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Immunisation in NSW

The *NSW Immunisation Strategy 2008–2011*: how are we doing?

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Australian and international experience demonstrates that ongoing monitoring of the delivery of immunisation programs against clear objectives is necessary to maintain the momentum and optimal performance of these programs. With New South Wales (NSW) well into the term of its second Immunisation Strategy, and with the process of re-developing the National Immunisation Strategy underway, it is timely to take stock.

A review of the first NSW Immunisation Strategy (2003–2006) in 2007 found that the NSW Immunisation Program had met its objectives for immunisation coverage (higher than 90% coverage for both Aboriginal and other children at 24 months of age) and had developed the infrastructure to successfully deliver school-based programs (as demonstrated by programs for meningococcal C conjugate and diphtheria-tetanus-pertussis vaccines).[1] The focus of the second strategy (2008–2011) includes: timeliness of immunisation (particularly for children aged 4 years); further progress on immunisation coverage for Aboriginal people of all ages; and further development of school-based programs. It nominates a number of key result areas including achieving coverage targets for specific age groups (Table 1) and priority population subgroups (Aboriginal people, health care workers, under-immunised children), as well as program enhancements (communication, provider support, vaccine supply, surveillance and reporting).

This issue of the *NSW Public Health Bulletin* serves as a mid-term report card for the *NSW Immunisation Strategy 2008–2011*. The intelligence provided will facilitate the contribution of NSW to the development of the new National Immunisation Strategy. To assist readers, at the end of this editorial is a glossary of the abbreviations of the vaccines referred to in this issue (Box 1).

Vaccine-preventable diseases in NSW

As reported in this issue by Spokes and Gilmour, vaccine-preventable disease control in NSW is good and in line with Australian national averages. Invasive disease due to *Haemophilus influenzae* type b, *Neisseria meningitidis* type C and *Streptococcus pneumoniae* serotypes included in the 7-valent pneumococcal conjugate vaccine was rare in 2009.

There are two main gaps in vaccine-preventable disease control: pertussis at all ages; and measles and mumps among adults aged 25–29 years. Epidemic pertussis in 2008 and 2009 and more extensive use of polymerase chain reaction as a diagnostic test in community laboratories combined to greatly increase pertussis reporting.[2] However, in contrast to the largest previous epidemic in 1995–1997 when there were six deaths recorded in NSW,[3] one death was recorded in 2008–2009. This suggests that the much higher levels of population coverage achieved over the past decade have had a favourable impact on the most severe manifestations of pertussis. Over the next 12 months it will be important to evaluate the impact of the NSW initiative (from the first half of 2009) to encourage earlier receipt of the first dose of pertussis-containing vaccine at 6 weeks of age and to offer adult-formulated pertussis vaccine to new parents and other close contacts of infants.

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Table 1. Immunisation coverage targets for the *NSW Immunisation Strategy 2008–2011*

Population group	Coverage category	Target (%)
Infants at birth	Hepatitis B	>90
Pre-school		
• 12 months of age[a]	Fully immunised[d]	>90
• 24 months of age[b]	Fully immunised *(including meningococcal C and varicella)*	>90
School age		
• 5 years of age[c]	Fully immunised	>90
• High school entry	Varicella vaccine	>40
• Females in Years 7 and 8	HPV	Progress towards 90
• Year 10	dTpa	>75
Adults		
• >65 years of age	Influenza	>80
	23vPPV	>60
Aboriginal adults		
• >50 years of age	Influenza	Improved
	23vPPV	

[a]'Fully immunised' = three doses of a diphtheria (D), tetanus (T) and pertussis (P)-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]'Fully immunised' = three or four doses of a DTPa-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 three doses of all other hepatitis B vaccines, and one dose of a measles, mumps and rubella-containing (MMR) vaccine.
[c]'Fully immunised' = four or five doses of a DTPa-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine.
[d]Aboriginal children fully immunised includes 7vPCV.

With respect to measles and mumps among 25–29 year-olds, this age cohort is the most prominent in notifications. These adults have relatively low coverage of the two-dose measles-mumps-rubella (MMR) vaccine as they were too old to be included in the 1998 measles school-based campaign.[4] This age group is also one of the most travelled and contact overseas with measles and mumps heightens their risk of disease. Making MMR vaccine available free of charge to young adults who are planning to travel is an important initiative which should continue, as should promoting public awareness of measles as a travel-acquired infection.

Immunisation coverage

As reported in this issue by Hull et al., at state level NSW is equal to or better than other Australian jurisdictions for all parameters of childhood immunisation coverage. At an area health service level there are some important pockets of low coverage. This is especially relevant to the potential impact of the introduction of measles, as was recently seen in another low coverage area in Australia, the Sunshine Coast in south-east Queensland.[5] Overall coverage at 2 years of age is lowest in the North Coast Area Health Service, but with substantial variability within that region and notable differences in coverage for individual vaccines. Much of this difference is attributable to conscientious objection, with the North Coast having almost four times the state average (4.9% versus 1.3%). If children with no vaccines recorded are broadly considered to be conscientious objectors (but unregistered as such), then the remaining proportion (when the proportions fully immunised and with no vaccines recorded are subtracted) approximates incompletely immunised children – this latter group is where further initiatives to improve access to and awareness of immunisation are most likely to be beneficial. The incompletely immunised proportion is below 4% in two area health services (Greater Western and Hunter New England) but above 5% in all others, with the highest proportion being in the Northern Sydney Central Coast Area Health Service (5.7%).

The most readily identifiable group of partially immunised and therefore late immunised children is Aboriginal children. At state level, coverage of Aboriginal children is almost equal to other children by 24 months of age but lags by 7% at 12 months of age, with an 11.3% gap in the Sydney South West Area Health Service. It is notable that in the North Coast Area Health Service coverage for Aboriginal children at 12 months of age is higher than for

non-Aboriginal children and remains so at 24 months of age.

Adverse events following immunisation

Recent Australian experience demonstrates the importance and the limitations of routine passive post-marketing surveillance of adverse events following immunisation in detecting a signal of excess fever and febrile convulsions in young children who had received one of the 2010 seasonal influenza vaccines (post-marketing – the vaccine has been approved by regulatory authorities for marketing). As emphasised in this issue by Mahajan et al., there is also value in providing reassurance to immunisers, parents and vaccine recipients that there is ongoing scrutiny for adverse events following immunisation and that data are made available to the public and immunisation providers on a regular basis. A stable system of adverse events reporting in NSW for over a decade and a solid denominator through the Australian Childhood Immunisation Register allows credible interpretation of trends. Given the importance of optimal management of adverse events following immunisation, evaluation of novel systems for active adverse event detection are certainly worth exploring.[6] As illustrated in this issue by Wood, the assessment of suspected adverse events is often complex, so the expansion of clinical and advisory services underway in NSW to create a statewide network of relevant medical subspecialists to assist in the assessment of adverse events following immunisation is a very welcome initiative.

School-based vaccination in NSW

As documented in this issue by Ward et al., the reintroduction of NSW school-based vaccination services in 2003 to implement the National Meningococcal C Vaccination Program, leading to the inclusion of all the vaccines recommended by the National Health and Medical Research Council for adolescents, has been a major development and is now well established. Good coverage for students who had not previously received a course of hepatitis B vaccine has been achieved when compared to the administration of vaccines for this age group by general practitioners.[7] The program facilitates the rapid introduction of new vaccines and the schedule changes for existing vaccines to address low coverage of particular age cohorts. An example is the recent change from 15 years of age to 12 years of age for the adult-formulated diphtheria-tetanus-pertussis vaccine (dTpa). The extensive range of catch-up vaccines offered in Intensive English Centres is an important public health initiative to protect these vulnerable students.

Health care worker vaccination

As discussed in this issue by Leask et al., NSW Health introduced a health care worker vaccination policy in 2007 to assist employers to meet their occupational health and safety obligations and their duty of care to staff, clients, students on placement and other users of health services. This international leading policy is unique in that it includes a wide range of vaccines (dTpa, MMR, varicella and hepatitis B) rather than focusing solely on influenza vaccine. Implementation of the policy by universities and area health services has progressed gradually and is now embedded in recruitment strategies.

Conclusion

Progress against the *NSW Immunisation Strategy 2008–2011* is encouraging but efforts to maintain and enhance these gains are needed to ensure that NSW residents continue to enjoy the benefits afforded by effective vaccination. The important contributions of vaccinators in general practice, Aboriginal medical services and area health services should be applauded.

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Box 1. Glossary of the abbreviations of vaccine types used in this issue

BCG	Bacillus of Calmette and Guérin (i.e. tuberculosis)
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
pH1N1	pandemic (H1N1) 2009 influenza
7vPCV	7-valent pneumococcal conjugate vaccine
23vPPV	23-valent pneumococcal polysaccharide vaccine

Erratum

Page 112 – *Chronic disease and climate change: understanding co-benefits and their policy implications* (*N S W Public Health Bull* 2010; 21(5–6): 109–13).

The editorial by Capon and Rissel stated that the cost of congestion in Australia was estimated at $64 million. However, this amount is the savings in the cost of congestion due to cycling.[1] The total cost of congestion was $9.4 billion in 2005, and is expected to rise to $20.4 billion by 2020.[2]

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NSW Annual Vaccine-Preventable Disease Report, 2009

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Abstract: Aims: To describe trends in case notification data for vaccine-preventable diseases in NSW for 2009. **Methods:** Risk factor and vaccination status data was collected from cases through public health unit follow-up. Data from the NSW Notifiable Diseases Database were analysed by: area health service of residence; age; vaccination status; and sub-organism, as appropriate for the period 1991–2009. **Results:** The incidence of vaccine-preventable disease has declined over time. Outbreaks of measles and pertussis occur in the community, associated with unimmunised groups (measles) or as a result of waning immunity (pertussis). **Conclusion:** Regular reporting of vaccine-preventable disease surveillance data will help inform control strategies in NSW.

This is the first in what is planned to be a series of annual reports on vaccine-preventable disease surveillance in New South Wales (NSW). The objectives of vaccine-preventable disease surveillance are to: detect and investigate outbreaks of vaccine-preventable disease; identify close contacts of patients who may be at risk of infection; identify cases of possible vaccine failure; and understand the epidemiology of vaccine-preventable disease (including the impact of immunisation) to inform the development of prevention strategies.

Cases of vaccine-preventable disease were defined according to national criteria.[1] Under the NSW *Public Health Act 1991*, since 1991: medical practitioners have been required to notify patients diagnosed with measles and pertussis; laboratories have been required to notify patients diagnosed with measles, pertussis, rubella, *Haemophilus influenzae* type b, meningococcal disease, mumps and rubella; and hospital general managers have been required to notify patients diagnosed with measles, pertussis, invasive pneumococcal infections (since 2002), *Haemophilus influenzae* type b and meningococcal disease, to NSW Health (via public health units).

Notifications of *Haemophilus influenzae* type b, measles, meningococcal disease, pertussis, pneumococcal disease (people aged less than 5 years and 50 years and over) and tetanus prompt public health follow-up according to NSW case definitions and response protocols.[2] Notifications of mumps and rubella are not routinely followed-up by public health units in NSW.[2] Public health unit staff enter data gathered on notified cases into the statewide Notifiable Diseases Database. This report describes trends in surveillance data for vaccine-preventable diseases in NSW.

Method

Notification data from the NSW Notifiable Diseases Database were reviewed for cases of vaccine-preventable diseases with a date of onset from 1991 to 2009. All rates were calculated using Australian Bureau of Statistics population estimates for the relevant year. Rates are presented as annual rates per 100 000 total population or population in age groups. Risk factor and vaccination status data was collected from cases through public health unit follow-up. In NSW, laboratories provide serotype data for measles, meningococcal and pneumococcal disease. Cases were analysed by place of usual residence according to geographical regions served by the relevant area health service public health unit.[3]

Results

Haemophilus influenzae *serotype b*

Haemophilus influenzae serotype b (Hib) is a bacillus which may be part of the flora of the upper respiratory tract. The bacteria are spread through contact with droplets from the nose or throat of an infected person, in household-like settings. Infection can result in invasive disease including meningitis, epiglottitis, septic arthritis, cellulitis and pneumonia.[4] Since 1993, vaccination against Hib has been available and is provided for infants at 2, 4, 6 and 12 months of age.[5]

Summary of notified cases

The number of notified cases of Hib has decreased significantly in NSW since the introduction of a vaccine, from 124 in 1993 to six in 2009 (Figure 1). In 2009 two cases were aged less than 12 months, one case was aged 14 years and the remaining cases were aged between 40 and 65 years. Two cases were female and four were male. There were no notified cases of Hib in Aboriginal people in 2009.

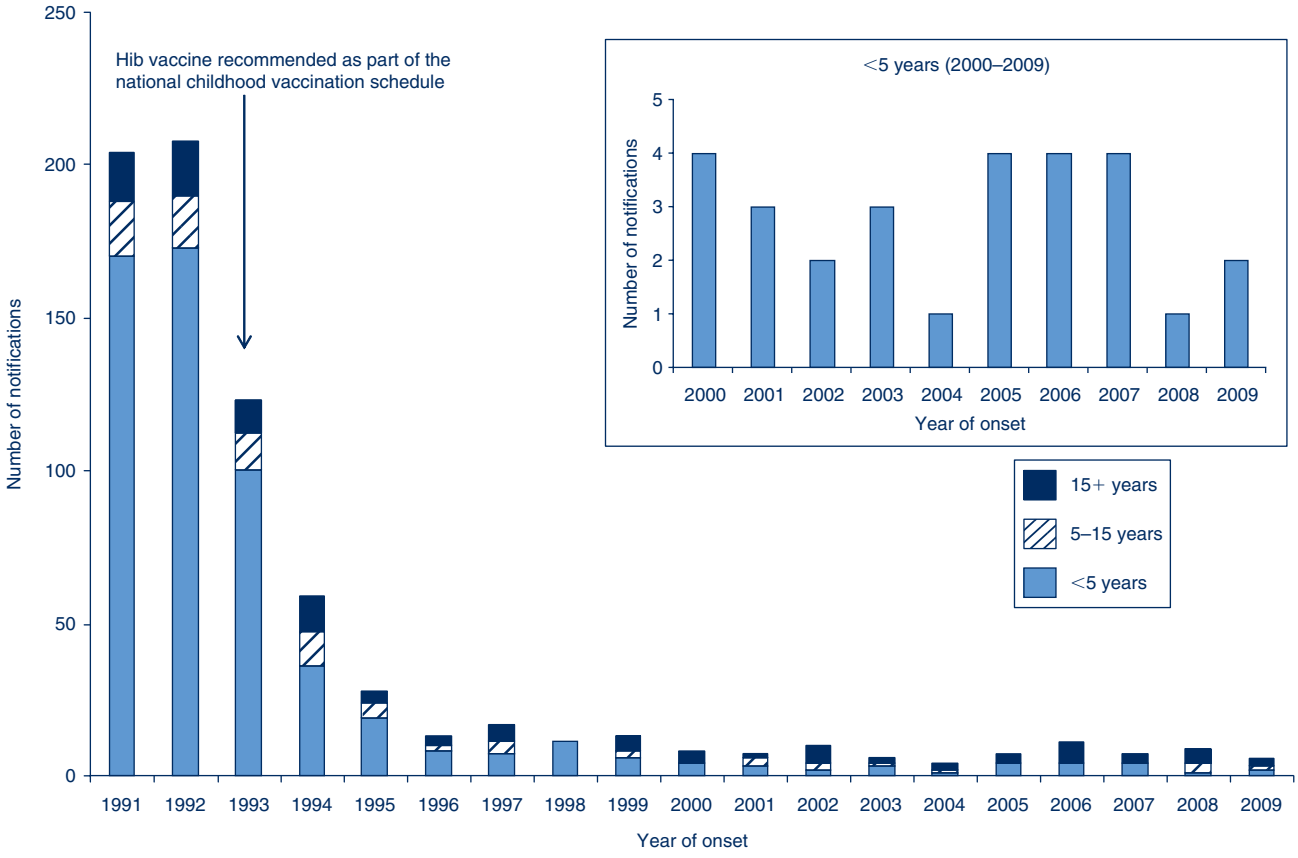

Figure 1. Number of notifications of *Haemophilus influenzae* serotype b by year of onset of illness and for three age groups (<5, 5–15 and 15+ years of age), NSW, 1991–2009. Number of notifications since 2000 in children aged less than 5 years, presented inset.
Source: NSW Notifiable Diseases Database.

Vaccination status

Of the six notified cases of Hib in 2009, three were unvaccinated (all adults), one case was fully vaccinated, one case was fully vaccinated for their age group and one case was too young to be vaccinated.

Comment

Hib is now rarely seen in Australian children. Children aged 6–7 months remain most vulnerable to Hib, until they can acquire their own natural immunity around the age of 2 years. Hib vaccination has successfully reduced the rate of disease in vaccinated children, reducing disease incidence in unvaccinated populations.

Measles

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

Summary of notified cases

In 2009, 19 cases of measles were notified in NSW, compared to 39 in 2008 (Figure 2). Two were unvaccinated infants aged less than 12 months, two were aged 5–9 years, six were aged 10–19 years and nine were aged 20–40 years. Ten cases were female and nine were male. No cases were reported from Aboriginal people in 2009. The highest notification rates were reported from Central Sydney in the Sydney South West Area Health Service (1.4 per 100 000 population) (Table 1).

Vaccination status

Five cases were unvaccinated and for seven cases the vaccination status was unknown. Of the seven cases that reported previous vaccination, four had received one dose, one reported two doses, and for two the number of doses was unknown.

