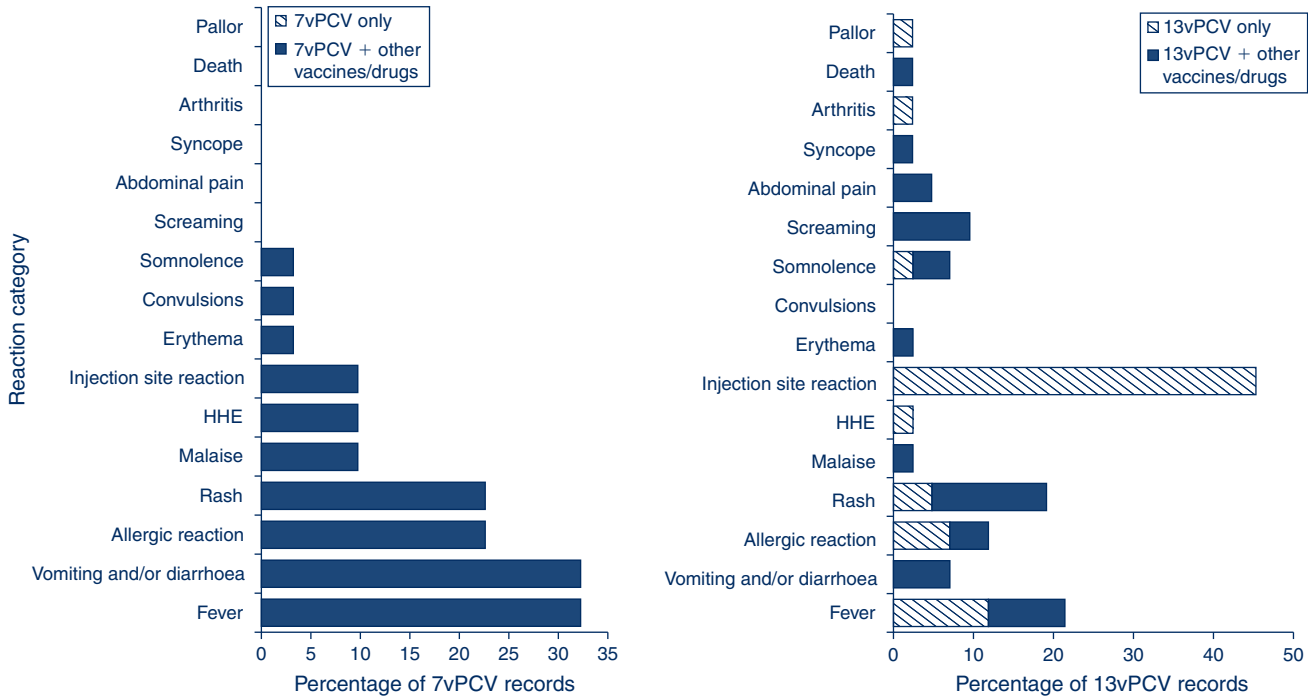

Figure 5. Most frequently reported adverse events following vaccination with 7vPCV and 13vPCV, by number of vaccines suspected of involvement in the reported adverse event, 2011.

Adverse events following immunisation are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
Percentage of 31 AEFI records (7vPCV) and 42 records (13vPCV) where both the vaccines were listed as suspected of involvement in the reported adverse event following immunisation.
13vPCV: 13-valent pneumococcal conjugate vaccine
23vPCV: 23-valent pneumococcal conjugate vaccine
HHE: hypotonic-hyporesponsive episode

Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

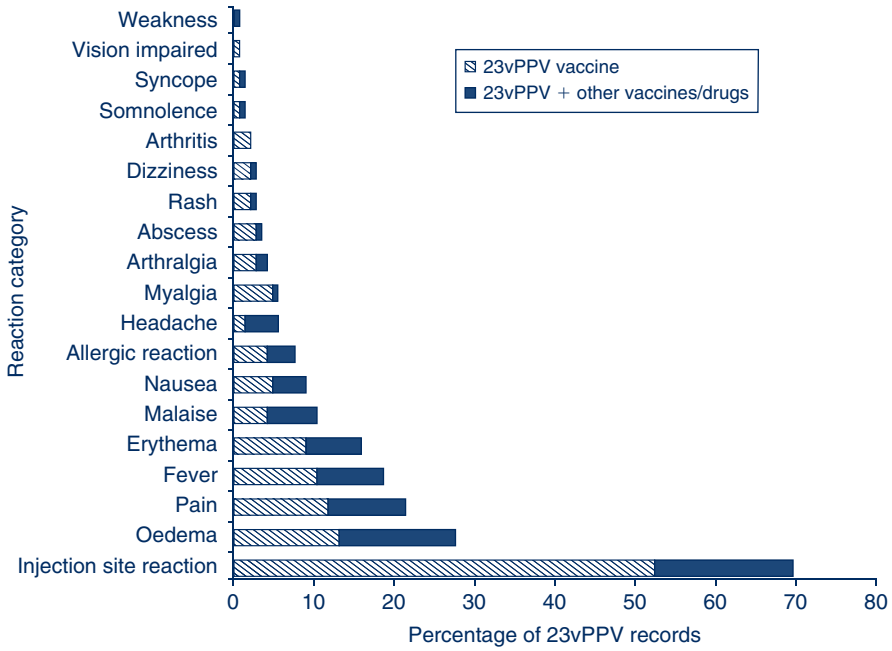

Figure 6. Most frequently reported adverse events following vaccination with pneumococcal polysaccharide (23vPPV), by number of vaccines suspected of involvement in the reported adverse event, 2011.

Adverse events following immunisation are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
Percentage of 145 AEFI records where the 23-valent pneumococcal polysaccharide vaccine (23vPPV) was listed as suspected of involvement in the reported adverse event following immunisation.

Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

13vPCV was the only suspected vaccine in 21 (50%) records. There were 19 (45%) reports of injection site reaction; nine (21%) of fever; eight (19%) of rash; five (12%) of allergic reactions; one case of syncope and one reported death following co-administration of hexavalent, 13vPCV and rotavirus vaccine.

Pneumococcal polysaccharide vaccine (23vPPV)

There were a total of 145 records for 2011 where 23vPPV was listed as a suspected vaccine. Five records were from those aged less than 18 years (three in the 0–6-year age group and two in the 12–17-year age group). There were 140 AEFI records for adults aged 18 years and over where 23vPPV was listed as suspected of involvement in the reported adverse event with four cases coded as serious and 97 reports of injection site reaction. Of the 140 cases, 108 cases were reported from older adults (aged 65 years and over). Using the 2009 estimate of the number of doses of 23vPPV administered to people aged 65 years and over ($n = 110\,899$),[23] the AEFI reporting rate was 97.4 per 100 000 doses; this was four times higher than in 2010 (23.4 per 100 000 doses). The distribution of reaction types for 23vPPV is presented in Figure 6. The most commonly reported reaction was injection site reaction ($n = 101$), oedema ($n = 40$), pain ($n = 31$), fever ($n = 27$), erythema ($n = 23$), malaise ($n = 15$) and nausea ($n = 13$).

Figure 7 shows the initial increase in reports following 23vPPV in 2011 (by week of report) until 25 March, which was much greater than the historical average. These initial reports triggered a national investigation, which led to a batch recall on 25 March, which then resulted in stimulated reporting.

Discussion

There has been a slight increase in the total number of AEFI records and population-based reporting rates in 2011 compared with the corresponding period in 2010. Compared with 2010, there was a large decline in AEFI reporting following vaccination with seasonal influenza vaccine and pH1N1 influenza vaccines. The reduced reporting of AEFIs related to seasonal influenza vaccine is notable and suggests that recommendations for not using the CSL vaccine (Fluvax®) in young children (aged under 10 years)[22,23] have decreased AEFIs at a population level.

An increase was observed in reporting rates per 100 000 doses of certain vaccines and age groups as shown in Table 1. By age group, reporting rates per 100 000 doses were higher in 2011 compared to 2010 for all age groups, but the increase was statistically significant in children aged 2 to less than 7 years (31.5 vs 16.2) and 12–17-year olds (19.4 vs 6.7). The increase in reporting of AEFIs in children aged 2 to less than 7 years in 2011 is primarily

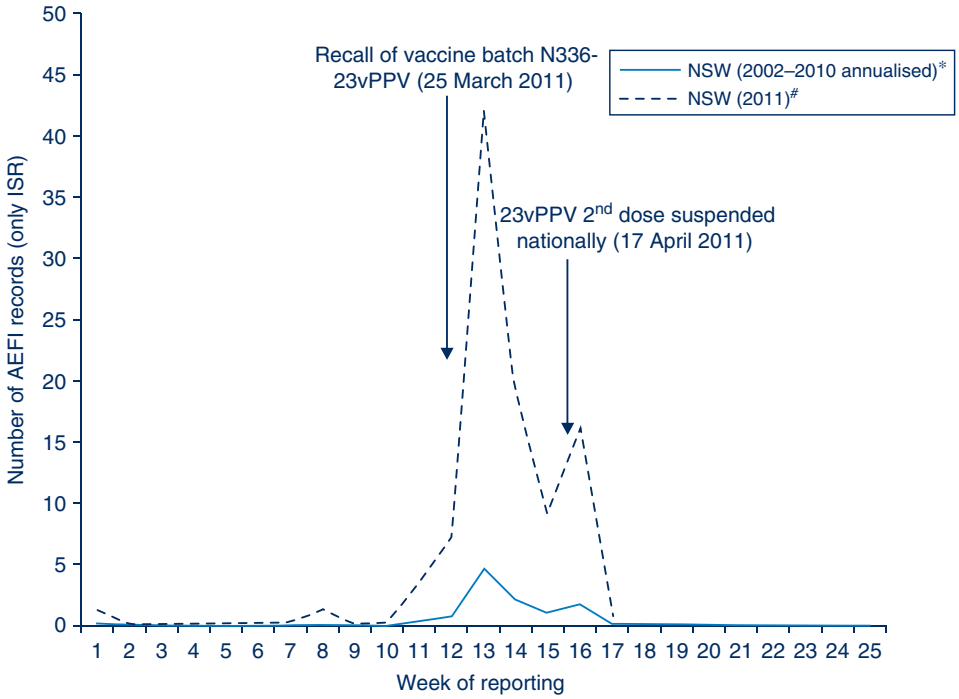

Figure 7. Injection site reactions following 23vPPV immunisation for individuals aged ≥65 years, NSW, 2002–2011, by week of vaccination (2002–2010) and week of report (2011).

Adverse events following immunisation (AEFI) are generally regarded as any serious or unexpected adverse events that occur after the administration of a vaccine(s).
23vPCV: 23-valent pneumococcal conjugate vaccine
ISR: injection site reaction
*NSW (2002–2010 annualised) – reports by date of vaccination
#NSW (2011) – reports by date of receipt at states and territories

Source: Adverse Drug Reaction Reporting System database, Therapeutic Goods Administration.

because of increased reporting of injection site reactions following vaccination with DTPa-IPV-containing vaccines and 13vPCV. Data from the clinical studies of Prevenar 13® demonstrated similar rates of injection site reactions when comparing 7vPCV with 13vPCV, with an increase in injection site reactions following the fourth dose of either 7vPCV or 13vPCV (in the second year of life) compared with earlier doses in infancy. A similar trend was also observed for other systemic reactions.[24] From October 2011 children aged between 12 and 35 months who had completed a primary pneumococcal vaccination course with 7vPCV have been eligible to receive a free supplementary dose of Prevenar 13®.[11] The increased reporting rate of injection site reactions for 13vPCV may be in part because it is being given as a fourth dose of a PCV vaccine at an older age. The higher number of reports following 13vPCV might also be attributed to the 'Weber effect'[25] which describes increased reporting frequently observed following the introduction of new vaccines.

A significant increase in reporting rates was also observed in adolescents, mainly due to injection site reactions following administration of dTpa vaccine. One suggested hypothesis for the mechanism of injection site reactions is an 'Arthus reaction' caused by the presence of high levels of pre-vaccination IgG antibody in the vaccinees.[26,27] Possible causes of higher pre-vaccination antibody levels include immunity induced from natural infection in the pertussis epidemic from 2008, which was notable for high notification rates in pre-school and primary school-aged children,[28] as well as the earlier age of administration of the pre-school DTPa-IPV booster and the adolescent booster (at age 12 years, compared with age 15 years) that has occurred in response to program changes in recent years.[29]

There was a higher than expected number of injection site reactions detected following administration of the 23vPPV vaccine in NSW. Reporting rates per 100 000 doses were four times higher in all AEFIs (97.4 in 2011 vs 23.4 in 2010) following vaccination with 23vPPV in the elderly population aged 65 years and over. This increase may be due to larger numbers of people receiving second doses following the commencement of the nationally funded vaccine in 2005, and related increased marketing of a second dose leading to increased use of 23vPPV in early 2011. However, the current method of estimating the number of doses administered does not allow the detection of changes in vaccinations by year

and cannot distinguish between first and subsequent doses. In response to the continued increase in reports of severe injection site reaction reports, in April 2011 the TGA issued advice to health professionals not to administer a second or subsequent dose of Pneumovax 23® vaccine.[13] An expert multidisciplinary working group was convened to investigate all reports of injection site reaction following 23vPPV. Revised recommendations regarding which patients should be re-vaccinated under the National Immunisation Program was provided in December 2011, with re-vaccination no longer recommended for those aged 65 years and over without predisposing medical conditions.[14]

We cannot exclude that the higher overall numbers of reports and reporting rates in 2011 may also be a result of an increased propensity by immunisation providers to report due to the heightened awareness of AEFIs following influenza vaccine safety issues in 2010. Increased reporting may also reflect changes in the proportion of reports transmitted from public health units to the NSW Ministry of Health, and thence to the TGA.

Conclusion

The total number of AEFIs reported in 2011 was slightly higher compared with the same period in 2010, mainly due to reports of injection site reactions. Increases in reports in infants were related to the introduction of 13vPCV onto the schedule from July 2011, particularly including the supplementary booster dose for children aged 12–35 months. Increases in the 2 to less than 7 year age group were related to the DTP-IPV vaccine, and follow an increasing trend since 2009. There was also an increase in the 12–17-year age group associated with dTPa. Increases in the 65 years and over age group were associated with injection site reactions following administration of 23vPPV, many of which may have been second doses. If a real increase in injection site reaction incidence has occurred following pertussis vaccines, one possible explanation for children and adolescents is higher pre-vaccination antibody levels, due to the recent pertussis epidemic and possibly also earlier receipt of the pre-school and adolescent booster. There may also be a greater propensity by vaccine providers to report in 2011 due to the heightened awareness of AEFIs following influenza vaccine safety issues in 2010.

The majority of AEFIs reported to the TGA were mild transient events and the data reported here are consistent with an overall high level of safety for vaccines included in the National Immunisation Program schedule.

Acknowledgments

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*The *Public Health Act 2010* (NSW) (http://www.health.nsw.gov.au/phact/)
The *Public Health Act 2010* (NSW) was passed by the NSW Parliament in December 2010 and commenced on 1 September 2012. The Public Health Regulation 2012 was approved in July 2012 and commenced, along with the *Public Health Act 2010* (NSW), on 1 September 2012. The objectives of the Regulation are to support the smooth operation of the Act. The Act carries over many of the provisions of the *Public Health Act 1991* (NSW) while also including a range of new provisions.

Measles in NSW, 2002–2011

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Abstract: Measles has been eliminated in NSW for more than a decade; however outbreaks associated with international travel do occur. This Epi*Review* describes the epidemiology of measles in NSW from 2002–2011. A total of 281 cases of measles were notified during the period, an average annual notification rate of 0.41 notifications per 100 000 population (range: 0.06–1.25). There were 139 hospitalisations recorded with a measles diagnosis in the 10-year reporting period, corresponding to a rate of 0.20 hospitalisations per 100 000 population. Of the 80 measles virus specimens genotyped, five genotypes were identified: D9 (38%), D8 (24%), D4 (16%), D5 (14%) with H1 identified less frequently (9%). No single genotype was associated with local transmission across successive years. To sustain good measles control, children should be vaccinated against measles on time through routine childhood immunisation, and all young adults who travel internationally should be vaccinated. Clinician awareness remains important in the early identification and control of measles to avoid further transmission during outbreaks and to enable the timely implementation of public health measures.