Outbreaks

Most notified cases of measles in NSW are reported in non-immune travellers who return with the infection from countries where measles is endemic or in non-immune people who are exposed to a known case.[6] Of the 19 cases,

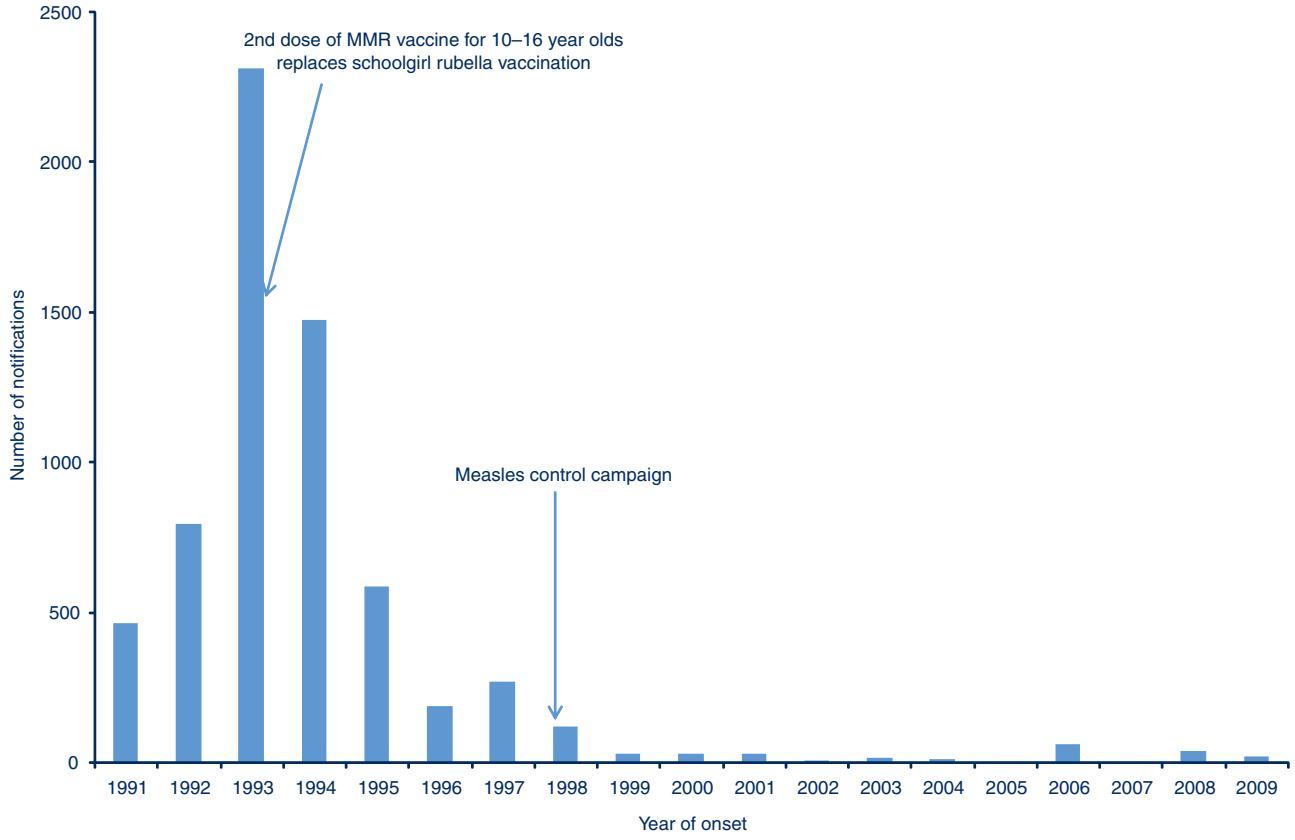

Figure 2. Number of notifications of measles by year of onset of illness, NSW, 1991–2009.
Source: NSW Notifiable Diseases Database.

11 (58%) were associated with overseas travel, five (26%) were secondary contacts of overseas travellers, and for three (16%) the source was unknown (Figure 3). In 2009, one cluster of measles in metropolitan Sydney (involving six cases) was associated with a secondary school trip to Vietnam.

Genotype

There are several different genotypes of the measles virus. In 2009, five cases had measles genotype information identified. Of these, three were identified as H1 (associated with travel to Vietnam), one was D8 (associated with travel to the United States), and one was D9 (associated with travel to Indonesia) (Figure 3).

Comment

In the past, measles infection was very common in childhood. People at risk of contracting measles are those who have never had measles or who have never been vaccinated. A second dose of measles-mumps-rubella (MMR) was added to the National Immunisation Program in 1992.[5] Non-immune travellers who return with the infection from countries where measles is endemic or non-immune people who are exposed to a known case make up the majority of notifications in NSW.

Meningococcal disease

Meningococcal disease is an acute bacterial disease that typically causes septic shock or meningitis (or a combination of these syndromes).[4] Meningococcal disease is caused by infection with meningococcus bacteria, of which here are several serogroups. A vaccine against serogroup C meningococcal disease was added to the National Immunisation Program in 2003 for children at 12 months of age and offered to all persons aged 1–19 years between 2003 and 2004.[5] There is no vaccine licensed in Australia to protect against disease caused by other serogroups.

Summary of notified cases

In 2009, 91 cases of invasive meningococcal disease were notified in NSW (80 confirmed and 11 probable). Eighty cases were reported in 2008 and 108 in 2007. The greatest reduction in notified cases of meningococcal disease has been for serogroup C, from 28% ($n = 44$) of known serogroup cases in 2003 to 9% ($n = 7$) in 2009 (Figure 4). Four deaths were reported in 2009 (two serogroup B, one serogroup W135, and one with an unknown serogroup) compared to three deaths in 2008 (all serogroup B). Eight cases were reported in Aboriginal people in 2009.

Table 1. Number and rate per 100 000 of notifications of vaccine-preventable diseases by area health service region,[a] NSW, 2009

Area Health Service		*Haemophilus influenzae* b		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
Northern Sydney	CCA	0	0	0	0	2	0.6	1	0.3	665	212.4	37	11.8	0	0	0	0
Central Coast	NSA	0	0	3	0.4	7	0.9	7	0.9	1113	135.3	41	5.0	2	0.2	0	0
South Eastern	ILL	0	0	1	0.3	10	2.6	2	0.5	1386	363.3	31	8.1	0	0	0	0
Sydney Illawarra	SES	1	0.1	3	0.4	20	2.5	8	1	1064	133.5	63	7.9	1	0.1	0	0
Sydney South	CSA	0	0	8	1.4	8	1.4	6	1	641	112	40	7	1	0.2	0	0
West	SWS	0	0	2	0.2	7	0.8	3	0.4	1044	122.4	62	7.3	0	0	1	0.1
Sydney West	WEN	2	0.6	0	0	4	1.2	0	0	952	295.8	18	5.6	0	0	0	0
	WSA	1	0.1	1	0.1	6	0.7	4	0.5	1182	146.3	49	6.1	1	0.1	0	0
Greater Southern	GMA	0	0	0	0	1	0.4	1	0.4	550	203.5	8	3	0	0	0	0
	SA	0	0	0	0	2	0.9	0	0	367	170.5	11	5.1	1	0.5	0	0
Greater Western	FWA	0	0	0	0	0	0	0	0	58	131.5	1	2.3	0	0	0	0
	MAC	0	0	0	0	3	2.9	1	1	283	271	4	3.8	0	0	0	0
	MWA	0	0	0	0	2	1.1	0	0	392	225.1	13	7.5	0	0	0	0
Hunter New	HUN	2	0.3	1	0.2	9	1.5	2	0.3	1251	209	65	10.9	1	0.2	0	0
England	NEA	0	0	0	0	4	2.2	1	0.6	226	124.7	15	8.3	0	0	0	0
North Coast	MNC	0	0	0	0	2	0.7	0	0	531	179	10	3.4	0	0	0	0
	NRA	0	0	0	0	4	1.4	3	1	811	278.3	13	4.5	0	0	0	0

[a]Area health service further divided into the geographical region covered by their component public health unit. CCA, Central Coast Area; NSA, Northern Sydney Area; ILL, Ilawarra Area; SES, South Eastern Sydney Area; CSA, Central Sydney Area; SWS, South Western Sydney Area; WEN, Wentworth Area; WSA, Western Sydney Area; GMA, Greater Murray Area; SA, Southern Area; FWA, Far West Area; MAC, Macquarie Area; MWA, Mid Western Area; HUN, Hunter Area; NEA, New England Area; MNC, Mid North Coast Area; NRA, Northern Rivers Area.

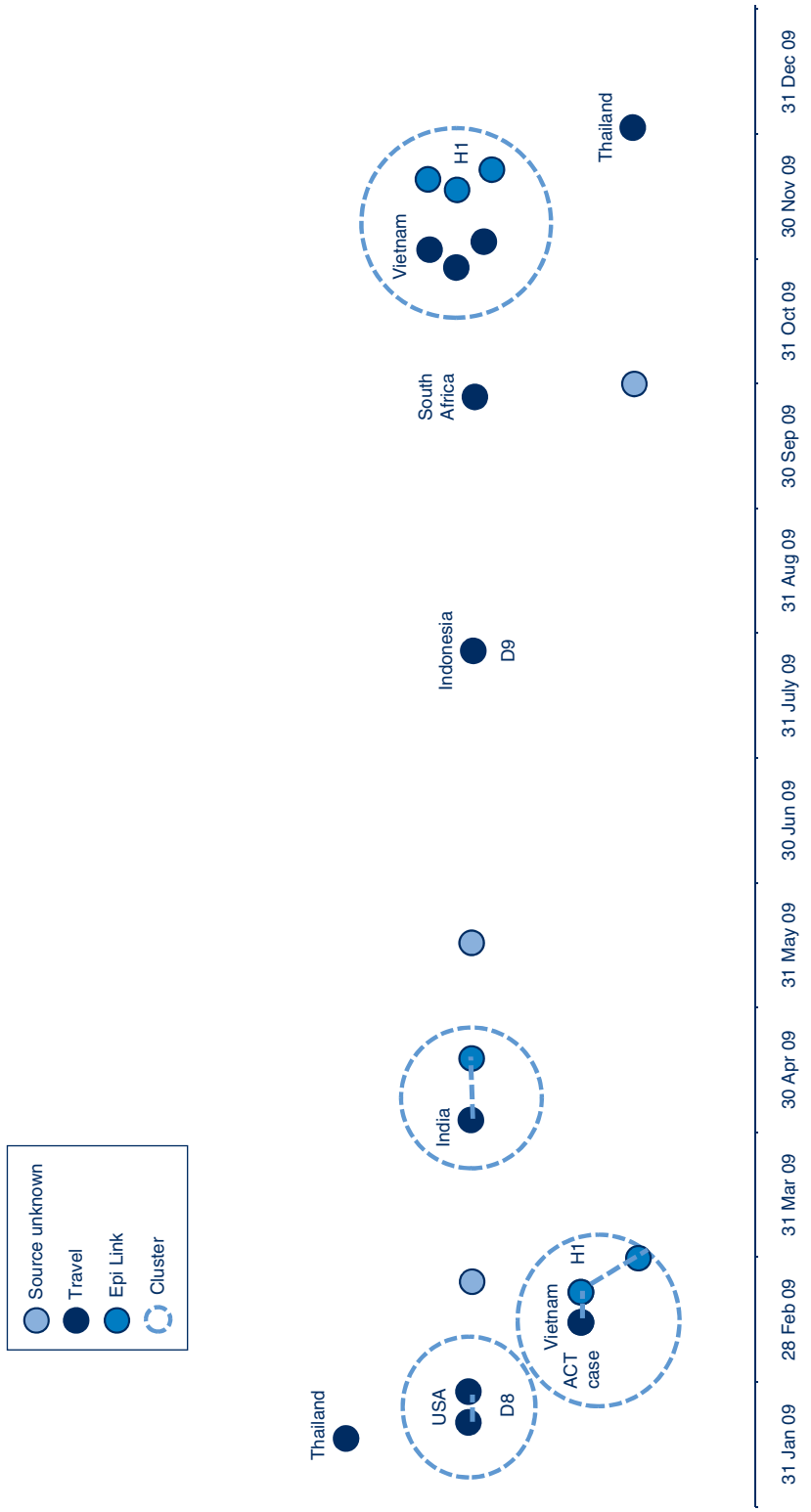

Figure 3. Cluster diagram of measles notifications by month of onset, source of infection and genotype, NSW, 2009.
Source: NSW Notifiable Diseases Database.

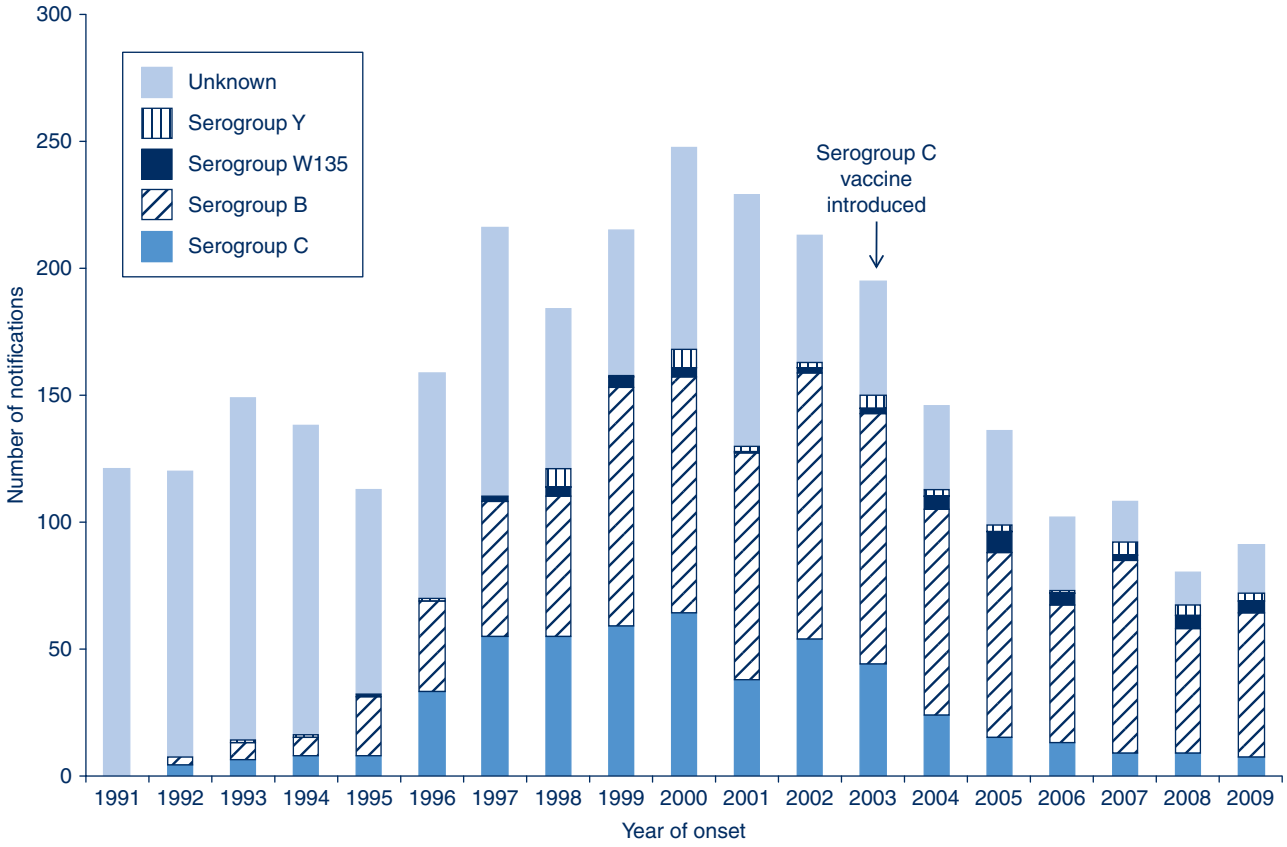

Figure 4. Number of notifications of invasive meningococcal disease for four serogroups (C, B, Y, W135) and where serogroups are unknown, NSW, 1991–2009.
Source: NSW Notifiable Diseases Database.

The highest notification rates of meningococcal disease were reported among children aged less than 5 years of age at onset of illness (29 cases, 6.2 per 100 000 population) and young people aged 15–19 years (21 cases, 4.4 per 100 000 population). Of the notifications from children aged less than 5 years, the highest rates were reported from infants aged less than 12 months (12 cases, 13.3 per 100 000 population) (Figure 5). Geographically, the highest notification rates were reported from Central Sydney in the Sydney South West Area Health Service (1.4 per 100 000 population) (Table 1).

Vaccination status

Vaccination status was complete for 84 cases (92%). Of these, 43 were vaccinated against serogroup C. Of the vaccinated cases, 31 (74%) were serogroup B, one was serogroup W135, one was serogroup Y, eight were unknown serogroup and one was serogroup C (an apparent vaccine failure).

Serogroup

Of the 91 cases notified in NSW in 2009, serogroup information was recorded for 74 (81%). In 2009, 59 (80%) cases with known serogroup information were caused by serogroup B (for which there is no vaccine), seven (9%) were serogroup C, five (7%) were serogroup W135 and three (4%) were serogroup Y. Of the 17 (19%) cases with unknown serogroup information, for eight the serogroup could not be typed and six were clinical diagnoses.