Measles is an acute and highly contagious viral disease that is currently the most important cause of vaccine-preventable death globally.[1] Measles is rare in Australia with low rates of hospitalisation and death.[2] Measles is transmitted by airborne particles, droplets or fomites and humans are the only host of the measles virus. Common symptoms of measles include fever, rash, cough, coryza, conjunctivitis, diarrhoea and loss of appetite. Complications include ear infections, pneumonia, convulsions, croup, encephalitis and death. A milder illness is sometimes seen in vaccinated individuals,[3] and severe disease tends to occur in infants and malnourished persons.[1] Sub-acute sclerosing panencephalitis is a rare, delayed, fatal complication of measles virus infection.

In Australia, measles-mumps-rubella (MMR) vaccines are scheduled as two doses for all children: the first at 12 months and the second at 4 years of age.[4] In 2013, the inclusion of measles-mumps-rubella-varicella vaccine (MMR-V) on the childhood immunisation schedule will bring forward the second measles dose to 18 months from 4 years.[5] In addition, documented immunity to measles has been a mandatory requirement for new health care workers in New South Wales (NSW) since 2007. In NSW, the percentage of children immunised with at least one dose of MMR at 2 years of age is 93.9%,[6] with some variation across local health districts (LHDs) and Aboriginal communities.[7] People at highest risk of measles infection include: infants aged less than 1 year (who are too young to be vaccinated); children aged 1–4 years who have received only a single dose of vaccine, especially if received late; and those born in the late 1960s to mid 1980s (who were neither infected with measles, nor vaccinated against it).[8]

Multiple lines of evidence suggest measles elimination (the absence of endemic measles transmission) has been achieved in Australia since 1999.[9] Contributing to this was the high population immunity achieved during the measles control campaign (1998) and maintained through high vaccination rates among children.[9] High vaccination coverage is required for each new birth cohort to maintain measles elimination: at least 95% for a single dose and at least 90% for two doses.[4]

However, outbreaks do occur in NSW and are generally linked to case-patients who acquired their illness overseas. Further transmission has historically been contained to non-immune direct contacts and contained within one to two generations of transmission. The number of chains of transmission from imported case-patients is directly related to the pool of susceptible people in the population. At the time of publication the largest measles outbreak in more than a decade was being investigated across metropolitan Sydney affecting infants too young to be vaccinated and some population groups with apparent low vaccination coverage.

An objective of measles surveillance is the timely detection of all cases[10] to enable the identification and implementation of public health measures to limit the spread of infection. Control strategies include protection of contacts

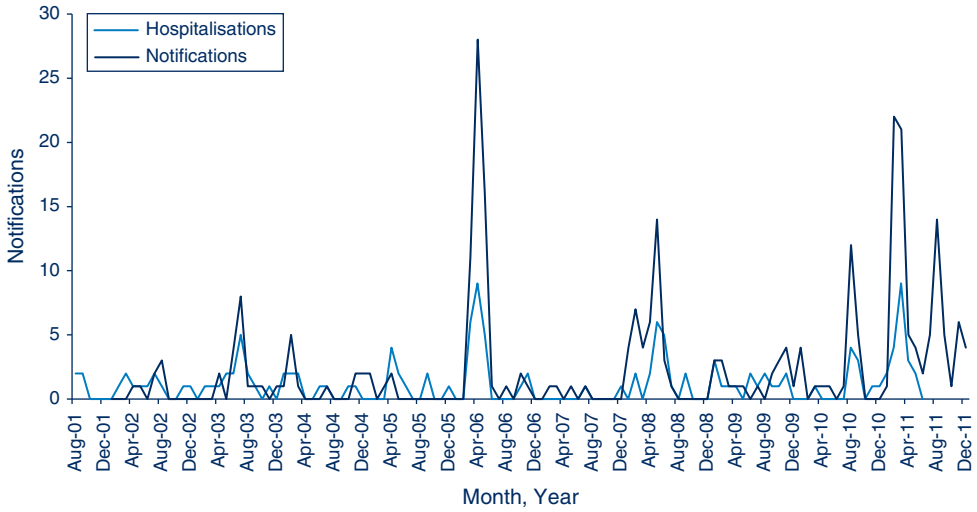

Figure 1. Number of measles case notifications and hospitalisations by month of onset, NSW, 2002–2011.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

through administration of vaccine or normal human immunoglobulin, active case finding, exclusion and isolation.[11] Measles surveillance also enables the epidemiological monitoring of the disease to inform prevention strategies. In this report we describe measles epidemiology in NSW from January 2002 to December 2011.

Methods

Notification and hospitalisation data were used to describe trends in measles epidemiology in NSW.

Notifications

During this period, doctors, hospitals and laboratories were required to notify all measles cases to their local public health unit (PHU) under the NSW *Public Health Act 1991**. Measles cases were defined according to National Case Definitions. The case definitions remained constant during the reporting period. A 'confirmed' case requires laboratory definitive or clinical and epidemiological evidence, a 'probable' case requires clinical and laboratory suggestive evidence, and a 'suspected' case requires clinical evidence alone.[12] In this report, a person with an illness that meets the case definition is called a case-patient.

On receipt of a notification, a public health unit surveillance officer determines whether or not the notification meets the definition of a case of measles, and if so, enters data gathered on each notified case into the NSW Notifiable Conditions Information Management System (NCIMS). Vaccination status is collected by these officers and, where possible, validated using the Australian Childhood Immunisation Register (since 1996) or other forms of evidence. We analysed the NCIMS notification data for measles cases with onset dates during the 10-year period from January 2002 to December 2011. Average annual case notification rates were calculated using annual mid-year population estimates from the Australian Bureau of Statistics (ABS).

Genotyping is generally performed in defined circumstances to support public health investigations. Sequencing and genotyping is routinely performed by the Victorian Infectious Diseases Reference Laboratory. Genotyping involves the amplification of part of the N (nucleocapsid) gene, and genotype classification is based on nucleic acid sequencing of the polymerase chain reaction products using established methods.[13]

Hospitalisations

Measles hospitalisation data was obtained from the Admitted Patient Data Collection for NSW residents with an ICD-10-AM diagnosis code of B05 (measles) admitted between July 2001 and June 2011. Hospitalisation rates were calculated using annual end-year population estimates from the ABS.

Results

Notifications

During the 10-year reporting period, 281 cases of measles were notified at an average annual notification rate of 0.41 per 100 000 population (range: 0.06–1.25). Of the 281 cases of measles, 247 (88%) were laboratory confirmed, with no trend in the annual case confirmation rates identified (range: 80–100%). There were case notifications every year, with as many as 90 reported in 2011 and as few as four in 2007; 2011 was also the first year in the study period when cases were reported every month (Figure 1). The highest average annual case notification rate in this period was in Northern NSW LHD (0.71 per 100 000 population) and the lowest was in Western NSW LHD (0.04 per 100 000 population) (Figure 2). In total, 145 of the measles case-patients (52%)

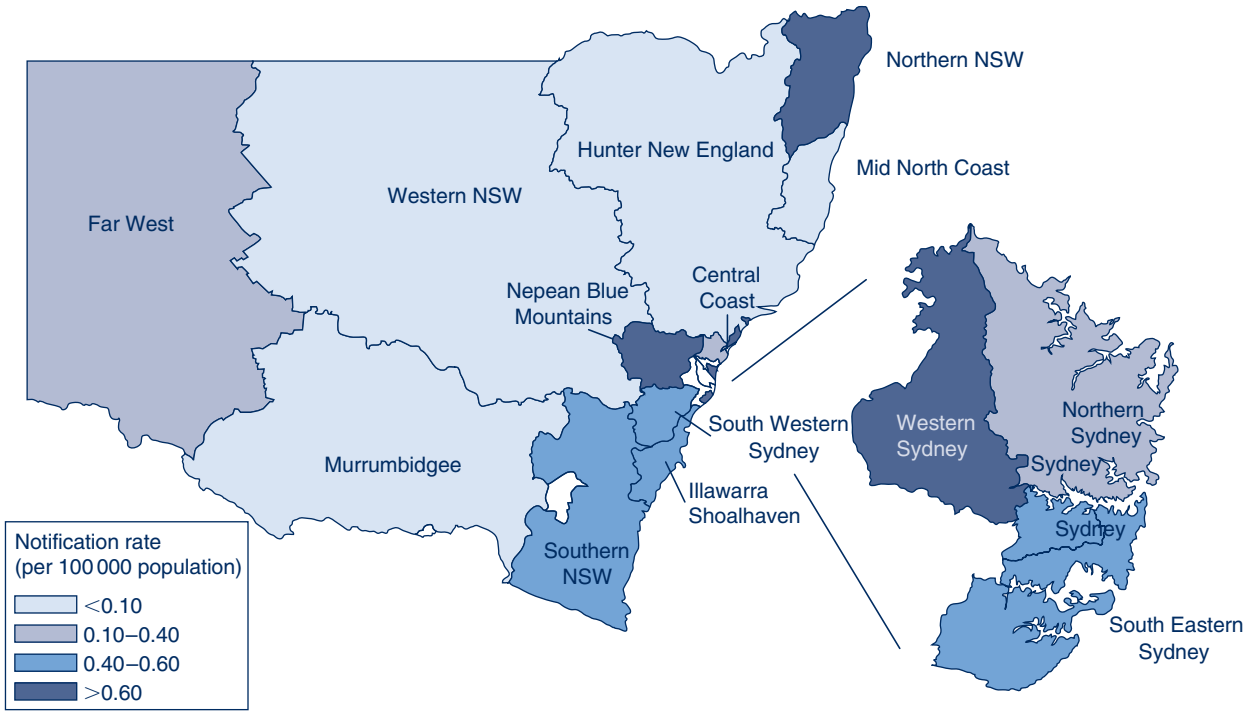

Figure 2. Average annual measles case notification rates in NSW, for each local health district (per 100 000 population), NSW, for the period 2002–2011.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

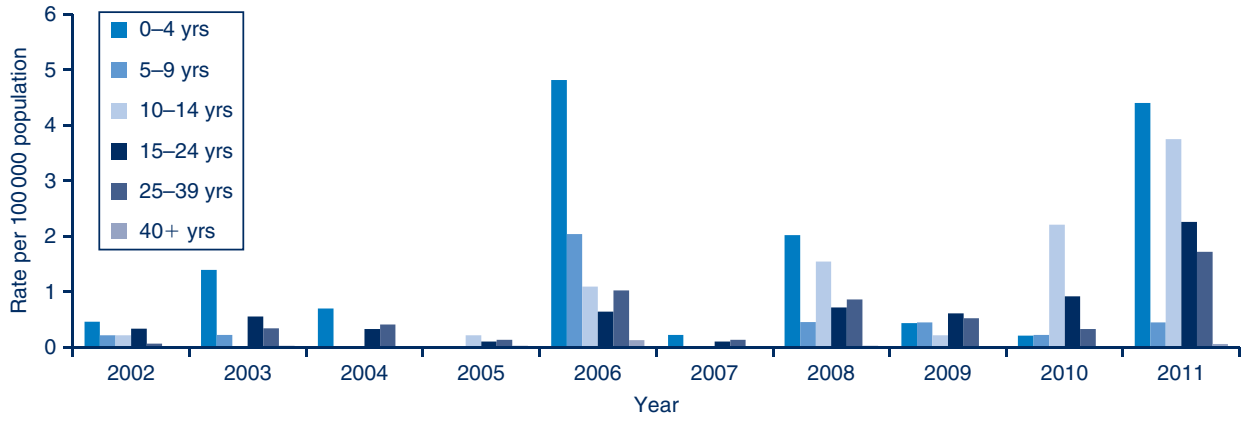

Figure 3. Measles case notification rate per 100 000 population for six age groups and year of onset, NSW, 2002–2011.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

were male, with annual fluctuations (range: 40–75%). There were 66 measles case-patients who were children aged under 5 years (24% of all measles cases) (Figure 3), of which 21 (7% of all measles case-patients) were infants aged under 1 year. Measles case notification rates were highest in the under 5-year age group (1.49 per 100 000 population) followed by 10–14-year olds (0.92 per 100 000 population) and 15–19-year olds (0.82 per 100 000 population). Notification rates for case-patients less than 5 years of age peaked in 2006 at 4.81 per 100 000 population (35% of 2006 cases) and were lowest in 2005 ($n = 0$). During this period, the majority of case-patients ($n = 274$, 98%) were among those born during or since 1966. Since then, measles has been less common and people were unlikely to have been exposed to the illness as a child.

The completeness of reporting Aboriginal status for measles cases improved during the reporting period, with an average annual completeness of 92% (range: 78–100%). There were 11 case-patients identified as Aboriginal people (rate 0.72 per 100 000 population), which was almost double that of non-Aboriginal people (Rate Ratio = 1.80; 95% CI 0.27–12.11). Nearly all ($n = 10$) of these cases occurred in 2011 and were distributed across three LHDs: South Eastern Sydney,

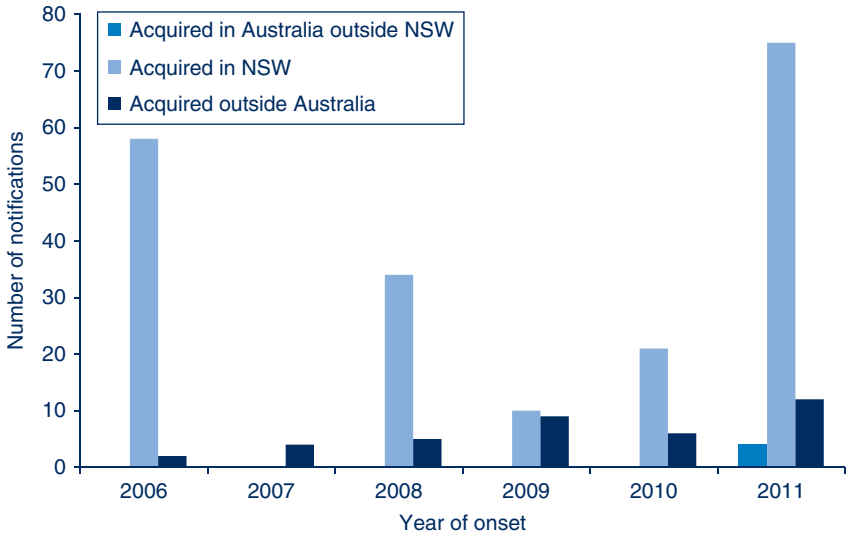

Figure 4. Number of measles case notifications by place of acquisition and year of onset, NSW, 2006–2011.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

Illawarra Shoalhaven and Western Sydney. In 2011, case notification rates were significantly higher for Aboriginal people compared to non-Aboriginal people (6.03 and 1.14 per 100 000, respectively).

Of the 281 cases, 145 (52%) had not been vaccinated, 72 (26%) had unknown vaccination status, while 62 (22%) reported being partially and two fully vaccinated. Of the 217 without evidence of vaccination, 21 were too young to vaccinate (less than 1 year old), 31 were aged between 1 and 4 years, and 165 were aged over 4 years. Of the notifications in children aged 18 months to 4 years, 20 (77%) had not been vaccinated or had unknown vaccination status.

During the period, measles outbreaks were associated with infectious residents returning from international travel and infecting unimmunised people upon their return. Affected groups included high school students, culturally and linguistically diverse groups, prisoners, a faith-based group, infants too young to be immunised, children in child care, as well as visitors to general practices and emergency departments.[3,14–18] There were 38 case-patients who acquired measles outside of Australia; one was in a visitor from overseas, the remainder were NSW residents returning from overseas travel (Figure 4). The median age of case-patients who acquired their infection overseas was 19 years (range: 6 months–41 years). The geographic origin of most of these imported measles cases were from the Asia Pacific and European regions.

Internationally, there are eight different clades and 24 subclades of measles viruses referred to as genotypes.[19] During the reporting period, 80 (28%) measles case-patients had specimens genotyped: 30 were found to be D9 (38%), 19 were D8 (24%), 13 were D4 (16%), 11 were D5 (14%) with H1 identified less frequently (9%) (Figure 5). No single genotype was identified in a large number of successive years, with the largest annual diversity of genotypes being four in 2008 and 2010, then three in 2009 and 2011, with fewer in other years.