Comment

The number of notified cases of invasive meningococcal disease has declined significantly since the National Meningococcal C Immunisation Program commenced in 2003. Serogroup C meningococcal disease is now mainly seen in adults and unimmunised children. Meningococcal disease associated with serogroup B has also decreased (although not to the extent of serogroup C disease) and non-vaccine serogroups (W135 and Y) have remained relatively stable over time.

Mumps

Mumps is an acute infectious disease caused by the mumps virus. Common symptoms of mumps include fever, loss of appetite, tiredness and headaches followed by swelling and tenderness of the salivary glands. Illness is usually more severe in people infected after puberty.[4] In NSW, vaccination is provided using MMR vaccine at 12 months and 4 years of age.[5]

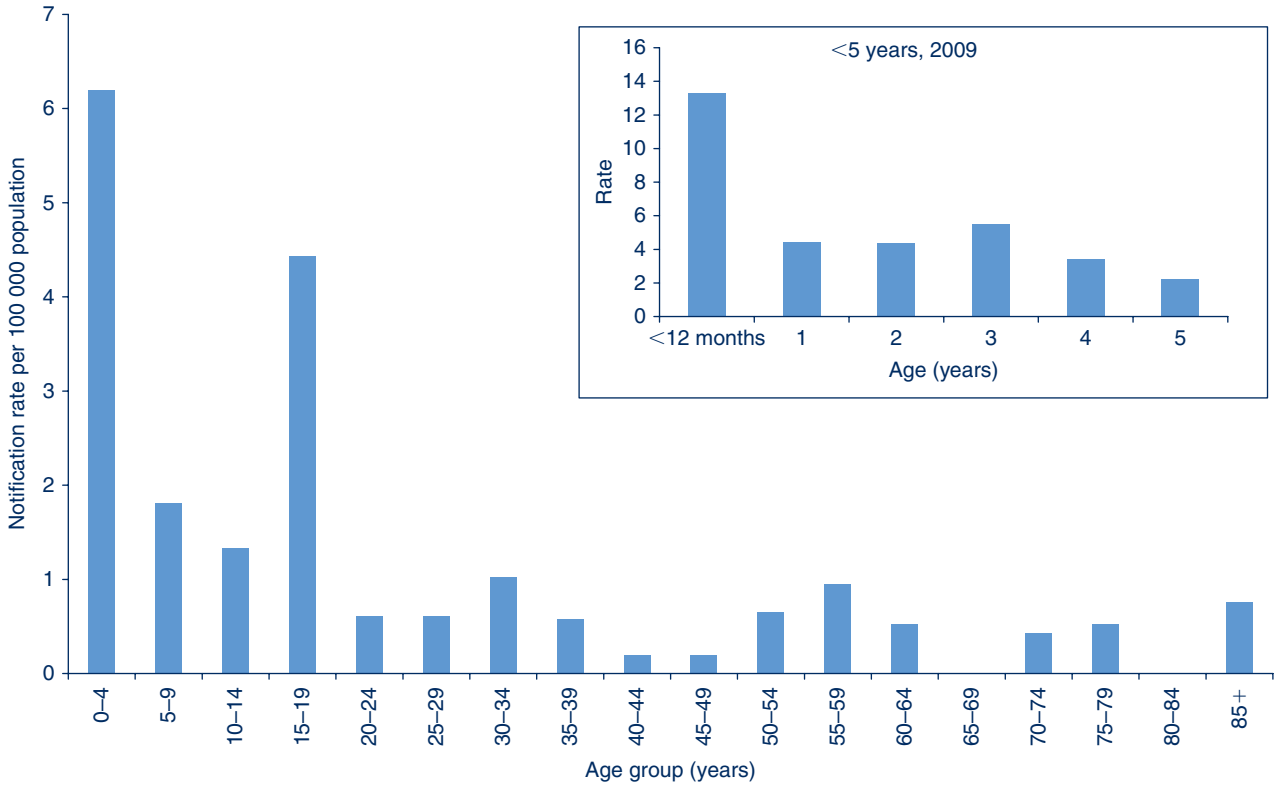

Figure 5. Annual notification rate of invasive meningococcal disease by 5 year age groups, NSW, 2009. Annual notification rate in children aged less than 5 years for 2009 for each year of age, presented inset.
Source: NSW Notifiable Diseases Database.

Summary of notified cases

In 2009, 39 cases of mumps were notified in NSW compared to 76 in 2008 and 318 in 2007 (Figure 6). The highest numbers of cases were reported among young adults aged 20–29 years at onset of their illness (10 cases, 1.0 per 100 000 population). Males made up 62% of cases. The highest rates were reported from Central Sydney in the Sydney South West Area Health Service (1.1 per 100 000 population) and Northern Rivers in the North Coast Area Health Service (1.0 per 100 000 population).

Vaccination status

Notified cases of mumps are not routinely followed-up by public health units in NSW to determine vaccination status. As a result, vaccination status was complete for 10 (26%) cases in 2009.

Comment

In NSW, notified cases of mumps are not routinely followed-up by public health units. A significant increase in mumps notifications (largely from young adults in South Eastern Sydney in the South Eastern Sydney Illawarra Area Health Service) was reported in 2007.[7] Notifications have since returned to baseline levels with no outbreaks or clusters reported in 2009.

Pertussis

Pertussis (or whooping cough) is a disease caused by infection of the throat with the bacteria *Bordetella pertussis*. Pertussis can be very serious in small children. Older children and adults may have a less serious illness, with bouts of coughing that continue for many weeks regardless of treatment.[4] Pertussis vaccination is combined with diphtheria and tetanus (DTPa) in a primary course at 2, 4 and 6 months of age and a booster at 4 years of age. A second booster dose is given between 15 and 17 years of age using the adult dTpa formulation.[5]

Summary of notified cases

In 2009, 12 578 cases of pertussis were notified in NSW compared with 8759 in 2008 and 2100 in 2007. While epidemics of pertussis occur every 3–5 years,[8,9] the number of cases notified in 2008 and 2009 far exceeded previous epidemic years (Figure 7). The number of notified cases peaked during the first quarter (5497) and declined in the last quarter of 2009 (1823).

The highest pertussis notification rates were reported from children aged less than 5 years (2826 cases, 623.5 per 100 000 population) and 5–9 years (2653 cases, 598.4 per 100 000 population). Of the cases aged less than 5 years, the highest notification rates were reported from

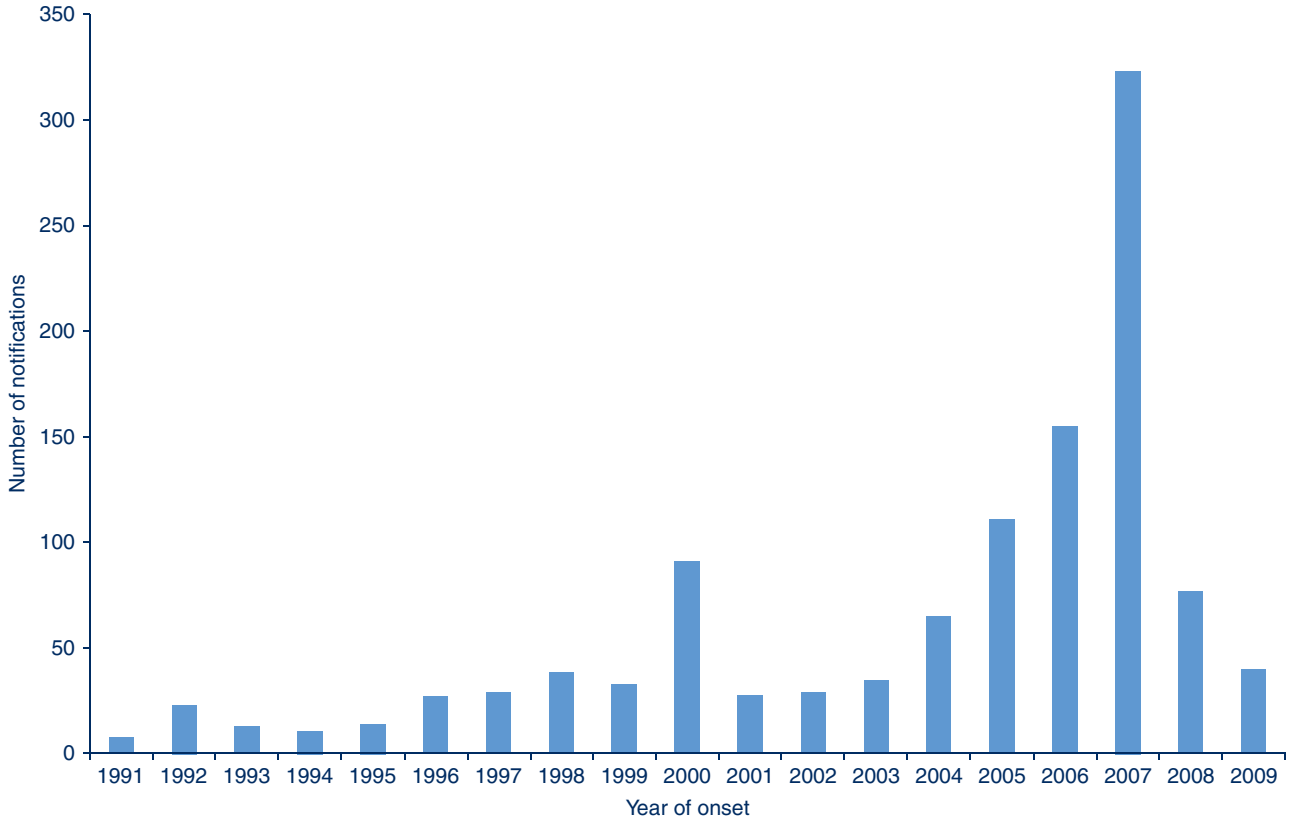

Figure 6. Number of notifications of mumps by year of onset of illness, NSW, 1991–2009.
Source: NSW Notifiable Diseases Database.

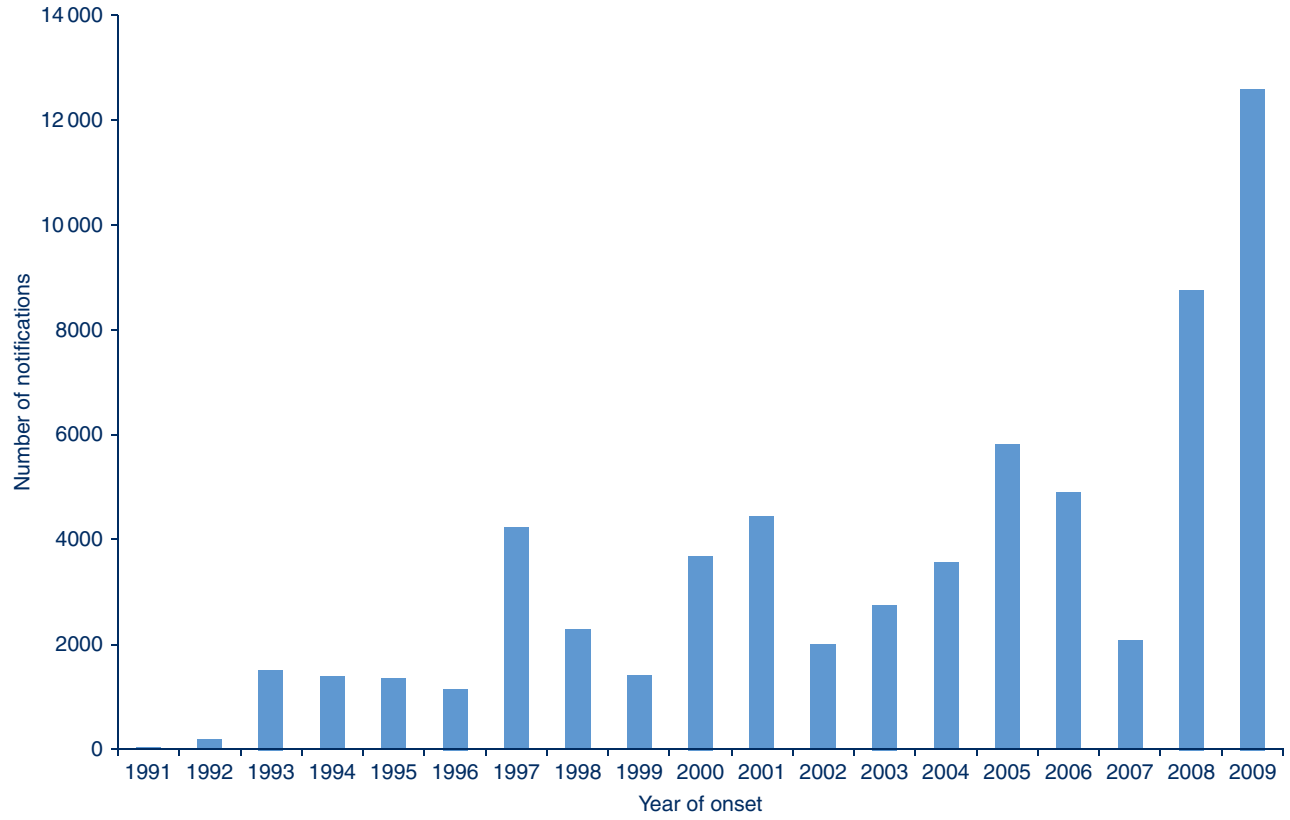

Figure 7. Number of notifications of pertussis by year of onset of illness, NSW, 1991–2009.
Source: NSW Notifiable Diseases Database.

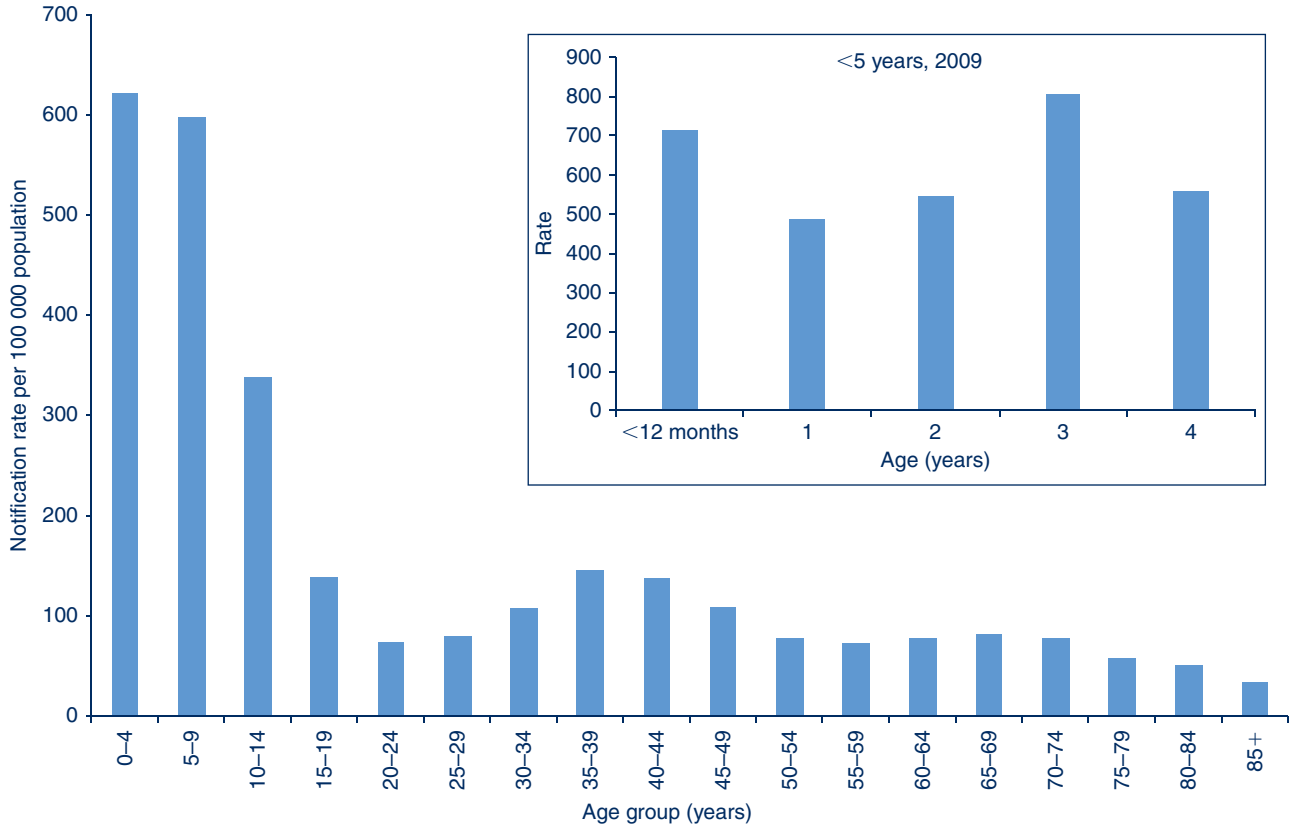

Figure 8. Annual notification rate of pertussis by 5 year age groups, NSW, 2009. Annual notification rate in children aged less than 5 years for 2009 for each year of age, presented inset.
Source: NSW Notifiable Diseases Database.

children aged 3 years (807.0 per 100 000 population) and infants aged less than 12 months (713.5 per 100 000 population) (Figure 8). The highest notification rates were reported from Illawarra in the South Eastern Sydney Illawarra Area Health Service (363.3 per 100 000 population) and Northern Rivers in the North Coast Area Health Service (278.3 per 100 000 population) (Table 1).