Hospitalisations

There were 139 hospitalisations recorded with a measles diagnosis in the 10-year reporting period, corresponding to a rate of 0.20 hospitalisations per 100 000 population. There were 54 measles hospitalisations reported in children aged under 5 years (39% of all measles hospitalisations), of which 21 were aged under 1 year. Hospitalisation rates in the under 5-year age group peaked in 2005–2006 at 2.08 per 100 000 (38% of 2005–2006 measles hospitalisations) and were lowest in 2004–2005 ($n = 1$). Hospitalisation rates were highest in those aged under 5 years (1.22 per 100 000 population) followed by 30–34-year olds (0.44 per 100 000) and 25–29-year olds (0.33 per 100 000). There were seven hospitalisations recorded with a diagnosis of measles in those aged over 65 years (in the same period, there were no measles notifications in this age group). There were seven Aboriginal people hospitalised with measles in the 10-year period (5% of all measles hospitalisations), associated with a hospitalisation rate of 0.46 per 100 000 population. Aboriginal people had a 2.4 (95% CI 0.2–25.5) times greater yearly measles hospitalisation rate than non-Aboriginal people in NSW between 2001–2002 and 2010–2011. Measles with complications were reported in 25 cases (18%); encephalitis was reported in two cases, one in 2003–2004 and the other in 2010–2011; and measles complicated by pneumonia was recorded in 10 cases.

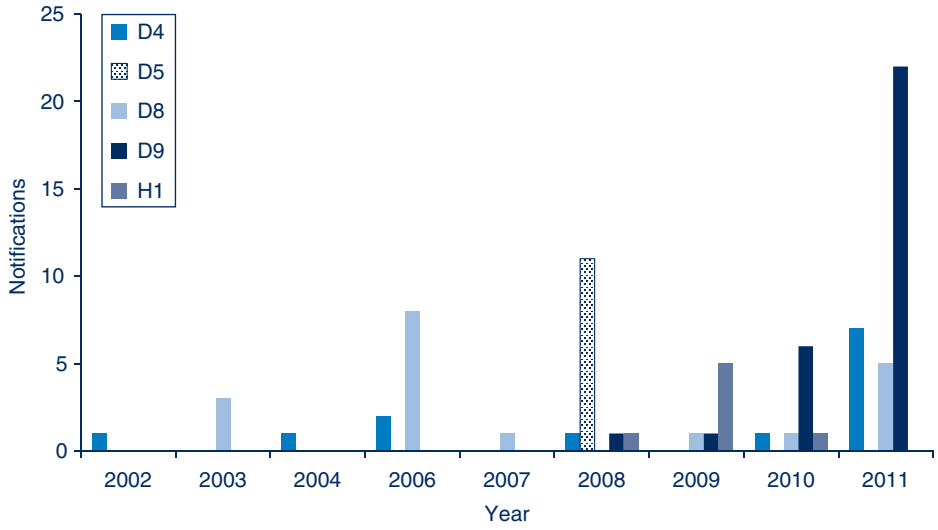

Figure 5. Number of measles case notifications by virus genotype and year of onset, NSW, 2002–2011.
Source: NSW Notifiable Conditions Information Management System, Health Protection NSW.

Discussion

Measles has generally been well controlled in NSW over the past decade. However, outbreaks of limited duration have occurred. For example, in 2006 an outbreak affecting more than 40 case-patients was found to be associated with a national tour of a spiritual leader. The public health investigation found that some members of the tour group were likely to have been infected with measles prior to their arrival in Australia.[17] Further transmission occurred in families members associated with the tour group.

Outside of the occasional outbreak, there have been low numbers of measles cases notified. In addition, cases have been found to have various genotypes identified during the period with no indigenous measles strain identified during the last decade. Sequencing and genotyping are powerful molecular tools to support epidemiological investigations and to assist countries to adhere to elimination criteria.[13] Access to genotyping information for measles cases is important to demonstrate the interruption of circulating virus strains and identify new importations of the measles virus.

The average annual case notification rate during the 10-year period dropped markedly compared to the previous report for the period 1991–2000 (from 10.4 to 0.41 per 100 000 population).[20] Case notification rates differed by geographic area and were highest in the LHD with the lowest vaccination coverage.[21] The 0–4-year old age group had the highest notification rates, and within this age group most case patients were aged between 18 months and 4 years. We found that 52% of all case patients had not received any doses of measles-containing vaccine. Some of the unvaccinated case-patients were due or overdue for measles-containing vaccine, which is supported by a detailed analysis of cases notified in 2011.[13] This highlights the importance of timely childhood vaccination. The introduction of MMR-V vaccine and bringing forward the timing of the second measles dose may further reduce disease burden among 0–4-year olds.

Under-immunised population groups that are susceptible to measles remain a feature of outbreaks, including: prisoners, culturally and linguistically diverse groups, as well as persons who object to the vaccination of their children. As with previous national reports,[22,23] measles case notification rates and hospitalisation rates were almost double for Aboriginal people during the overall reporting period but was not found to be statistically significant. However in 2011, this differential increased, and Aboriginal persons had statistically significantly higher measles notification rates.

Measles surveillance systems will not always identify every case of disease,[13,24] as evidenced by the retrospective identification of measles index cases in emergency department outbreaks[13,25,26] and through analysis of the hospitalisation data that identified possible case-patients that were not notified. Diagnostic or coding errors would most likely explain the additional measles hospitalisations identified among persons aged 65 years and over that were not notified. This misclassification may contribute to an overestimation of measles hospitalisations. Strategies for enhancing clinician awareness of measles are important for early diagnosis and have been successfully implemented at the LHD level in NSW.[27]

Despite the successes in regional and global measles control since 2000,[28,29] unvaccinated young international travellers remain at risk of infection (and a potential source of infection for unimmunised contacts), as demonstrated

by the international travel history among index case-patients identified in NSW clusters during the reporting period. As with other countries where measles has been eliminated, importations have been found to reflect travel destinations rather than global measles incidence.[30] In the context of steadily increasing short term international departures from NSW during the reporting period, which reached the highest on record in 2011,[31] the current targeting of this group with communication interventions by health authorities would appear relevant. The median age of imported measles cases indicates that international travellers of school age should also be targeted, as evidenced by the outbreaks among school groups returning from overseas trips and in schools subsequent to student travel to affected areas.

Conclusion

Vaccination remains the only available protection against measles and is highly effective. Several challenges remain for NSW to maintain good measles control. All children should be vaccinated against measles on time through routine childhood immunisation. Identifying inadequately vaccinated children at the time of school entry could provide a fail-safe mechanism to increase immunisation coverage to the levels required to sustain control over the long-term. All young adults who travel internationally should be vaccinated. Continued effort is required to improve vaccination coverage among under-immunised populations; including prisoners, culturally and linguistically diverse communities and Aboriginal communities. Clinician awareness remains important in the early identification and control of measles to avoid outbreaks, and to enable the timely implementation of public health measures.

Acknowledgments

We acknowledge those who have notified cases of measles as well as the surveillance officers in public health units who manage NCIMS data. We also recognise the crucial work of laboratories performing measles diagnosis and are extremely grateful to the Victorian Infectious Diseases Reference Laboratory for performing sequencing and genotyping of specimens.

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*The *Public Health Act 2010* (NSW) (http://www.health.nsw.gov.au/phact/)
The *Public Health Act 2010* (NSW) was passed by the NSW Parliament in December 2010 and commenced on 1 September 2012. The Public Health Regulation 2012 was approved in July 2012 and commenced, along with the *Public Health Act 2010* (NSW), on 1 September 2012. The objectives of the Regulation are to support the smooth operation of the Act. The Act carries over many of the provisions of the *Public Health Act 1991* (NSW) while also including a range of new provisions.

The early impact of the National HPV Vaccination Program

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The human papillomavirus (HPV) family are a group of DNA viruses that are diverse and ubiquitous. There are about 100 HPV genotypes known to infect humans, of which about 40 infect the anogenital epithelium. These genotypes can be further divided into risk categories depending on their association with cancer. Low-risk genotypes (such as HPV 6 and 11) are responsible for over 90% of genital warts and high-risk genotypes (such as HPV 16 and 18) are responsible for 70–80% of cervical, 85–90% of anal, about 50% of penile and 40–70% of vulvovaginal cancers.[1]

Although the incidence of cervical cancer in Australia has reduced over time, mostly due to the National Cervical Screening Program, there is morbidity, potential psychosocial harm and economic cost associated with detecting and treating pre-cancerous cervical abnormalities. In the last decade, clinical trials have demonstrated the safety, immunogenicity and efficacy of HPV vaccines. In 2006 the Pharmaceutical Benefits Advisory Committee considered the cost effectiveness of the quadrivalent vaccine, Gardasil®, which protects against HPV types 6, 11, 16 and 18. Gardasil® became the first vaccine licensed in Australia for the prevention of HPV infection. Based on this evidence, and with some political pressure, Australia became the first country in the world to fund a mass vaccination program against HPV infection.

Within a short time, each jurisdiction organised the purchasing, provision and infrastructure to implement the vaccine program for school girls in 2007. The vaccine was also made freely available through general practitioners between 2007 and 2009 for women up to the age of 26. In NSW between 2007 and 2011, over 900 000 doses of HPV vaccine were administered in schools, with 79% of the eligible cohort receiving at least one dose and 68% being fully vaccinated (three-dose schedule). Three doses of the vaccine continue to be offered routinely to all NSW schoolgirls in Year 7. Data from the National HPV Vaccination Program Register have shown that, during the catch-up campaign, the national schools-based program had coverage rates of 66–73% for all three doses; uptake declined in all age groups after the first dose.[2] Recent data have also shown that Australia has a comparably low rate of adverse events following immunisation and that serious events are rare.[3]

With the ongoing national vaccination and cervical screening programs, a further reduction in cervical cancer incidence is expected, but given the long interval between the acquisition of HPV infection and cancer diagnosis, a reduction may not be obvious for some time. However, early data from the Victorian Cervical Cytology Registry have revealed a significant decrease in the detection of high-grade cervical abnormalities in girls under 18 years during the vaccine period.[4] Data from eight sentinel sexual health clinics across Australia revealed that the prevalence of genital warts also declined substantially in women (aged 12–26 years in 2007) with the vaccine program. In addition, the proportion of heterosexual men diagnosed with warts significantly declined over this time, perhaps indicating the protective affects for men through herd immunity.[5]

Early data suggest that the National HPV Vaccination Program is effective at the population level. However, challenges include increasing vaccine coverage rates (particularly in low socioeconomic and non-English speaking groups) and educating women about the continued need for cervical screening. The Pharmaceutical Benefits Advisory Committee has recently recommended extending the vaccination program to include all boys aged 9–15 years, which may further protect men and unvaccinated women from HPV-related disease.

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Measles

What is measles?

Measles is a viral disease that may have serious complications. In the past, measles infection was very common in childhood. Measles is now rare in New South Wales (NSW) because of immunisation.

What are the symptoms?

- The first symptoms are fever, tiredness, cough, runny nose, sore red eyes and feeling unwell. A few days later a rash appears. The rash starts on the face, spreads down to the body and lasts for 4–7 days.
- Up to a third of people with measles have complications. These include ear infections, diarrhoea and pneumonia, and may require hospitalisation. About one in every 1000 people with measles develops encephalitis (swelling of the brain).

How is it spread?

- Measles is usually spread when a person breathes in the measles virus that has been coughed or sneezed into the air by an infectious person. Measles is one of the most easily spread of all human infections. Just being in the same room as someone with measles can result in infection.
- People with measles are usually infectious from just before the symptoms begin until 4 days after the rash appears. The time from exposure to becoming sick is usually about 10 days. The rash usually appears around 14 days after exposure.

Who is at risk?

Measles was common before 1966, so most people born before then are immune.

People at risk of measles include:

- people born during or since 1966 who have never had measles and who have not had two doses of measles-mumps-rubella (MMR) vaccine from the age of 12 months
- people with a weak immune system (e.g. people receiving chemotherapy or radiotherapy for cancer or people who take high-dose steroid medications) even if they have been fully immunised or have had past measles infection
- people who are not immune and who travel overseas.

How is it prevented?

- The best protection against measles is immunisation with two doses of MMR vaccine. This vaccine provides protection against infection with measles, as well as against mumps and rubella.
- MMR vaccine should be given to children at age 12 months; a second dose is given at 4 years of age.
- Anyone born during or after 1966 and who has never had measles infection or MMR vaccination should make sure that they have had two doses of MMR vaccine at least 4 weeks apart.
- It is safe to have the vaccine more than twice, so people who are unsure should be vaccinated.
- People with measles should stay at home until they are no longer infectious (i.e. until 4 days after the rash starts).
- For people who are not immune and who have come into contact with a person with measles, infection can sometimes still be prevented with MMR vaccine if it is given within 3 days of exposure or with immunoglobulin given within 7 days of exposure.

How is it diagnosed?

- Measles is suspected when a person feels unwell, has a cough, runny nose or sore eyes and a fever followed by a rash.
- Whenever measles is suspected a blood test and samples from the nose, throat and urine should be collected to confirm the diagnosis. Confirmation of the diagnosis is important as it allows prompt public health follow-up of other people who are at risk of measles.

How is it treated?

- People with measles infection are normally advised to rest, drink plenty of fluids, and take paracetamol to treat the fever. There is no specific treatment.
- While a person is infectious with measles it is important that he or she remains at home to reduce the possibility of spreading it to other people.

What is the public health response?

Doctors, hospitals, laboratories, schools and childcare centres must notify cases of measles to the local public health unit. Public health unit staff will interview the doctor and patient (or carers) to find out how the infection occurred, identify other people at risk of infection, implement control measures (such as immunisation and restrictions on attending school or work) and provide other advice.

10.1071/NB12112

Communicable Diseases Report, NSW, July and August 2012

Communicable Diseases Branch
Health Protection NSW

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 2012 in New South Wales (NSW).

Enteric infections

Outbreaks of suspected foodborne disease

Two of the nine complaints received by the NSW Food Authority about suspected foodborne disease in July and August 2012 were thought to be related to consumption of contaminated food. July and August was however a period of high levels of viral gastrointestinal disease in the community and most reports of suspected foodborne gastrointestinal illness in this period were, upon investigation, thought to be cases of viral gastrointestinal disease spread person-to-person.

In July, NSW Health was notified of cases of gastrointestinal illness in nine members of a group of 15 people who shared a meal at a restaurant in Sydney. Case-patients developed vomiting and diarrhoea 25 hours after the meal and their symptoms lasted between 8 and 44 hours. Public health unit staff interviewed 12 members of the group, six of whom were case-patients. Foods consumed included scallop soup, baked pie, cheese soufflé, lamb, eggnog (served in an egg shell), mulled wine and three desserts (plum pudding Alaska, pear and walnut truffle and raspberry macaroons). The group had also attended pre-dinner drinks together which included casual food (chips, dips, salad and cupcakes). On analysis, illness was not associated with the consumption of any food items. No stool specimens were submitted for testing. The NSW Food Authority inspected the premises based on the inclusion on the menu of raw egg food products that have a high risk for *Salmonella* contamination. The restaurant has subsequently taken extra steps to ensure food safety including sterilising the egg shells used in serving the eggnog and baking the meringue used in the Alaska dessert. The cause of the outbreak remains unknown.

In August, two separate groups of people reported illness following meals at a restaurant in Sydney on the same day. Four people in a group of seven, and six people in a group of eight, were affected with abdominal cramps and diarrhoea approximately 14 hours after eating at the restaurant. Symptoms lasted between 10 and 20 hours. No stool specimens were submitted for testing. The common ingredient eaten only by the case-patients and not by other members of the groups was a creamy mushroom sauce. The symptoms and duration of illness are suggestive of a bacterial toxin, however an environmental investigation was not possible as the restaurant was destroyed by fire soon after illness was reported.

Viral gastrointestinal disease

There were 188 outbreaks of gastroenteritis in an institution reported in July and August 2012, affecting at least 3684 people. The previous 5-year average for this period was 150 outbreaks. A total of 115 outbreaks occurred in aged-care facilities, 40 in child-care centres and 33 in hospitals. In the 138 outbreaks in which a stool specimen was collected, norovirus was confirmed in cases from 69 outbreaks and rotavirus was confirmed from 15.

There were 394 cases of rotavirus reported in July and August. This is the largest number of notifications for rotavirus since it became a notifiable condition in 2010. This increase is in parallel with increases in institutional outbreaks and presentations of gastroenteritis in emergency departments.

Respiratory infections

Influenza

Influenza activity, as measured by the number of people who presented with influenza-like illness to 59 of the state's largest emergency departments, peaked in mid-July and has since continued to decline. In addition, the number of people who tested positive for influenza A by diagnostic laboratories decreased throughout July and August after a peak in late June. The number of patients who tested

 10.1071/NB12114

positive for influenza B increased over the same reporting period but is well below the peak reached in June.