Vaccination status

In 2009, 2426 (85.8%) notified cases of pertussis in children aged 0–4 years had complete immunisation status data. Of these, 423 (17%) were unimmunised or partially immunised infants aged less than 12 months.

Method of diagnosis

Prior to the 2008–2009 epidemic the majority of pertussis cases notified in NSW were identified through serological testing, largely for people aged 20 years and over. During 2008 there was an increase in the use of polymerase chain reaction testing for pertussis diagnoses by laboratories across all age groups. Diagnoses by polymerase chain reaction testing accounted for 83% of pertussis cases notified in 2009.

Comment

The number of notified cases of pertussis increased significantly in the second half of 2008 and peaked during the first quarter of 2009. In 2009, the number of cases in children aged 1–4 years increased dramatically and in disproportion to previous years. This was particularly striking for children aged 3 years at onset of illness; 82% (of those with complete vaccination data) were reported to have received the full primary course (three doses) of vaccine, but had not received the 4-year booster dose. One reason for the increase in cases from the 3–4 year age group may be associated with waning immunity prior to the first booster dose recommended at 4 years of age.

There has been a significant shift in diagnostic testing practices by laboratories for pertussis in NSW from serology to the more sensitive polymerase chain reaction. In addition, the cut-off levels for a commonly used serological test changed across NSW. As a result, it may be difficult to compare 2008 and 2009 data with previous epidemic years.

Pneumococcal disease (invasive)

Pneumococcal disease is caused by infection with the bacteria *Streptococcus pneumonia* and is a frequent cause of serious bacterial infections.[4] There are more than 90 different serotypes that can cause the disease. Vaccines for children aged less than 5 years (7-valent pneumococcal conjugate vaccine – 7vPCV) and adults older than 65 years

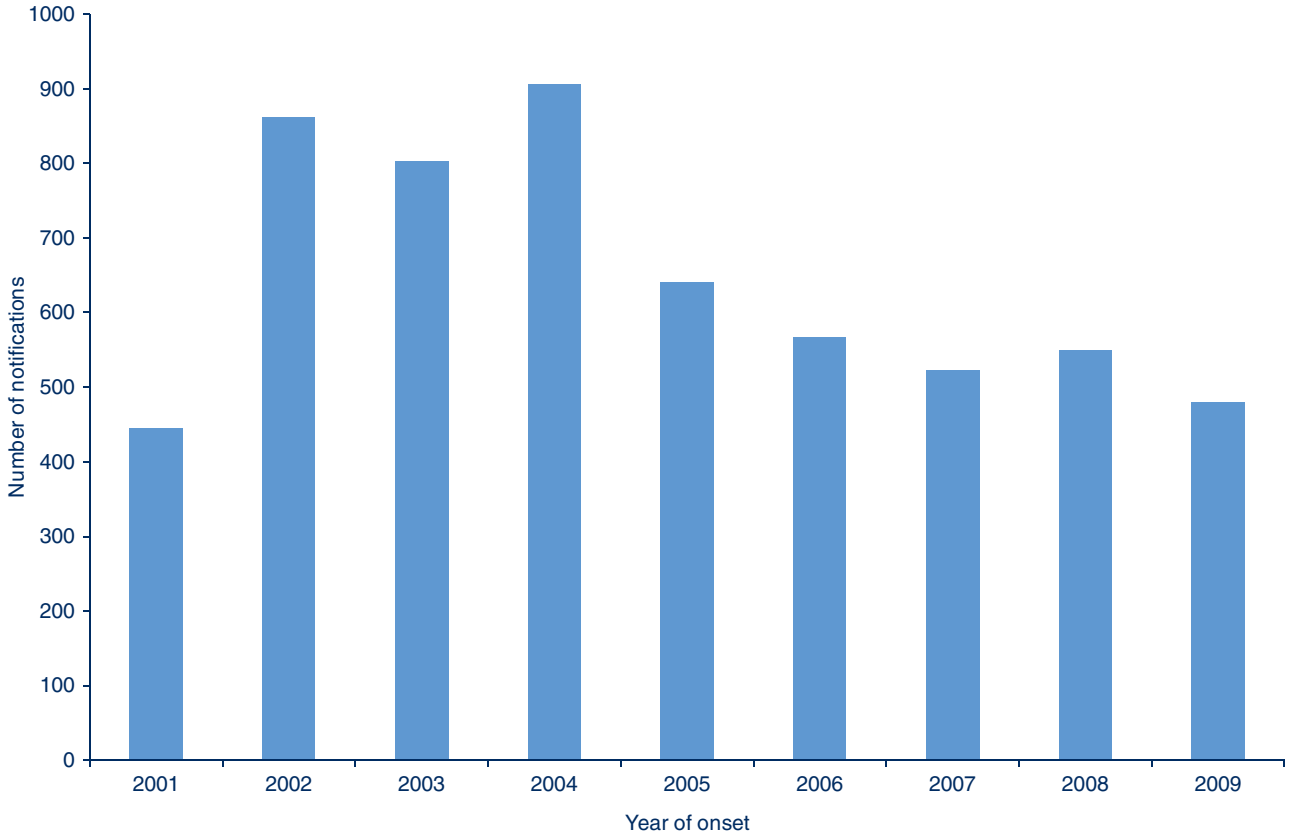

Figure 9. Number of notifications of pneumococcal disease by year of onset of illness, NSW, 2001–2009. Source: NSW Notifiable Diseases Database.

(23-valent pneumococcal polysaccharide vaccine – 23vPPV) were introduced into the National Immunisation Program in 2005.[5] In NSW, cases aged 5–49 years are not routinely followed-up by public health units.

Summary of notified cases

The number of notified cases of invasive pneumococcal disease has declined significantly since 2005 (Figure 9). In 2009, 480 cases of invasive pneumococcal disease were reported in NSW (6.8 per 100 000 population). The highest notification rates of invasive pneumococcal disease were reported in adults aged more than 80 years (29.2 per 100 000 population) and children aged less than 5 years (16.6 per 100 000 population) (Figure 10). Of the cases aged less than 5 years, the highest notification rates were reported in infants aged less than 12 months (30.0 per 100 000 population) and children aged 1 year (19.9 per 100 000 population). Geographically, the highest notification rates were reported from the Central Coast in the Northern Sydney Central Coast Area Health Service (11.8 per 100 000 population) and the Hunter in the Hunter New England Area Health Service (10.9 per 100 000 population) (Table 1). Aboriginal status was complete for 82% of cases and 11 cases were reported from Aboriginal people (data is incomplete for cases aged 5–49 years). Fifty-three deaths were reported in adults aged 50 years and over. There were no deaths reported in children.

Serotype

Of the 480 cases of invasive pneumococcal disease notified in 2009, 445 (93%) had complete serotype information. In children aged less than 5 years with known serotype information, five (8%) had disease caused by a vaccine-related serotype 19F. The majority of invasive pneumococcal disease in children is caused by serotypes not covered by the 7-valent vaccine, particularly serotype 19A which accounted for 39 (52%) cases. In adults aged 50 years and over, 71 (28%) cases were caused by a non-vaccine-related serotype. However, serotype 19A, which is included in the adult vaccine, accounted for 67 (26%) notifications.

Antibiotic susceptibility

Penicillin resistance was reported in 22% of cases aged less than 5 years and 11% of cases aged 50 years and over. Serotype 19A accounted for 79% of penicillin-resistant serotypes in cases aged less than 5 years and 69% in cases aged 50 years and over.

Vaccination status

Of the 75 notified cases from children aged less than 5 years, 63 (84%) were fully vaccinated. Of these, three (5%) were vaccine failures from serotype 19F, 54 (86%) were from serotypes not included in the current vaccine and in six (10%) cases the serotypes were unknown.

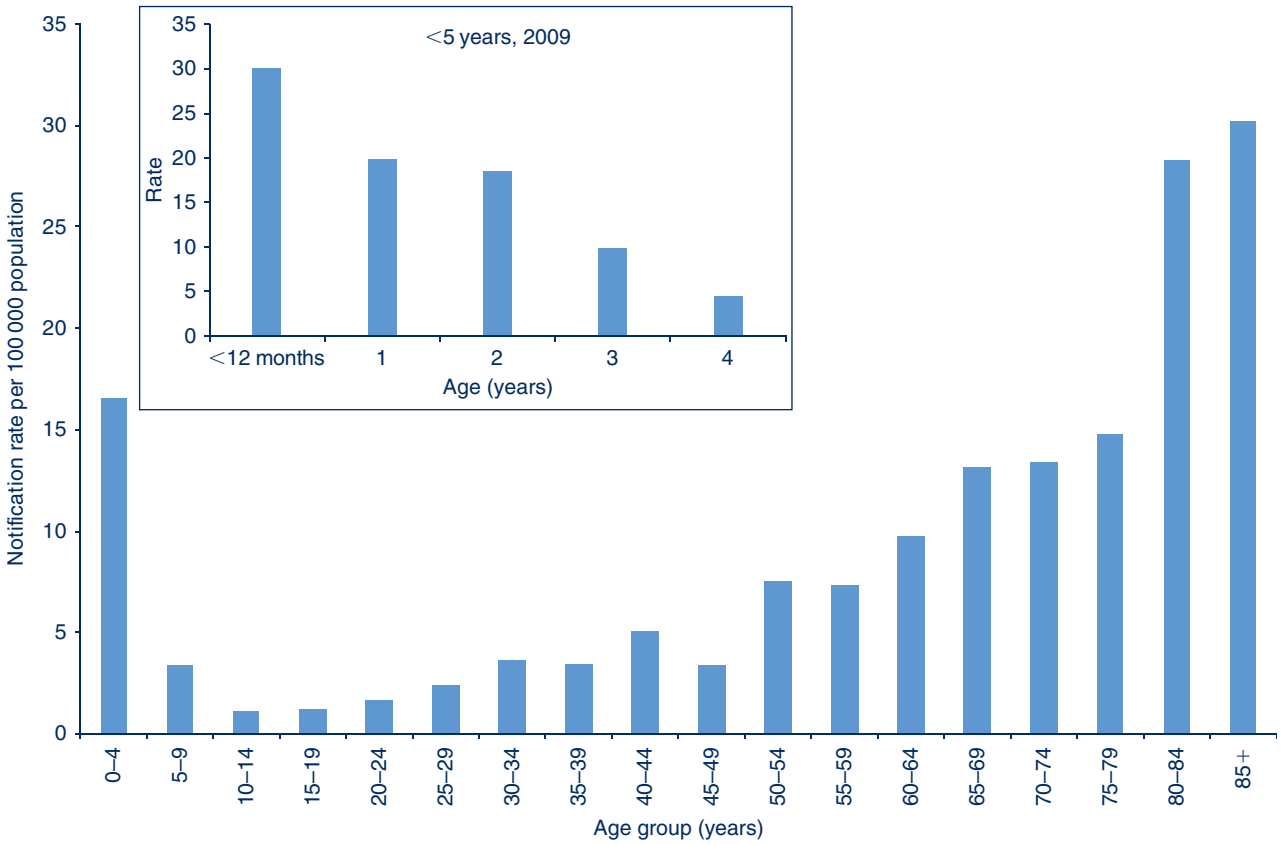

Figure 10. Annual notification rate of invasive pneumococcal disease by 5 year age groups, NSW, 2009. Annual notification rate in children aged less than 5 years for 2009 for each year of age, presented inset.
Source: NSW Notifiable Diseases Database.

Of the 280 notified cases from adults aged 50 years and over, 59 (21%) were fully vaccinated. Of these, 33 (56%) were from serotypes included in the vaccine, 24 (41%) were from serotypes not included in the current vaccine and in two (3%) cases the serotypes were unknown.

Comment

Invasive pneumococcal disease has significantly decreased in children under the age of 5 years, with moderate decreases in adults aged 50 years and over following the inclusion of pneumococcal vaccines (7vPCV and 23vPPV) into the National Immunisation Program in 2005.[10] In children especially, disease caused by serotypes included in the 7-valent vaccine are uncommon, however, replacement invasive disease (disease caused by serotypes not included in the 7vPCV vaccine) has been increasing in recent years (particularly disease caused by serotype 19A). Furthermore, penicillin resistance – which has been relatively stable in NSW for the past 10 years – has significantly increased in the last 2 years. Previously, resistance in NSW primarily occurred in serotypes 9V and 19F (serotypes covered by the 7vPCV vaccine) (Gilmour R, unpublished data, 2010). Since the introduction of the 7vPCV vaccine in NSW, these serotypes rarely if at all occur and, therefore, penicillin resistance has been low. In both 2008 and 2009, penicillin resistance in children aged less than 5 years in NSW was at the highest levels recorded since data collection began in 1997: serotype 19A contributes to 79% resistance in children aged less than 5 years and 69% resistance in adults aged 50 years and over.

Rubella

Rubella (or German measles) is an infectious viral disease. Although a mild infection in most people, infection in early pregnancy can cause serious birth defects or miscarriage. Rubella is spread from an infected person by droplets from the nose or mouth or by direct contact.[4] Rubella is easily spread to people who have not been vaccinated or previously infected. Rubella vaccination is provided using MMR vaccine at 12 months and 4 years of age.[5]

Summary of notified cases

In 2009, seven cases of rubella were notified in NSW compared to 17 in 2008. The number of notified cases of rubella has remained stable since 2005 with an average of 18 cases reported annually. The highest notification rates were reported among young adults aged 25–29 years (0.6 per 100 000 population). In 2009, three (43%) cases were female. The highest rates were reported from North Sydney in the Northern Sydney Central Coast Area Health Service (0.2 per 100 000 population) (Table 1).

Comment

Notifications of rubella are not routinely followed-up by public health units in NSW. Notification trends for rubella are similar to those observed for measles and mumps, with cases generally declining over time.[11]

Tetanus

Tetanus (sometimes called lock-jaw) is a disease caused by the bacteria *Clostridium tetani*. Toxin made by the bacteria, which grows at the site of an injury, attacks a person's nervous system. Although now rare due to immunisation, tetanus can be fatal. *C. tetani* bacteria are found in dust and animal faeces and infection may occur after minor injury (sometimes unnoticed punctures to the skin that are contaminated with soil, dust or manure) or after major injuries such as open fractures, dirty or deep penetrating wounds, and burns.[4] Tetanus is not passed from one person to another. Vaccination against tetanus is given to children with diphtheria and pertussis (DTPa) in a primary course at 2, 4 and 6 months of age. A booster dose of DTPa is given at 4 years.[5] A second booster dose has been included in the National Immunisation Program for those aged 15–17 years since 2004 using the adult dTpa formulation.

Summary of notifications

In 2009, one case of tetanus was notified in NSW. The man, aged in his thirties, reported symptoms after standing on a nail.

Comment

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

Discussion

The numbers of notified cases of most vaccine-preventable diseases reported in NSW is low although occasional outbreaks do occur. In NSW, outbreaks of vaccine-preventable disease are usually the result of non-vaccinated people travelling to countries where vaccine-preventable disease is more common, as was the case in the measles outbreak where 84% of cases reported in NSW had either travelled overseas or had had contact with someone who had recently travelled overseas.

Epidemics of vaccine-preventable disease occur from time to time. For pertussis, outbreaks occur every 3–4 years and are thought to be the result of waning immunity, particularly in adults and adolescents who become a significant reservoir for infection. Ongoing review of vaccines and vaccination schedules is paramount in preventing vaccine-preventable disease.

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

Conclusion

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

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NSW Annual Immunisation Coverage Report, 2009

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Abstract: Aims: This is the first in a series of annual immunisation coverage reports that document trends in NSW for a range of standard measures derived from Australian Childhood Immunisation Register data, including overall coverage at standard age milestones and for individual vaccines. This report includes data up to and including 2009. **Methods:** Data from the Australian Childhood Immunisation Register, the NSW Health Survey and the NSW School Immunisation Program were used to calculate various measures of population coverage relating to childhood vaccines, adult influenza and pneumococcal vaccines and adolescent vaccination, respectively. **Results:** Immunise Australia Program targets have been reached for children at 12 and 24 months of age but not for children at 5 years of age. Delayed receipt of vaccines is an issue for vaccines recommended for Aboriginal children. Pneumococcal vaccination in the elderly has been steadily rising, although it has remained lower than the influenza coverage estimates. For adolescents, there is better coverage for the first and second doses of human papillomavirus vaccine and the dose of dTpa than for varicella. **Conclusion:** This comprehensive analysis provides important baseline data for NSW against which future reports can be compared to monitor progress in improving immunisation coverage. Immunisation at the earliest appropriate age should be a public health goal for countries such as Australia where high levels of vaccine coverage at milestone ages have been achieved.

This is the first *New South Wales (NSW) Annual Immunisation Coverage Report*. A series of annual reports will provide NSW Health with information on important trends and issues in immunisation coverage in NSW. It provides a detailed summary for 2009 that includes: vaccination coverage at the standard milestone ages for vaccines not included in standard assessments; vaccination coverage for adolescents, the elderly and Aboriginal children; data for small geographic areas on coverage; and information on the prevalence of conscientious objectors to immunisation.

This report uses the longstanding international practice of reporting coverage at key milestone ages to measure coverage against national targets and to track trends over time. It is adapted from annual national immunisation reports published since 2008.[1]

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

The Australian Childhood Immunisation Register was established on 1 January 1996 by incorporating demographic data from Medicare on all enrolled children aged less than 7 years.[3] Medicare constitutes a nearly complete population register, as approximately 99% of children are registered by 12 months of age. The operations of the Australian Childhood Immunisation Register have been discussed in detail elsewhere.[2]

Table 1 presents the NSW Immunisation Program for children in 2009. No new vaccines were introduced to the NSW Immunisation Program during 2009.