In July, there were:
- 659 presentations to emergency departments (rate 3.3 per 1000 presentations)
- 1711 cases of laboratory-confirmed influenza including:
  - 1552 (91%) influenza A
  - 159 (9%) influenza B.

In August, there were:
- 477 presentations (rate 2.4 per 1000 presentations)
- 1259 cases of laboratory-confirmed influenza including:
  - 915 (73%) influenza A
  - 344 (27%) influenza B.

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

Twenty-two cases of meningococcal disease were notified in NSW in July and August 2012 (14 in July and eight in August), an increase from 15 notified in the same period in 2011. The age of the case-patients ranged from 3 months to 88 years and included five case-patients aged less than 5 years. The death of a 7-month old due to meningococcal disease serogroup B was notified in this period. Thirteen (59%) cases were due to serogroup B (for which there is no vaccine), three were due to serogroup Y, two (9%) were unable to be typed, and for three there was insufficient specimen collected. Of the 15 cases notified during the same period in 2011, 10 were due to serogroup B, two to serogroup W135, one to serogroup Y, and the remaining two were of an undetermined serogroup.

It is recommended that a single vaccine against meningococcal C disease be given to all children at the age of 12 months as well as persons at high risk of disease.[1]

Measles

Fifty-eight cases of measles were notified in NSW in July and August 2012; all were part of an ongoing outbreak that began in April. This was an increase compared to the 16 cases reported for the same period in 2011.

The age groups most affected were children aged 0–4 years ($n = 25$), of which 18 were infants aged less than 1 year, and young people aged 15–19 years ($n = 11$) and 10–14 years ($n = 9$). The average age of notified cases was 12.7 years (range: 4 months–41 years). Approximately half the case-patients were female ($n = 28$, 48%). Four (7%) case-patients were Aboriginal people, and all resided in Sydney South West Local Health District (LHD). Pacific Islander communities continue to be disproportionately affected.

Most cases were notified in the Sydney South West Local Health District (88%), followed by Sydney West (Parramatta) (10%) and Illawarra (2%) LHDs, with a concentration of cases from a small number of local government areas including Campbelltown and Liverpool.

Of the 58 notifications, 57 (98%) were laboratory confirmed. All specimens that were genotyped ($n = 16$) were measles virus genotype D8, indicating this outbreak is associated with the one measles importation from Thailand that was identified in April. Measles virus genotype D8 importations from Thailand in April have also been reported in Europe.[2]

The majority (90%) of the case-patients were not vaccinated for measles. Of the six case-patients that were reported to have been vaccinated, four were aged over 17 years and their vaccination status could not be verified on the Australian Childhood Immunisation Register; the other two case-patients were reported, based on parent recall, of having received one dose.

Two doses of measles-mumps-rubella (MMR) vaccine are recommended for all children (at 12 months and 4 years of age),[1] as well as all young adults planning international travel.

Pertussis

During July and August, 831 cases of pertussis were notified in NSW, less than half the number of cases notified for the same period in 2011 ($n = 1966$). Most case-patients were aged 5–9 years ($n = 220$), followed by the 0–4-year age group ($n = 162$) and the 10–14-year age group ($n = 129$). A 6-week old unvaccinated infant from the Illawarra died from pertussis infection in July.

Direct protection for young infants remains available through free vaccination for pertussis that is administered at 2, 4 and 6 months of age. The first dose can be provided as early as 6 weeks of age. There is also a booster dose at 3½ to 4 years. New parents and grandparents should also discuss the benefits of pertussis vaccination with their general practitioner.

Sexually transmissible infections and bloodborne viruses

Gonorrhoea

There were 678 cases of gonorrhoea notified in NSW in July and August 2012, an increase of 45% compared with the same period last year ($n = 467$). Most cases were notified in South Eastern Sydney LHD (35%) and Sydney LHD (20%) and 81% of case-patients were men.

People most at risk of gonorrhoea are men who have unsafe sex with men, and males and females who have unsafe heterosexual sex. NSW Health is working to enhance surveillance of the infection to better understand the mode of transmission, risk factors and testing patterns at a local level. Gathering further information will help inform campaigns promoting safer sex messages to high-risk communities.

References

1. National Health and Medical Research Council. The Australian Immunisation Handbook. 9th ed. Canberra: Australian Government Department of Health and Ageing; 2008.
2. European Centre for Disease Prevention and Control (ECDC)-HCU-E editorial. Travellers returning with measles from Thailand to Finland, April 2012: infection control measures. Available at: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20184 (Cited 10 October 2012).

Figure 1. Reports of selected communicable diseases, NSW, January 2004 to August 2012, 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%

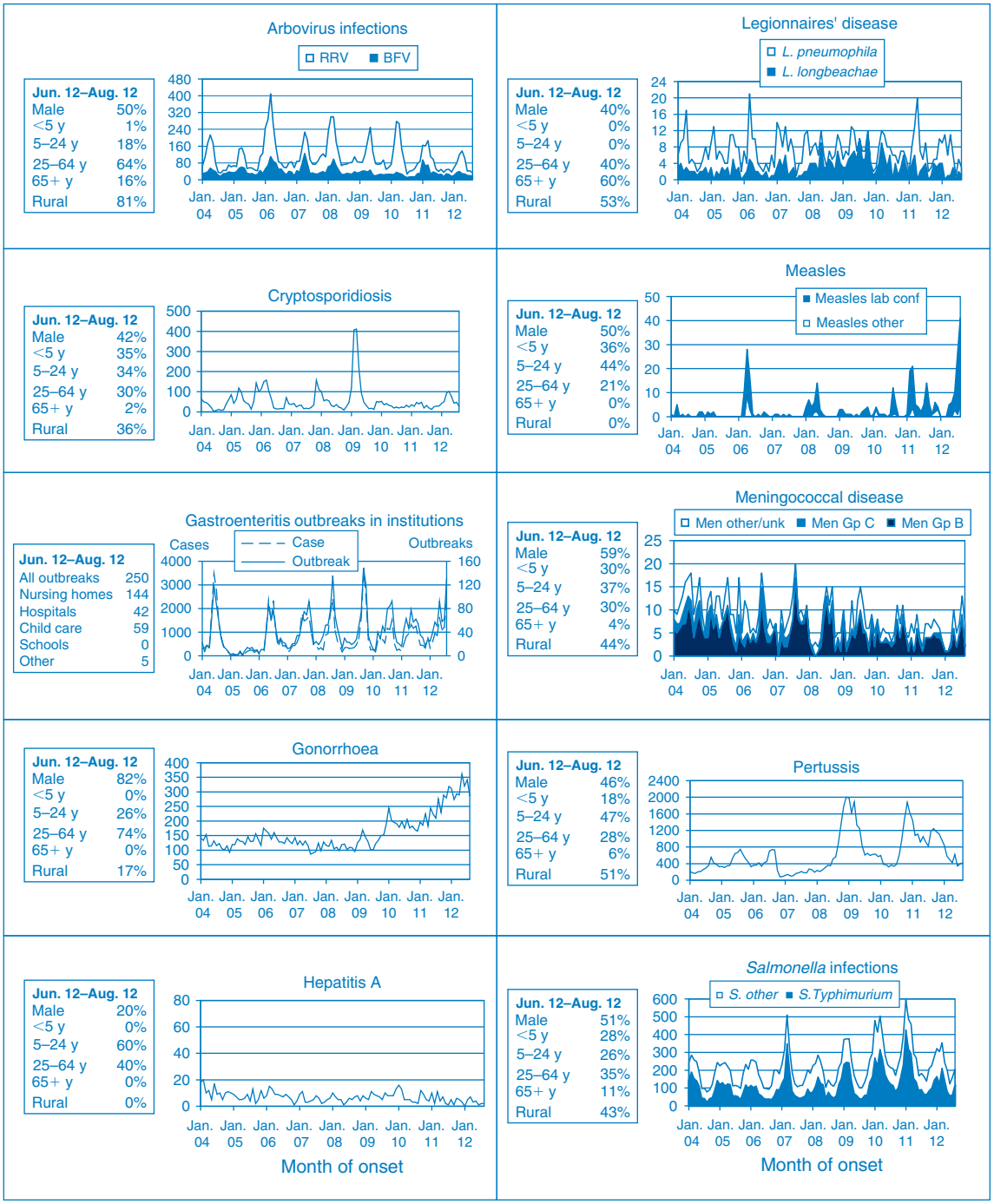

Table 1. Notifications of scheduled medical conditions received in July 2012 by Local Health District, NSW