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),

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

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

October 2009 – The recommendation that the fourth dose of DTPa vaccine can be given from 3½ years of age instead of the previously recommended 4 years of age.

January 2009 – The Maternity Immunisation Allowance changed to be 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.

October 2008 – The General Practice Immunisation Incentive Service Incentive Payment ceased.

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 for children up to 4 years of age delivered through the NSW Immunisation Program, 2009

Age	Vaccine								
Birth	Hep B								
2 months	Hep B	DTPa	Hib	Polio			7vPCV		Rotavirus
4 months	Hep B	DTPa	Hib	Polio			7vPCV		Rotavirus
6 months	Hep B	DTPa	Hib	Polio			7vPCV		
12 months			Hib		MMR			Men C	
18 months						VZV			
4 years		DTPa		Polio	MMR				

Hep B = hepatitis B vaccine; DTPa = diphtheria, tetanus, and acellular pertussis-containing vaccine; Hib = *Haemophilus influenzae* type b vaccine; MMR = measles-mumps-rubella vaccine; VZV = varicella zoster virus vaccine; 7vPCV = 7-valent pneumococcal conjugate vaccine; Men C = meningococcal C vaccine.
Source: National Immunisation Program Schedule.

24 months of age (for vaccines due at 12 and 18 months), and 5 years of age (for vaccines due at 4 years). A minimum 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 completely immunised with the vaccines of interest by the designated age as the numerator and the total number of Medicare-registered children in the age cohort as the denominator. 'Fully immunised' at 12 months of age was defined as a child having a record on the Australian Childhood Immunisation Register of three doses of a diphtheria (D), tetanus (T) and pertussis-containing (P) vaccine, three doses of polio vaccine, three doses of *Haemophilus influenzae* type b (Hib) vaccine and three doses of hepatitis B vaccine. 'Fully immunised' at 24 months of age was defined as three or four doses of a DTP-containing vaccine, three doses of polio vaccine, four doses of Hib vaccine, three doses of hepatitis B vaccine, and one dose of a measles, mumps and rubella-containing (MMR) vaccine. 'Fully immunised' at 5 years of age was defined as four or five doses of a DTP-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine.

Immunisation coverage estimates were also calculated for individual National Immunisation Program vaccines, including the National Immunisation Program vaccines not included in calculations for incentive payments and 'fully immunised' status. They were: the third dose of 7vPCV and second dose of rotavirus vaccine by 12 months of age; and the first dose of varicella vaccine and first dose of meningococcal C vaccine by 24 months of age.

Timeliness

Age-appropriate immunisation was defined as receipt of a scheduled vaccine dose within 30 days of the recommended age. We categorised delayed vaccination as 1–6 months and greater than 6 months. All children included in the analysis were old enough to potentially experience delays in immunisation greater than 6 months for immunisation due by 24 months of age or earlier. Timeliness of

different vaccines and doses was also compared by plotting the cumulative percentage receiving each vaccine dose by age, with the proportion ever immunised set as 100%.

Aboriginal status

Aboriginal status on the Australian Childhood Immunisation Register is recorded as 'Aboriginal', 'non-Aboriginal' or 'unknown', as reported by the child's carer to Medicare or by the immunisation provider to the Australian Childhood Immunisation Register. For this report we considered two categories of children: 'Aboriginal' and 'non-Aboriginal'; children with unknown Aboriginal status were presumed to be 'non-Aboriginal'. Coverage estimate time trends are presented from 2004 only, due to poor rates of reporting of Aboriginal status prior to that time.[8]

Small area coverage

Coverage was calculated for Australian Bureau of Statistics (ABS)-defined Statistical Subdivisions.[9] We chose ABS-defined Statistical Subdivisions as areas to be mapped because they provide more detail than area health services (AHSs) but are not too small to render maps unreadable (child population sizes for Statistical Subdivisions in NSW range from 89 to 7000 children). Maps were created using version 10 of the MapInfo mapping software (version 10, MapInfo Corporation, New York, USA) and the ABS Census Boundary Information. As postcode is the only geographical indicator on the Australian Childhood Immunisation Register, the ABS Postal Area to Statistical Local Area Concordance 2006 was used to match the Australian Childhood Immunisation Register residential postcodes of the children to Statistical Subdivsions.[10]

Conscientious objection/No vaccine recorded

A child must be registered with Medicare before its parent(s) can lodge a conscientious objection to immunisation. Conscientious objectors are eligible for immunisation incentive payments, however parents may also object to immunisation but refuse to lodge any official objection. We used the percentage of children with no vaccines recorded on the Australian Childhood Immunisation Register as a proxy measure of the number of these children. Proportions of conscientious objectors and children with no vaccines recorded by AHSs were calculated from the cohort of children registered with Medicare and born between 1 January 2003 and 31 December 2008. At the time of data extraction they were 12–72 months of age. We chose this cohort when calculating proportions so that children under the age of 12 months were not included, to allow sufficient time for registration of objection and to exclude infants late for vaccination.

Coverage in the elderly and adolescents

Influenza and pneumococcal vaccination coverage estimates in the elderly were from the NSW Health Survey. This is a rolling random digit-dialled telephone survey, with vaccination status determined from patient recall at the time of the interview. Methods and results are presented in more detail elsewhere.[7] Coverage for vaccines given to adolescents were collected from the NSW School Immunisation Program. Vaccination status is recorded by school immunisation teams and counts collated by AHSs and NSW Health. The denominator is the school population. Methods and more results are presented in the accompanying paper in this issue.[11]

Results

Overall coverage estimates

In NSW, coverage for all individual vaccines and 'fully immunised' for the 12-month and 24-month age groups is greater than the Immunise Australia Program's target of 90% in all AHSs (except for rotavirus at 12 months of age and varicella at 24 months of age) (Tables 2 and 3). Recorded coverage for the 5-year age group is below the target, at around 82% for all vaccines and even lower in particular AHSs (Table 4). Figure 1 shows time trends in 'fully immunised' coverage at three milestone ages. The proportion 'fully immunised' at 1 and 2 years of age increased steadily over the period. Coverage estimates at 6 years of age (for vaccines due at 4 years) increased steadily from early 2002 to late 2007, including a noticeable increase in June 2006 corresponding with the introduction of combination vaccines. However, from the beginning of 2008 the assessment age was changed from 6 years to 5 years, resulting in substantially lower coverage for this age group by December 2009.

Coverage estimates for individual vaccines

Coverage for the Hib and hepatitis B vaccines at 12 months of age are greater than DTPa and polio coverage prior to the change in algorithm to measure coverage that occurred in the later half of 2009. The change tightened the rules regarding Hib and hepatitis B vaccines for 12-month olds to lead to more accurate measures of Hib and hepatitis B vaccine coverage in NSW. Coverage has since lowered, becoming similar to the coverage estimates of DTPa and polio in the last two cohorts of 2009 (Figure 2). Almost all AHSs had 12-month coverage at more than 90% for all vaccines except rotavirus (Table 2).

The trends in childhood vaccination coverage in Australia for individual vaccines at 24 months of age are shown in Figure 3. Coverage for the 24-month age group increased substantially and suddenly in September 2003 following the removal of the 18-month dose of DTPa from the immunisation schedule. For most of the study period, hepatitis B coverage was higher than for all other vaccines, at just under 95%, due to the different coverage algorithm described above. Coverage was lowest for MMR and Hib, the only vaccines that have a 12-month dose used in

Table 2. Percentage of children immunised at 12 months of age, by vaccine for each area health service in NSW, compared with NSW and Australia, 2009[a]

Vaccine	Area Health Service[b]								NSW	Australia
	GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	%	%
Diphtheria-tetanus-pertussis	93.9	93.0	93.5	87.7	93.4	92.5	92.6	93.0	92.7	92.3
Poliomyelitis	93.8	93.0	93.4	87.6	93.4	92.4	92.5	93.0	92.6	92.3
Haemophilus influenzae type b	96.1	95.9	96.1	90.9	95.0	94.8	95.1	95.3	95.1	94.8
Hepatitis B	96.0	95.8	96.0	90.7	94.6	94.7	95.2	95.4	95.0	94.7
Rotavirus	89.0	87.0	87.7	82.2	86.6	86.2	86.5	86.3	86.5	83.9
7vPCV[d]	93.6	92.6	93.0	87.1	92.2	91.5	91.7	92.2	91.9	91.5
Fully immunised[c]	93.6	92.9	93.3	87.2	92.6	91.9	92.1	92.7	92.2	91.8
Fully immunised (including rotavirus and 7vPCV)[d]	87.4	85.0	86.2	80.4	85.3	84.0	84.1	84.6	84.7	84.8
Total number of children	**6947**	**3734**	**13 227**	**5465**	**13 319**	**17 143**	**20 670**	**16 987**	**97 492**	**296 759**

[a]For the birth cohort born in 2008.
[b]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
[c]'Fully immunised' = three doses of a diphtheria (D), tetanus (T) and pertussis-containing (P) vaccine, three doses of polio vaccine, two or three doses of PRP-OMP containing *Haemophilus influenzae* type b (Hib) vaccine or three doses of any other Hib vaccine, and two or three doses of Comvax hepatitis B vaccine or three doses of all other hepatitis B vaccines.
[d]7vPCV = 7-valent pneumococcal conjugate vaccine.
Source: The Australian Childhood Immunisation Register.

Table 3. Percentage of children immunised at 24 months of age, by vaccine for each area health service in NSW, compared with NSW and Australia, 2009[a]

Vaccine	Area Health Service[b]								NSW	Australia
	GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	%	%
Diphtheria-tetanus-pertussis	95.9	96.2	95.9	90.4	93.9	94.5	94.8	94.7	94.7	94.6
Poliomyelitis	95.9	96.2	95.9	90.5	93.8	94.5	94.7	94.7	94.6	94.6
Haemophilus influenzae type b	95.9	96.7	96.1	90.7	94.0	94.7	95.2	95.1	94.9	94.3
Hepatitis B	96.6	97.5	96.9	91.6	94.3	95.2	95.8	95.8	95.5	95.4
Measles-mumps-rubella	97.7	97.0	97.1	95.8	96.4	96.5	96.3	96.3	96.6	96.9
Varicella	82.1	83.0	83.6	74.8	79.3	79.3	80.9	80.2	80.5	81.8
Meningococcal C	95.0	95.6	95.4	89.2	92.4	92.8	93.1	93.0	93.3	93.4
Fully immunised[c]	94.1	94.1	94.3	88.1	90.8	91.7	92.1	92.0	92.1	92.1
Fully immunised (including meningococcal C and varicella)	81.0	81.2	82.3	73.7	77.2	77.3	78.5	77.9	78.5	79.8
Total number of children	**6914**	**3945**	**13 441**	**5573**	**13 626**	**17 108**	**20 271**	**17 242**	**98 474**	**298 899**

[a]For the birth cohort born in 2008.
[b]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
[c]'Fully immunised' = three or four doses of a DTPa-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 (MMR) vaccine.
Source: The Australian Childhood Immunisation Register.

coverage calculations. Almost all AHSs had 24-month coverage estimates at more than 90% for all vaccines except varicella (Table 3).

The coverage trends in NSW for individual vaccines at 6 years of age (5 years of age from December 2007) are shown in Figure 4. Coverage for all three vaccines was almost identical and remained steady until mid-2006 when a sharp increase of almost 5% was recorded, likely due to the introduction of combination vaccines. From December 2007, due to the change in assessment age discussed previously, coverage was markedly lower for all vaccines

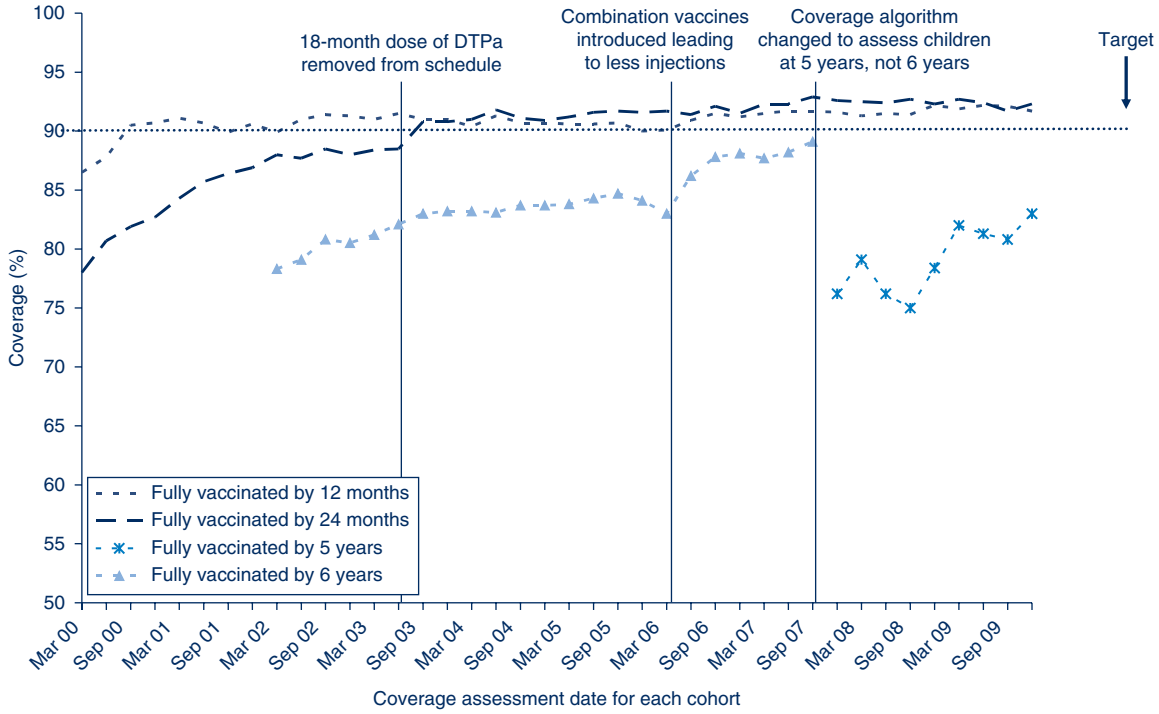

Figure 1. Trends in 'fully immunised' vaccination coverage, NSW, 2000–2009, for four age cohorts compared with the Immunise Australia Program coverage target.
Source: Australian Childhood Immunisation Register.

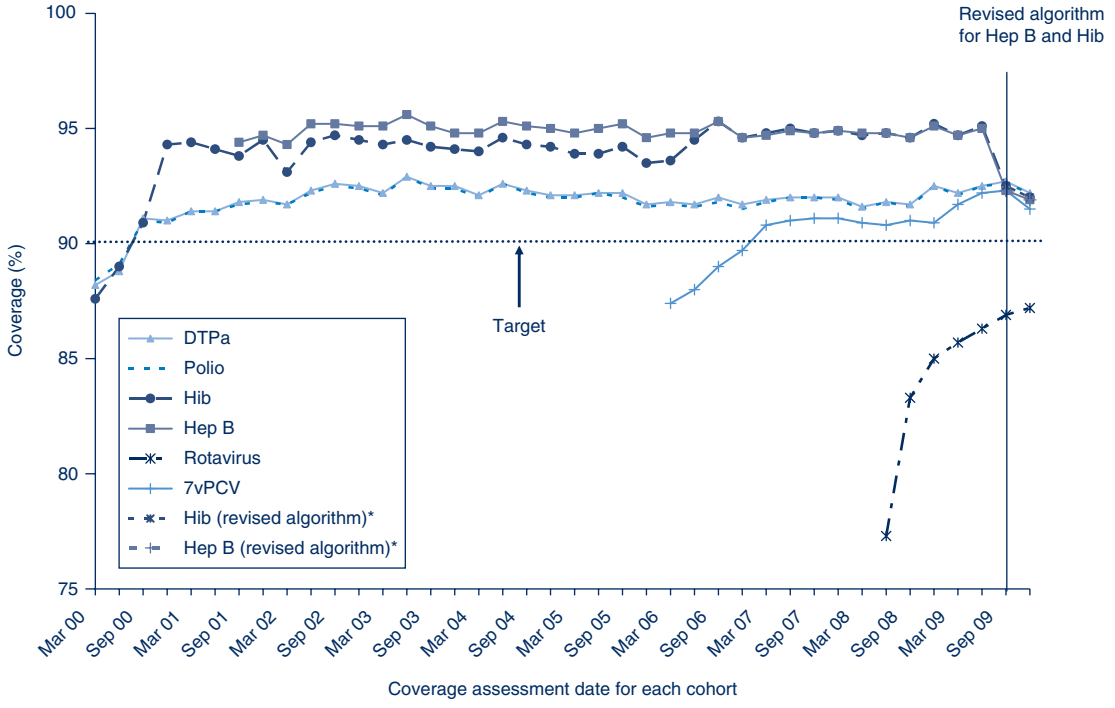

Figure 2. Trends in vaccination coverage estimates for individual vaccines at 12 months of age (DTPa, polio, hepatitis B, Hib, rotavirus and 7vPCV),[a] NSW, 2000–2009, compared with the Immunise Australia Program coverage target.

By 3-month birth cohorts born between 1 January 1999 and 31 December 2008. Coverage assessment date was 12 months after the last birth date of each cohort.
[a]Third dose of DTPa, polio, Hib, Hep B, rotavirus and 7vPCV.
*Prior to September 2009, the algorithm stated that receipt of 2 or 3 doses of Hib and Hep B vaccines rendered a child 'fully immunised' for these vaccines. After September 2009, changes to the algorithm were made to tighten the rules regarding 'fully immunised' for Hib and Hep B vaccines.

Source: Australian Childhood Immunisation Register.

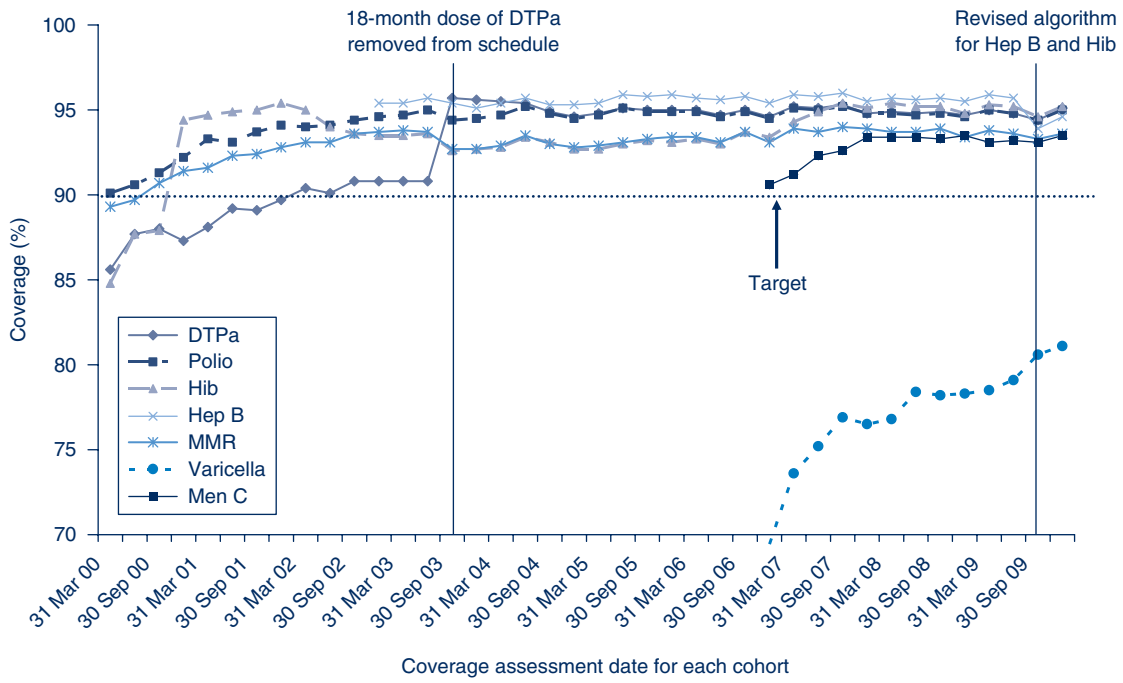

Figure 3. Trends in vaccination coverage estimates for individual vaccines at 24 months of age (DTPa, polio, hepatitis B, Hib, MMR, varicella and Men C)[a] compared with the Immunise Australia Program coverage target.

By 3-month birth cohorts born between 1 January 1996 and 31 December 2007. 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 Hib, third dose of Hep B, one dose of MMR, one dose of varicella and one dose of Men C.

Source: Australian Childhood Immunisation Register.

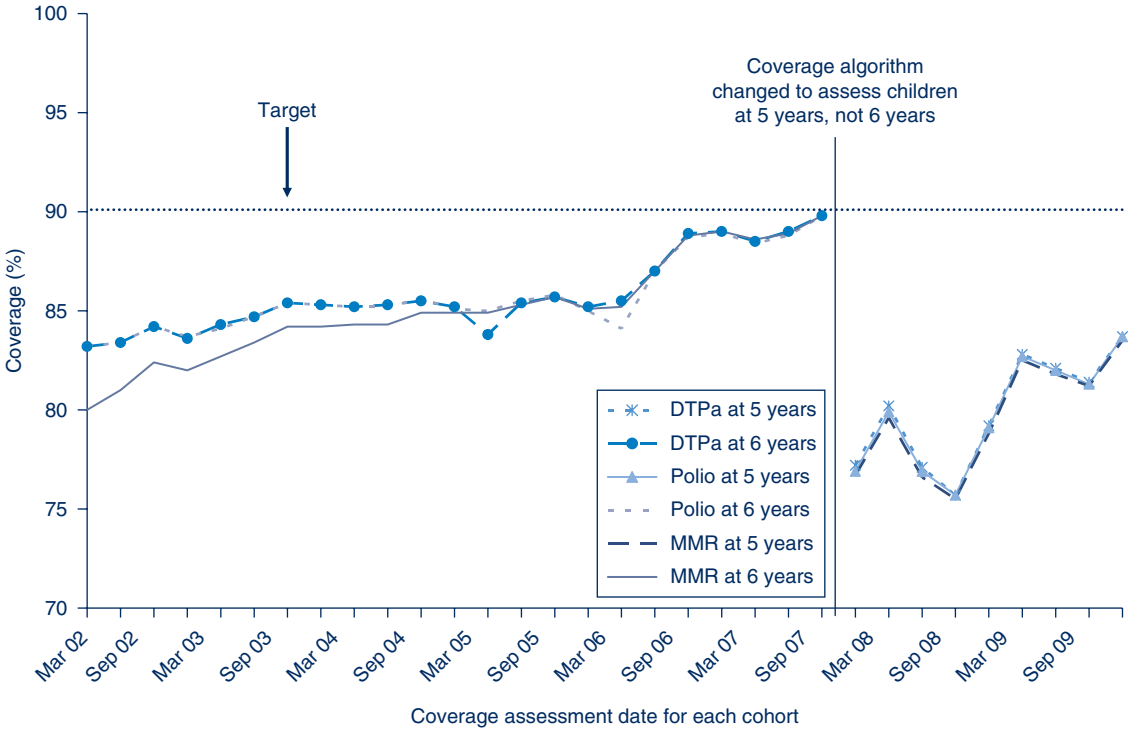

Figure 4. Trends in vaccination coverage estimates for individual vaccines (DTPa, polio and MMR)[a] at 6 years of age (5 years from December 2007) compared with the Immunise Australia Program coverage target.

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, second dose of MMR.

Source: Australian Childhood Immunisation Register.

Table 4. Percentage of children immunised at 5 years of age, by vaccine and area health service in NSW, compared with NSW and Australia, 2009[a]

Vaccine	Area Health Service[b]								NSW	Australia
	GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	%	%
Diphtheria-tetanus-pertussis	84.3	80.3	86.0	75.5	82.9	82.5	81.8	82.9	82.6	83.4
Poliomyelitis	84.2	80.3	86.0	75.5	82.9	82.5	81.8	82.9	82.6	83.4
Measles-mumps-rubella	84.2	80.4	85.9	75.5	82.5	82.3	81.5	82.6	82.4	83.2
Fully immunised[c]	83.9	80.0	85.5	74.9	82.0	81.7	81.1	82.0	81.9	82.7
Total number of children	**6543**	**3466**	**12 182**	**5301**	**12 603**	**15 176**	**17 802**	**15 207**	**88 502**	**269 719**

[a]For the birth cohort born in 2004.
[b]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
[c]'Fully immunised' = four or five doses of a DTPa-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine.
Source: The Australian Childhood Immunisation Register.

due by 5 years of age. The overall 'fully immunised' estimate for 5-year coverage was approximately 82% in NSW, slightly lower than the national 5-year coverage rate of 82.7%. No AHSs in NSW had 5-year coverage estimates at more than 90%, the lowest being the North Coast AHS with around 75% (Table 4).

Coverage estimates for Aboriginal children

Vaccination coverage estimates in 2009 for the three milestone ages for individual vaccines by Aboriginal status are shown in Table 5. These show that coverage was lower for Aboriginal children than non-Aboriginal children at the 12-month and 5-year age milestones, with the difference being greater at 12 months of age.

The proportion of Aboriginal children fully immunised at 12 months of age was lower compared with coverage for non-Aboriginal children (Table 6). Coverage was lower among Aboriginal children in most AHSs, except in the Northern Sydney Central Coast and North Coast AHSs where coverage in Aboriginal children was 1.3% higher than in non-Aboriginal children. The extent of the difference varied among AHSs, reaching more than 11% in some. However, by 24 months of age, coverage disparities between Aboriginal and non-Aboriginal children had almost disappeared in most AHSs (Table 6). All AHSs had more than 90% coverage for Aboriginal children with the highest Aboriginal 24-month coverage observed in the Greater Western AHS.

At 5 years of age, the proportion recorded as being 'fully immunised' was lower than that of earlier age milestones. There was 4% lower coverage in Aboriginal children compared to non-Aboriginal children while, for individual AHSs, coverage in Aboriginal children was lower in most AHSs than in non-Aboriginal children and higher in one AHS.

Coverage estimates for National Immunisation Program vaccines not routinely reported elsewhere

7vPCV and rotavirus

Coverage for 7vPCV vaccine has remained at high levels since first calculated for NSW in early 2006 (Figure 2). Coverage is similar in all AHSs at greater than 91%, except the North Coast (Table 2).

Rotavirus vaccine was added to the National Immunisation Program in July 2007; coverage for three doses at 12 months of age was calculated only from the July 2008 quarter onwards. Coverage increased in NSW from July 2008 to December 2009 (Figure 2). Rotavirus coverage was lower and had greater variation between AHSs compared with other vaccines given at 2, 4 and 6 months of age, which is expected from the vaccine most recently introduced to the National Immunisation Program. Reported coverage for two doses of rotavirus at 12 months of age varied amongst AHSs (Table 2).

Meningococcal C and varicella

Meningococcal C vaccine was added to the National Immunisation Program in January 2003. Coverage for this vaccine has remained at high levels since first calculated for NSW in early 2006 (Figure 3). Coverage is similar in all AHSs at greater than 92%, except the North Coast (Table 3).

Figure 3 shows coverage for varicella vaccine has consistently been lower than that for meningococcal C vaccine. Coverage is similar in all AHSs except the North Coast (Table 3).

Coverage estimates for vaccines for the elderly (pneumococcal and influenza)

The proportion of people aged 65 years and over vaccinated for influenza in the past 12 months remained relatively stable at over 70% during the period

Table 5. Vaccination coverage estimates by age, vaccine and Aboriginal status in NSW, 2009

Vaccine	Milestone age	Aboriginal %	Non-Aboriginal %
Diptheria-tetanus-pertussis	12 months[a]	87.5	92.9
	24 months[b]	94.3	94.7
	5 years[c]	78.2	82.1
Poliomyelitis	12 months	87.5	92.8
	24 months	94.3	94.6
	5 years	78.1	82.1
Haemophilus influenzae type b	12 months	93.8	95.1
	24 months	95.3	94.9
	5 years	N/A[d]	N/A[d]
Hepatitis B	12 months	93.8	95.0
	24 months	97.3	95.5
	5 years	N/A[d]	N/A[d]
Measles-mumps-rubella	12 months	N/A[d]	N/A[d]
	24 months	95.2	96.7
	5 years	77.8	81.9
Varicella	12 months	N/A[d]	N/A[d]
	24 months	78.9	80.5
	5 years	N/A[d]	N/A[d]
Meningococcal C	12 months	N/A[d]	N/A[d]
	24 months	93.5	93.2
	5 years	N/A[d]	N/A[d]
7vPCV[e]	12 months	87.3	92.1
	24 months	N/A[d]	N/A[d]
	5 years	N/A[d]	N/A[d]
Rotavirus	12 months	80.2	86.8
	24 months	N/A[d]	N/A[d]
	5 years	N/A[d]	N/A[d]

[a]Birth cohort born 1 January 2008–31 December 2008.
[b]Birth cohort born 1 January 2007–31 December 2007.
[c]Birth cohort born 1 January 2004–31 December 2004.
[d]This vaccine at this age milestone is not included in the calculation of coverage estimates.
[e]7vPCV = 7-valent pneumococcal conjugate vaccine.
Source: Australian Childhood Immunisation Register.

2002–2009. However, the coverage rate of the elderly receiving a dose of pneumococcal vaccination during the previous 5 years (23vPPV) has been steadily rising: from 39% in 2002 to 55% in 2009. Despite this rise it remains lower than the influenza coverage estimates. The highest coverage rate for pneumococcal vaccination in the elderly was observed in 2006, the year after its inclusion in the National Immunisation Program (Figure 5 and Table 7).

In 2009, influenza (vaccinated in the past 12 months) and pneumococcal (vaccinated in the past 5 years) vaccine coverage in the elderly was highest in the Hunter New England AHS and lowest in the Sydney West AHS (Table 7).

Coverage estimates for adolescents

NSW Adolescent Vaccination Program coverage data for high school students for 2009 are shown in Table 8. Coverage varies by vaccine, dose and AHS with better coverage for the first and second doses of human papillomavirus vaccine and the dose of dTpa. Varicella coverage was lower, with no AHS achieving coverage greater than 43%. This lower coverage for varicella is likely due to some children gaining natural immunity as a result of having a prior varicella infection and hence not requiring vaccination.

Timeliness of immunisation

For the third dose of DTPa, there was significantly greater delay in immunisation for Aboriginal children than non-Aboriginal children, with a 16.6% differential at 7 months of age (Figure 6). A similar difference was found for timeliness of the second dose of MMR, but with a smaller differential of 5% (Figure 7). However, timeliness of this dose was poor for both population groups with only 29–33% of children receiving the vaccine on time.

Table 6. Percentage of children fully immunised at 12 months, 24 months and 5 years of age, by Aboriginal status for each area health service in NSW, compared with NSW and Australia, 2009

Child age and Aboriginal status	Area Health Service[a] GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	NSW %	Australia %
12 months – fully immunised[b]										
Aboriginal	87.5	88.1	86.6	88.4	93.9	88.9	80.9	87.3	87.4	85.0
Non-Aboriginal	94.0	93.9	93.8	87.1	92.6	92.0	92.2	92.8	92.4	92.2
12 months – fully immunised (including rotavirus and 7vPCV)										
Aboriginal	70.4	77.6	76.5	79.2	81.1	78.4	70.9	78.1	76.4	73.7
Non-Aboriginal	88.6	86.6	87.0	80.5	85.3	84.1	84.3	84.7	85.0	85.4
24 months – fully immunised[c]										
Aboriginal	90.0	92.1	91.9	90.9	90.0	91.6	91.9	91.2	91.4	90.6
Non-Aboriginal	94.4	94.6	94.6	87.8	90.8	91.7	92.1	92.1	92.2	92.2
24 months – fully immunised (including varicella and meningococcal C)										
Aboriginal	73.9	77.3	80.9	75.3	78.0	72.4	71.6	73.8	76.5	77.3
Non-Aboriginal	81.4	82.1	82.4	73.6	77.1	77.4	78.5	77.9	78.6	79.9
5 years – fully immunised[d]										
Aboriginal	79.6	73.8	81.6	76.3	85.8	77.6	72.4	74.8	78.0	78.6
Non-Aboriginal	84.1	81.1	85.8	74.8	81.9	81.8	81.2	82.2	82.0	82.9

[a]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
[b]'Fully immunised' = three doses of a diphtheria (D), tetanus (T) and pertussis-containing (P) vaccine, three doses of polio vaccine, two or three doses of PRP-OMP-containing *Haemophilus influenzae* type b (Hib) vaccine or three doses of any other Hib vaccine, and two or three doses of Comvax hepatitis B vaccine or three doses of all other hepatitis B vaccines.
[c]'Fully immunised' = 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-containing (MMR) vaccine.
[d]'Fully immunised' = four or five doses of a DTPa-containing vaccine, four doses of polio vaccine, and two doses of an MMR-containing vaccine.
Source: Australian Childhood Immunisation Register.

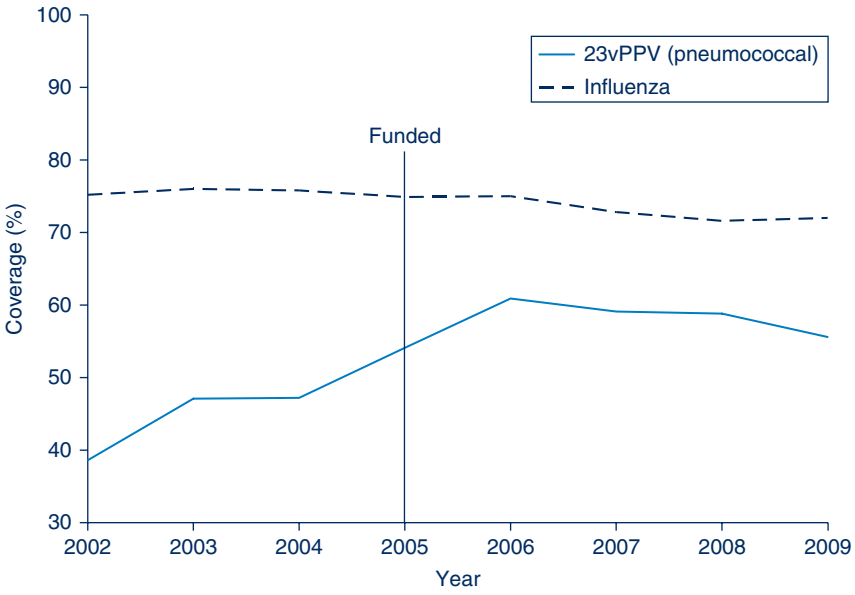

Figure 5. Trends in vaccination coverage estimates for individual vaccines (23vPPV and Influenza),[a] for adults aged 65 years and over in NSW, 2002–2009.

[a]Vaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months.