Condition	Local Health District																Total	
	Murrumbidgee (including Albury)	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 July[b]	Year to date[b]
Bloodborne and sexually transmitted																		
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	66	38	79	9	213	73	60	86	151	292	87	171	171	163	74	17	1758	12 749
Gonorrhoea[a]	3	2	4	3	23	6	5	3	17	118	13	83	38	27	7	–	352	2358
Hepatitis B – acute viral[a]	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	2	13
Hepatitis B – other[a]	3	1	4	–	5	2	2	3	23	39	3	30	40	43	2	2	202	1392
Hepatitis C – acute viral[a]	–	–	1	–	–	1	–	–	1	–	–	–	–	–	–	1	4	26
Hepatitis C – other[a]	16	11	17	4	26	8	6	24	9	32	13	17	34	17	7	31	272	1961
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	8
Syphilis	–	–	1	–	2	–	–	6	4	24	1	–	–	3	–	3	44	396
Vectorborne																		
Barmah Forest virus[a]	1	–	1	–	2	10	3	1	–	–	2	–	–	–	–	–	20	203
Ross River virus[a]	5	–	3	–	8	2	3	1	–	1	2	–	–	–	1	–	26	449
Arboviral infection (other)[a]	–	–	–	–	–	–	–	–	4	3	1	2	2	1	–	–	13	178
Malaria[a]	3	–	1	–	–	–	–	1	–	1	–	2	–	1	–	–	9	35
Zoonoses																		
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brucellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Leptospirosis[a]	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	18
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	10
Q fever[a]	–	1	–	–	2	1	1	–	–	–	–	–	–	–	–	–	5	72
Respiratory and other																		
Blood lead level[a]	3	–	10	27	1	1	–	1	1	4	1	–	–	1	4	–	54	299
Influenza[a]	47	136	29	7	354	105	45	50	402	364	91	179	273	526	142	6	2757	4625
Invasive pneumococcal infection[a]	7	1	5	1	14	4	1	8	6	7	7	4	6	4	3	–	79	299
Legionella longbeachae infection[a]	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	15
Legionella pneumophila infection[a]	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	2	46
Legionnaires' disease (other)[a]	1	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	3	9
Leprosy	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	2
Meningococcal infection (invasive)[a]	–	–	1	–	2	1	2	1	1	2	–	–	3	–	1	–	14	42
Tuberculosis	1	–	–	–	–	–	–	1	2	2	2	2	3	1	–	–	14	162
Vaccine-preventable																		
Adverse event after immunisation	2	–	–	–	3	–	–	–	1	–	2	–	4	1	–	–	13	111
H. influenzae b infection (invasive)[a]	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	2	2
Measles	–	–	–	–	–	–	–	–	–	–	–	1	19	2	–	–	22	42
Mumps[a]	–	–	–	–	1	–	–	1	3	1	–	1	–	1	–	–	8	73
Pertussis	31	25	62	–	33	14	10	12	23	29	16	24	26	58	18	–	381	3902
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Enteric																		
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Cryptosporidiosis[a]	1	1	4	–	11	2	2	2	6	11	3	6	3	5	3	–	60	500
Giardiasis[a]	5	6	8	–	15	1	–	5	17	36	10	6	9	18	3	–	139	1347
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6
Hepatitis A[a]	–	–	–	–	–	–	–	–	1	1	–	–	–	1	–	–	3	23
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	5
Listeriosis[a]	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	2	22
Rotavirus[a]	–	–	2	–	12	4	1	1	12	7	4	5	16	20	11	–	95	437
Salmonellosis[a]	10	4	2	1	17	12	8	6	25	14	8	11	17	9	2	–	146	1802
Shigellosis[a]	–	1	–	–	2	–	–	1	3	1	–	6	2	–	–	–	16	83
Typhoid[a]	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	2	29
Verotoxin producing *E. coli*[a]	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	10
Miscellaneous																		
Creutzfeldt–Jakob disease	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	2
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.
NB: 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.
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Source: Notifiable Conditions Information Management System, Health Protection NSW.

Table 2. Notifications of scheduled medical conditions received in August 2012 by Local Health District, NSW

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Bloodborne and sexually transmitted																		
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	76	43	65	6	275	77	50	73	147	286	83	126	119	170	76	31	1711	14 460
Gonorrhoea[a]	3	2	5	1	16	6	1	6	30	122	7	52	19	36	17	1	326	2684
Hepatitis B – acute viral[a]	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	2	15
Hepatitis B – other[a]	4	1	2	–	4	–	1	1	39	29	1	31	41	56	–	2	213	1605
Hepatitis C – acute viral[a]	–	–	–	–	2	1	–	1	1	–	–	–	–	–	–	–	5	31
Hepatitis C – other[a]	14	8	12	1	48	17	10	20	13	19	12	31	25	27	7	28	292	2253
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8
Syphilis	–	–	–	–	2	–	–	4	5	3	–	1	–	1	1	4	21	417
Vectorborne																		
Barmah Forest virus[a]	1	1	1	–	3	7	1	–	–	–	1	–	–	–	1	–	16	219
Ross River virus[a]	7	1	2	–	4	3	3	1	–	–	1	–	1	–	–	–	23	472
Arboviral infection (other)[a]	–	–	2	–	3	1	1	–	2	2	2	1	2	1	–	1	18	196
Malaria[a]	1	–	–	–	1	–	–	–	–	1	1	–	1	3	1	–	9	44
Zoonoses																		
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brucellosis[a]	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	3
Leptospirosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10
Q fever[a]	–	–	2	–	2	–	–	–	–	–	–	–	1	–	–	–	5	77
Respiratory and other																		
Blood lead level[a]	4	–	6	2	2	1	–	–	1	–	2	–	–	4	2	–	24	323
Influenza[a]	137	71	54	12	393	105	33	31	179	202	94	69	140	161	71	1	1754	6379
Invasive pneumococcal infection[a]	3	3	4	–	11	8	3	3	8	9	5	4	9	13	5	–	88	387
Legionella longbeachae infection[a]	–	–	–	–	1	–	–	–	1	–	1	–	–	1	–	–	4	19
Legionella pneumophila infection[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	3	49
Legionnaires' disease (other)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Meningococcal infection (invasive)[a]	–	–	–	–	–	–	–	1	–	1	–	1	1	2	2	–	8	50
Tuberculosis	–	–	–	–	1	–	–	–	2	4	–	1	–	5	–	–	13	175
Vaccine-preventable																		
Adverse event after immunisation	1	2	–	–	–	–	–	–	2	1	–	1	–	1	1	–	9	120
H. influenzae b infection (invasive)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Measles	–	–	–	–	–	–	–	–	–	–	–	1	30	4	–	–	36	78
Mumps[a]	–	–	1	–	–	–	–	1	1	5	2	3	1	–	–	–	14	87
Pertussis	29	24	42	–	32	16	8	9	51	31	39	22	46	72	29	–	450	4352
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	2	9
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Enteric																		
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	2
Cryptosporidiosis[a]	4	1	–	–	4	–	1	–	4	11	1	1	2	3	2	–	34	534
Giardiasis[a]	6	3	6	–	14	1	1	5	27	20	5	8	6	10	6	–	118	1465
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	7
Hepatitis A[a]	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	2	25
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5
Listeriosis[a]	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	23
Rotavirus[a]	3	2	12	–	25	7	3	7	36	14	19	22	28	49	19	–	246	683
Salmonellosis[a]	11	4	4	4	21	5	1	14	17	26	16	16	20	28	14	–	201	2003
Shigellosis[a]	–	–	–	–	–	–	–	1	1	2	–	2	2	–	–	–	8	91
Typhoid[a]	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	2	31
Verotoxin producing *E. coli*[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	11
Miscellaneous																		
Creutzfeldt–Jakob disease	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.
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NSW GOVERNMENT Health

Contents

NSW PUBLIC HEALTH BULLETIN

The *NSW Public Health Bulletin* is a peer-reviewed journal produced by the NSW Ministry 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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