Source: New South Wales Population Health Survey 2009 (HOIST). Centre for Epidemiology and Research, NSW Department of Health.

Table 7. Adults aged 65 years and over vaccinated against pneumococcal disease and influenza for each area health service in NSW, compared with NSW, 2009[a]

Vaccine	Area Health Service[b]								NSW
	GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	%
23vPPV (pneumococcal)	59.6	61.7	62.5	61.1	53.8	55.7	49.9	47.7	55.6
Influenza	74.2	72.2	75.8	69.3	73.1	73.8	69.7	66.9	72.0

[a]Vaccinated against pneumococcal disease in the last 5 years and vaccinated against influenza in the last 12 months.
[b]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
Source: New South Wales Population Health Survey 2009 (HOIST). Centre for Epidemiology and Research, NSW Department of Health.

Table 8. Vaccination coverage estimates for individual vaccines, NSW adolescent school attendees for each area health service in NSW, compared with NSW, 2009

Vaccine	Area Health Service[a]								NSW
	GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	%
HPV dose 1 (%)[b]	81	85	81	78	82	80	79	78	80
HPV dose 2 (%)	75	79	77	74	79	76	76	76	77
HPV dose 3 (%)	72	74	69	64	70	67	70	67	69
Hepatitis B dose 1 (%)[c]	68	72	63	68	62	60	64	60	63
Hepatitis B dose 2 (%)	56	58	51	50	50	47	49	46	50
Varicella[d]	35	43	39	35	32	29	35	33	34
dTpa[e]	70	68	71	61	70	68	67	67	68

[a]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
[b]Year 7 school attendees, 96 215 total HPV doses administered.
[c]Year 7 school attendees, 98 430 total hepatitis B doses administered. Only children not vaccinated under the high-risk program eligible.
[d]Year 7 school attendees, 29 567 total varicella doses administered. Only children without prior history of varicella eligible.
[e]Year 10 school attendees, 59 215 total dTpa doses administered.
Source: NSW School Immunisation Program.

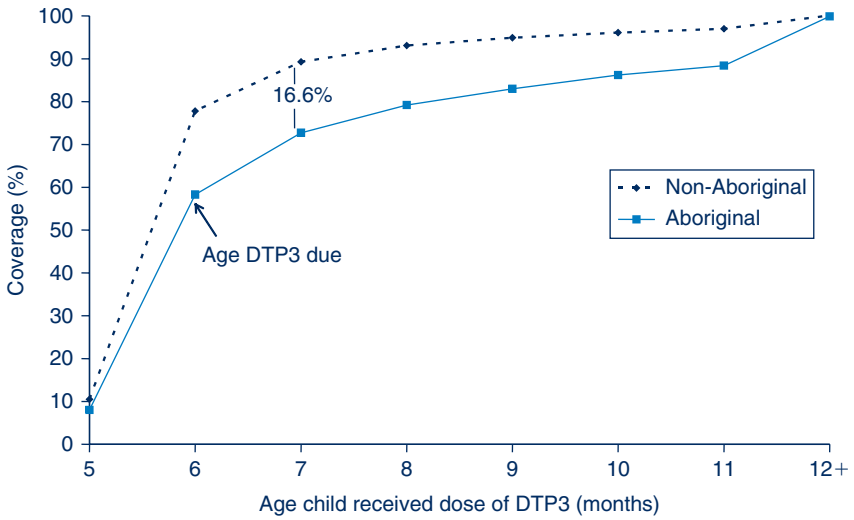

Figure 6. Timeliness of the third dose of DTPa vaccine (DTP3) by Aboriginal status – cohort born in 2006 in NSW.[a]

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

Source: Australian Childhood Immunisation Register.

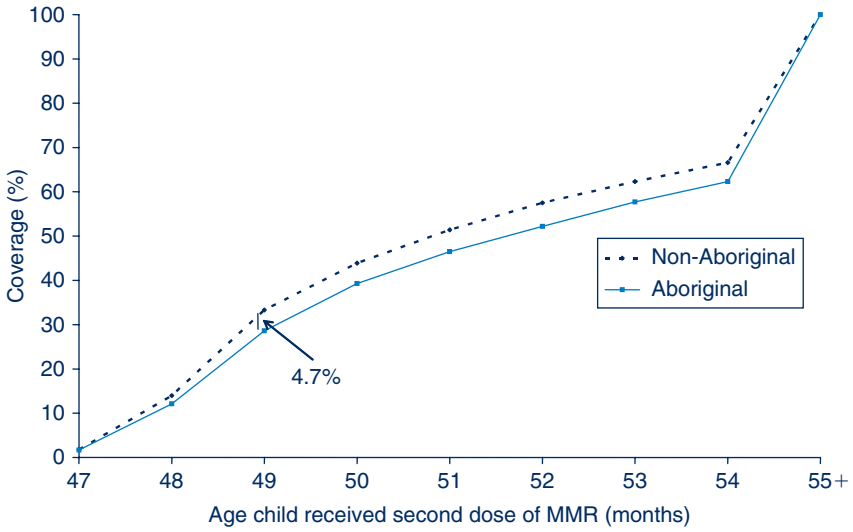

Figure 7. Timeliness of the second dose of MMR vaccine for Aboriginal and non-Aboriginal children, for the cohort of children born in 2003 in NSW.[a]

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

Source: Australian Childhood Immunisation Register.

Table 9. Vaccination delay for the third dose of DTPa, for Aboriginal and non-Aboriginal children and area health service for the cohort of children born in 2006, NSW

Vaccination delay and Aboriginal status	Area Health Service[a]								NSW
	GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	%
1–6 months delay									
Aboriginal	30.0	31.0	27.6	26.5	22.2	25.5	26.0	23.3	27.5
Non-Aboriginal	18.1	17.5	15.6	18.4	14.8	15.7	15.3	15.3	15.8
>6 months delay									
Aboriginal	11.9	10.5	9.7	7.1	5.2	6.8	7.1	4.1	8.7
Non-Aboriginal	2.3	3.1	2.5	3.9	1.8	1.8	1.8	2.3	2.2

[a]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
Source: Australian Childhood Immunisation Register.

A similar pattern is illustrated in Tables 9 and 10 where delay is categorised into 1–6 months and greater than 6 months. The Northern Sydney Central Coast and Sydney West AHSs had the lowest degree of vaccination delay for both Aboriginal and non-Aboriginal children and for both delay categories. The AHSs experiencing the greatest delay were Greater Southern and Greater Western, especially for Aboriginal children. The degree of vaccination delay for the second dose of MMR vaccine was very high for all AHSs and for both Aboriginal and non-Aboriginal children (Table 10).

Conscientious objectors and no vaccines recorded

The percentage of children with no vaccines recorded in NSW is greater than those recorded as conscientious objectors (Table 11). Both indicators varied by AHS with a high percentage of objectors and children with no vaccines recorded in the North Coast AHS and the lowest in the Greater Western AHS.

Small area coverage

'Fully immunised' coverage in NSW by Statistical Subdivision for the 5-year milestone age group in 2009 varies substantially, with many Statistical Subdivisions having recorded coverage below 80%, putting them at higher risk of outbreaks of contagious diseases such as measles and pertussis[12] (Figure 8). In fact, there are very few small areas (Statistical Subdivisions) in NSW with 'fully immunised' coverage for vaccines due at 4 years of age above national target levels.

First dose of DTPa at 6 weeks of age

In response to the current pertussis epidemic and to provide early protection for young infants, it was recommended in

Table 10. Vaccination delay for the second dose of measles-mumps-rubella, for Aboriginal and non-Aboriginal children in each area health service in NSW for the cohort of children born in 2003, compared with NSW

Vaccination delay and Aboriginal status	Area Health Service[a] GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	NSW %
1–6 months delay									
Aboriginal	38.2	33.0	36.3	37.4	41.7	33.6	37.7	34.2	36.3
Non-Aboriginal	36.5	35.5	38.6	34.4	37.3	36.6	36.6	36.1	36.7
>6 months delay									
Aboriginal	36.7	41.4	38.0	38.8	29.2	47.3	36.4	38.7	38.7
Non-Aboriginal	36.5	36.2	30.4	42.2	35.1	34.6	34.1	34.0	34.5

[a]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
Source: Australian Childhood Immunisation Register.

Table 11. Percentage of conscientious objectors and children with no vaccines recorded on the Australian Childhood Immunisation Register for the cohort born 2003–2008, for each area health service in NSW, compared with NSW

	Area Health Service[a] GS %	GW %	HNE %	NC %	NSCC %	SESI %	SSW %	SW %	NSW %
Conscientious objectors	1.3	0.8	1.2	4.9	1.7	1.3	0.6	0.7	1.3
No vaccines recorded	2.3	1.7	1.9	6.4	3.5	3.1	2.6	2.8	2.9

[a]GS = Greater Southern; GW = Greater Western; HNE = Hunter New England; NC = North Coast; NSCC = Northern Sydney Central Coast; SESI = South Eastern Sydney Illawarra; SSW = Sydney South West; SW = Sydney West.
Source: Australian Childhood Immunisation Register.

March 2009 that NSW immunisation providers give the first dose of DTPa vaccine (Infanrix-hexa) at 6 weeks of age instead of 8 weeks of age. Figure 9 shows the age at which children in NSW were given the first dose of DTPa by month of vaccination during 2009. Prior to the recommendation, very few children received the vaccine dose at 6 weeks of age; the percentage rose during 2009 with more than 50% of children receiving the dose prior to 8 weeks of age in the last quarter.

Discussion

These data reveal that Immunise Australia Program coverage targets have been reached for children at both 12 and 24 months of age in NSW and for all AHSs except the North Coast. However, this is not the case for children aged 5 years, with relatively poor coverage of 82% for NSW and for all AHSs. This is also the case in other jurisdictions.[1]

Coverage at 24 months of age exceeds that at 12 months of age in NSW and all AHSs. This is likely related to the greater period of time between due date and assessment time (12 versus 6 months respectively), and potentially an impact of the maternity incentive payment which is assessed at 18–24 months. It should be noted that several vaccines are not included in this assessment, including some with relatively high coverage (pneumoccocal conjugate, meningococcal C), and some with lower coverage (rotavirus, varicella). The change in December 2007 in assessment age from 6 to 5 years for vaccines due at 4 years resulted in lower coverage estimates for vaccines due at this age and has revealed that many children are not fully protected in a timely way from the diseases these vaccines guard against. This was of particular concern during the pertussis epidemic of 2008 and 2009, when children aged 5–9 years were seriously affected.[13]

A number of vaccines included in the National Immunisation Program are excluded when calculating 'fully immunised' status and eligibility for incentive payments. While this annual report provides coverage data on these vaccines, data for the more longstanding and established vaccines are also available in data provided to GP Divisions and immunisation providers. Coverage estimates for 7vPCV and meningococcal C vaccines are comparable with estimates for vaccines that are included in 'fully immunised' calculations, but estimates for varicella and rotavirus are lower. As these abovementioned vaccines have been routinely incorporated into the childhood immunisation schedule for some time, their inclusion in official coverage assessments for 'fully immunised' and wider dissemination should be considered to facilitate monitoring of program delivery.

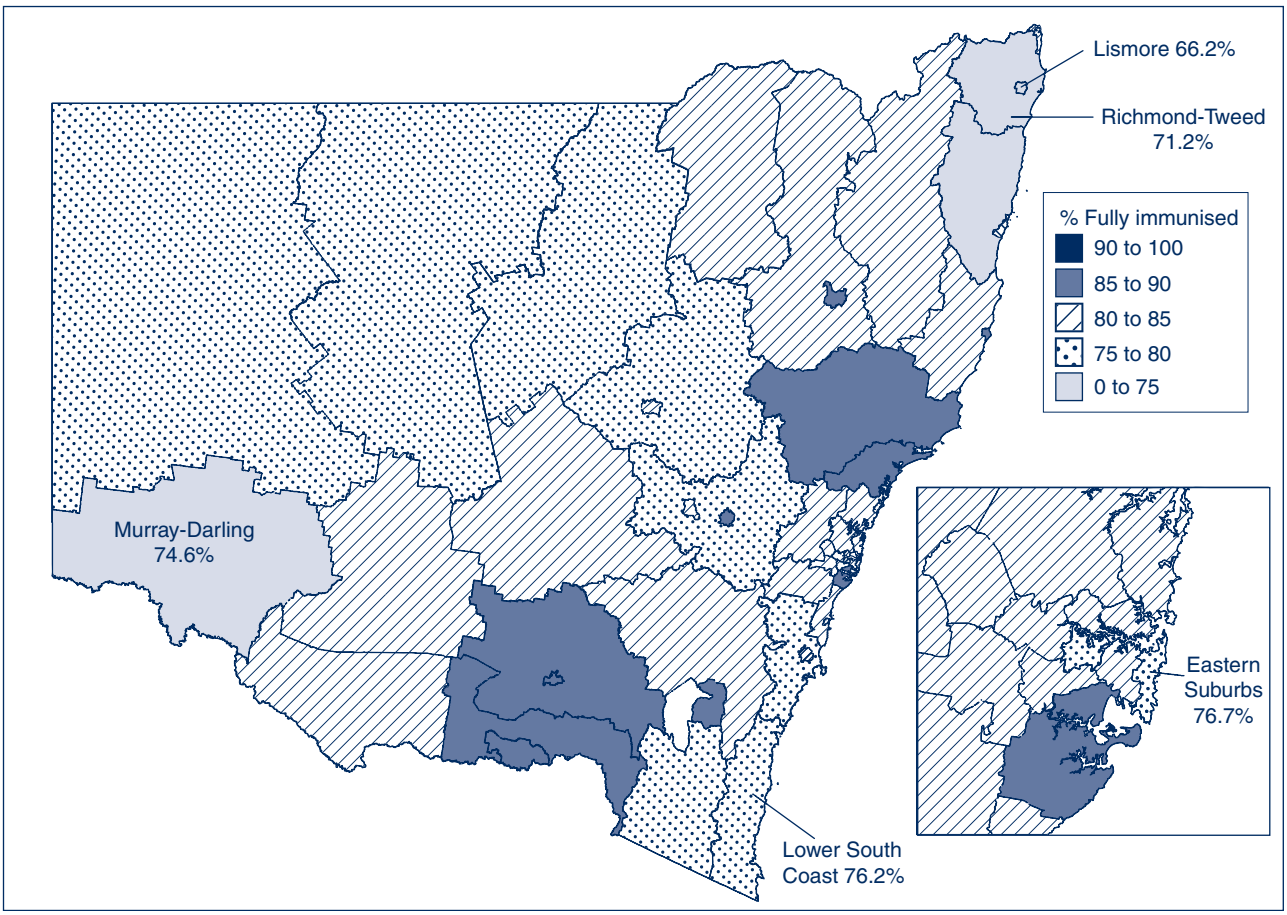

Figure 8. 'Fully immunised' coverage at 5 years of age, by Statistical Subdivision, NSW, for the cohort of children born in 2004. Source: Australian Childhood Immunisation Register.

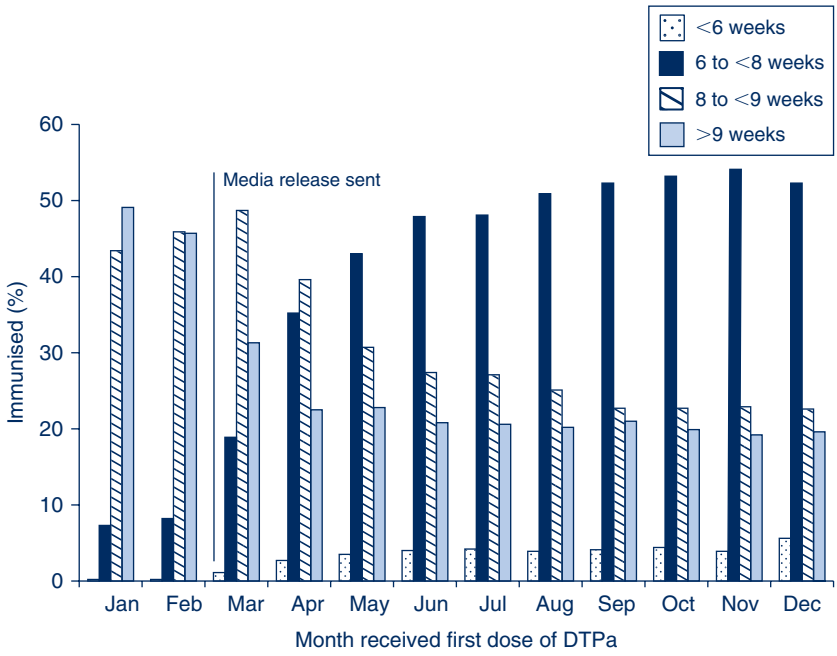

Figure 9. Age that children in NSW received their first dose of DTPa/Hexa vaccine by month of receipt, January–December 2009.

The media release was a message for providers and the public on 10 March 2009 which asked parents and providers to consider bringing the first dose of DTPa forward to 6 weeks of age to provide earlier protection.

Source: Australian Childhood Immunisation Register.

Although most children eventually complete the scheduled series by the 24-month milestone, many still do not do so in a timely manner. This is more pronounced for Aboriginal children, as has been noted previously.[1,14] This is of particular concern for diseases where multiple vaccine doses are required for protection, where the disease risk among young infants is significant (e.g. pertussis, pneumococcal disease), and for Aboriginal children for whom early vaccination is critical for any impact on the incidence of otitis media and pneumonia.

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

There are some limitations to the data used to compile this report. Common to almost all analyses of Australian Childhood Immunisation Register data is the problem of underreporting of immunisation encounters by providers. We do know from a previous study that underreporting of immunisation encounters leads to underestimation of coverage rates.[15] However, the level of underreporting over the past 4–5 years has decreased somewhat as a result of a number of initiatives,[15] and we have no evidence to suggest that dates of administration of immunisations provided to the Australian Childhood Immunisation Register by providers are incorrect. Vaccine coverage data for the elderly is limited as the NSW Health Survey relies on self-reported vaccination status.[7] Finally, vaccination coverage for adolescents only includes school attendees and school-administered doses.

Conclusion

Data provided by the Australian Childhood Immunisation Register in this report reflect the successful delivery of the National Immunisation Program in NSW, while identifying some areas for improvement. The Australian Childhood Immunisation Register, the NSW 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 Adverse Events Following Immunisation Report, 2009

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Abstract: Aim: This is the first annual report for NSW of adverse events following immunisation. It summarises Australian passive surveillance data for adverse events following immunisation for NSW for 2009. **Methods:** Analysis of de-identified information on all adverse events following immunisation reported to the Therapeutic Goods Administration. **Results:** 450 adverse events following immunisation were reported for vaccines administered in 2009; this is 32% higher than 2008 and the highest since 2003. The increase was almost entirely attributed to the commencement of the pandemic (H1N1) 2009 influenza vaccine in September 2009. Only 6% of the reported adverse events were serious in nature and the most commonly reported reactions were allergic reaction, injection site reaction, fever and headache. **Conclusion:** Reports of adverse events following immunisation in 2009 were dominated by the pandemic (H1N1) 2009 influenza vaccine. A large proportion of these adverse events were reported directly to the Therapeutic Goods Administration by members of the public. Reports were predominantly mild transient events, similar to those expected from the seasonal flu vaccine.

Adverse events following immunisation are defined as unwanted or unexpected events following the administration of a vaccine(s). They may be caused by a vaccine(s) or may be coincidental. Adverse events may also include conditions that occur following the incorrect handling and/or administration of a vaccine(s). The post-licensure surveillance of adverse events following immunisation is important to detect rare, late onset and unexpected events which are difficult to detect in pre-licensure vaccine trials.

This is the first annual report for adverse events following immunisation in New South Wales (NSW). It summarises passive surveillance data reported from NSW in 2009 and describes reporting trends over the 10-year period 2000–2009. To assist readers, at the end of this report is a glossary of the abbreviations of the vaccines referred to in this issue (Box 1).

Trends in reported adverse events following immunisation are heavily influenced by changes to vaccines provided through the National Immunisation Program. Changes in previous years have been reported elsewhere.[1–12] The most significant change during 2009 was the introduction of the pandemic (H1N1) 2009 influenza vaccine which was rolled out nationally on 30 September for those aged 10 years and over. In December 2009 the pandemic vaccine was made available to children aged from 6 months to 10 years.

Methods

Adverse events following immunisation are notifiable to public health units by medical practitioners and hospital CEOs under the NSW *Public Health Act 1991*. They are investigated by public health units and NSW Health and forwarded to the Therapeutic Goods Administration. The Therapeutic Goods Administration also receives reports directly from vaccine manufacturers, members of the public and other sources.[13,14] All reports are assessed by the Therapeutic Goods Administration using internationally-consistent criteria[15] and entered into the Australian Adverse Drug Reactions System database.

Adverse events following immunisation data

De-identified information on adverse events following immunisation reports from the Australian Adverse Drug Reactions System database was released to the National Centre for Immunisation Research and Surveillance for analysis and reporting. Adverse events following immunisation (AEFI) records contained in the Australian Adverse Drug Reactions System database were eligible for inclusion in the analysis if: a vaccine was recorded as 'suspected' of involvement in the reported adverse event; the vaccination occurred between 1 January 2000 and 31 December 2009; and the residential address of the individual was recorded as NSW. If the vaccination date was not

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recorded the date of onset of symptoms or signs was taken as the date of vaccination.

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

AEFI records are classified as 'suspected' by the Adverse Drug Reactions Advisory Committee, an expert committee of the Therapeutic Goods Administration. An AEFI record is excluded from the Adverse Drug Reactions Advisory Committee database if: there is no reasonable temporal association between the use of a drug and the clinical event; the record does not contain enough information for an adequate assessment or the information is contradictory; or if a clinical event is explained as likely to have arisen from other causes.

Study definitions of adverse events following immunisation outcomes and reactions

AEFIs were defined as 'serious' or 'non-serious' based on information recorded in the Australian Adverse Drug Reactions System database and using criteria similar to those used elsewhere.[15,16] 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.

The causality ratings of 'certain', 'probable' and 'possible' are assigned to individual AEFI records by the Therapeutic Goods Administration. They describe the likelihood that a vaccine or vaccines was or were associated with a reported reaction in an individual. Factors that are considered in assigning causality ratings include: timing (minutes, hours, etc. following vaccination); spatial correlation (for injection site reactions) of symptoms and signs in relation to vaccination; and whether one or more vaccines were administered. These factors are outlined in more detail elsewhere.[17] 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 often not possible to attribute the event to a single vaccine.

Typically, each AEFI record listed several symptoms, signs and diagnoses that had been re-coded by Therapeutic Goods Administration staff from the description provided by the reporter into standardised terms using the Medical Dictionary for Regulatory Activities (MedDRA®).[18] AEFI reports of suspected anaphylaxis and hypotonic-hyporesponsive episodes were classified using the Brighton Collaboration case definitions.[19,20]

Data analysis

All data analyses were performed using SAS (version 9.1.3, SAS Institute, Cary, NC, USA). Average annual population-based reporting rates were calculated using population estimates obtained from the Australian Bureau of Statistics.[21]

AEFI reporting rates per 100 000 administered doses were estimated where information on dose numbers was available from: the Australian Childhood Immunisation Register for 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 Health Survey for influenza and 23vPPV vaccines for adults aged 65 years and over.[22] For the 23vPPV vaccine, the dose numbers were divided by five to get the denominator dose numbers for a single year.

Notes on interpretation

The data reported here are provisional only, particularly for the fourth quarter of 2009, because of reporting delays and the late onset of some AEFIs. The information collated in the Australian Adverse Drug Reactions System database is intended primarily to detect signals of adverse events and to inform hypothesis generation. While AEFI reporting rates can be estimated using appropriate denominators, they cannot be interpreted as incidence rates due to under-reporting and biased reporting of suspected events, and the variable quality and completeness of information provided in individual notification reports.[1–12,23]

It is important to note that this annual report is based on vaccine and reaction term information collated in the Australian Adverse Drug Reactions System database and not on comprehensive clinical notes. Individual records in the database list symptoms, signs and diagnoses that were used to define a set of reaction categories based on the case definitions provided in the 9th edition of *The Australian Immunisation Handbook*.[14] These reaction categories are similar, but not identical, to the AEFI case definitions.

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

Results

There was a total of 450 AEFI records for NSW in the Australian Adverse Drug Reactions System database with a date of vaccination (or onset of an adverse event if vaccination date was not reported) in 2009. This was a 32% increase on the 340 records in 2008. Sixty-nine percent ($n = 312$) of the AEFI records during 2009 were reported in the fourth quarter of the year, a substantial increase (93%) from the corresponding period in 2008

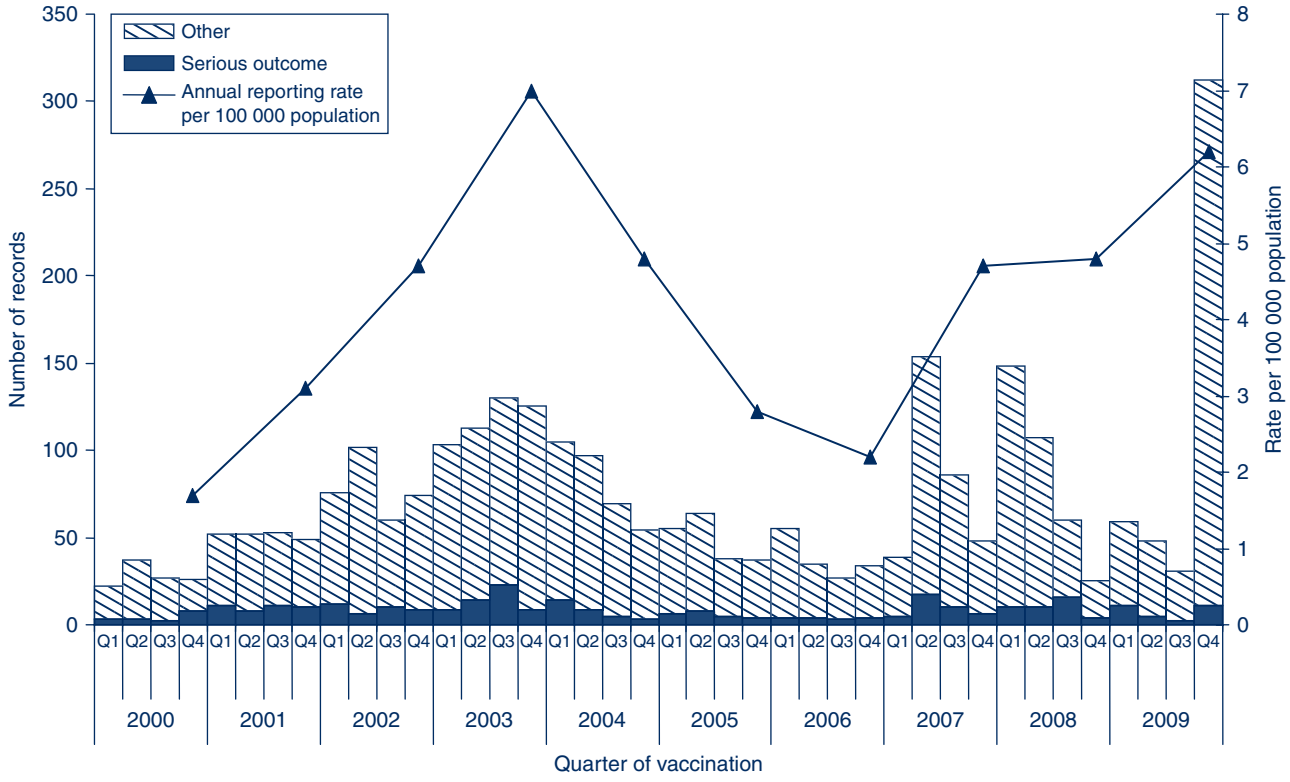

Figure 1. Reports of adverse events following immunisation, NSW, 2000–2009, by quarter of vaccination.

For reports where the date of vaccination was not recorded, the date of onset was used as a proxy for vaccination date.

Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

(7%, $n = 22$). Fourteen percent ($n = 62$) were for children aged less than 7 years and 84% ($n = 379$) were for people aged 7 years and over. Thirty-three percent ($n = 149$) were reported by members of the public, 25% ($n = 114$) by general practitioners, 21% ($n = 94$) by health care providers via NSW Health, 13% ($n = 60$) by nurses, 4% ($n = 19$) by hospitals, 2% ($n = 9$) by pharmacists and 1% ($n = 5$) by others. In contrast, during 2008 only 2% ($n = 7$) of AEFI records were reported by members of the public, 71% ($n = 241$) were reported by health care providers via NSW Health and the rest ($n = 92$) were reported by general practitioners (17%), pharmacists (4%), hospitals (3%), nurses and specialists (2% each).

Reporting trends

The AEFI reporting rate for 2009 was 6.2 per 100 000 population, compared with 4.8 per 100 000 population in 2008 (Figure 1). This is the second highest reporting rate for the period 2000–2009, after the peak in 2003 that coincided with the national program for meningococcal C conjugate vaccine and high rates of reporting from the 18-month dose of DTPa (Figure 2). Figure 1 shows that the vast majority of reported events are of a non-serious nature. Figures 2 and 3 demonstrate marked variations of reporting levels in association with changes to the National Immunisation Program, such as the commencement of new vaccination programs in 2003, 2005 and 2007, and the removal of the 18-month DTPa dose in 2003.

The usual seasonal pattern of AEFI reporting from older Australians receiving 23vPPV and influenza vaccine during the autumn months (March–June) is evident in Figure 3.

Age distribution

In 2009, the highest population-based AEFI reporting rate occurred in infants aged less than 1 year, the age group that received the highest number of vaccines (Figure 4). Compared with 2008, AEFI reporting rates increased among the less than 1 year age group (a 24% increase from 25.6 to 31.8 per 100 000 population) and the 1 to less than 2 year age group (11.5 to 14.9 per 100 000 population) but decreased among the 2 to less than 7 year age group (7.2 to 4.1 per 100 000 population). The increase in AEFI reporting rates among the less than 1 and 1 to less than 2 year age groups is mainly associated with the introduction of the pH1N1 vaccine while the decrease among the 2 to less than 7 year age group is mainly attributed to reduction in AEFI reports following DTPa-IPV and MMR vaccination. Rates also declined for older children and adolescents (13.4 to 4.1 per 100 000 population), mainly attributable to the cessation of the HPV catch-up program. However, there was a three-fold increase in AEFI reporting rates among adults (2.1 to 6.3

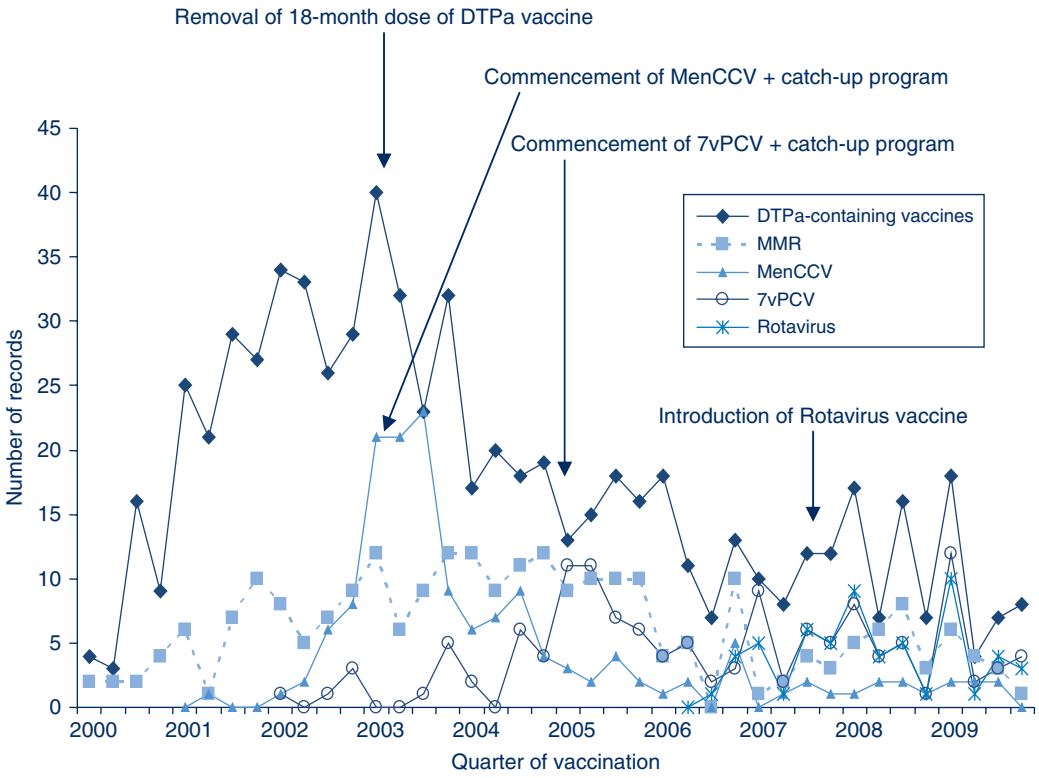

Figure 2. Adverse events following immunisation for children aged less than 7 years in frequently suspected vaccines (including DTPa-containing vaccines, MMR, MenCCV, 7vPCV and rotavirus), NSW, 2000–2009, by quarter of vaccination.

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; DTPa-IPV and DTPa-IPV-HepB-Hib (Hexavalent) vaccines in November 2005; and Rotavirus (RotaTeq® and Rotarix®) vaccines on 1 July 2007.

Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

per 100 000 population), associated with pH1N1 vaccine introduction.

Vaccines

The most frequently reported individual vaccine was pH1N1 with 305 records (68%) (Figure 3). Vaccines containing diphtheria, tetanus and acellular pertussis antigens were reported in 59 (13%) records, with dTpa (23 records, 5%) and hexavalent DTPa-IPV-HepB-Hib (20 records, 4.4%) being the most frequently reported vaccines among DTPa-containing vaccines. The other frequently reported vaccines were: HPV (34 records, 8%); 7vPCV (21 records, 5%); and 23vPPV, rotavirus and seasonal influenza (18 records each, 4%) (Table 1). Of vaccines with reliable data on doses administered, those with the highest AEFI rates per 100 000 doses were HPV (28.1), DTP-IPV (14.3) and rotavirus (10.5).

Reactions

The distribution and frequency of reactions listed in AEFI records for 2009 are shown in Table 2. The most frequently reported adverse events were: allergic reaction (25%); injection site reaction (19%); fever (17%); headache (16%); malaise (9%); myalgia (8%); and nausea (7%) (Table 2).

AEFIs following pH1N1 vaccine

For pH1N1 vaccine events, 94% ($n = 287$) were for people aged 7 years and over. Forty-seven percent ($n = 146$) of the recorded AEFIs were self-reported. There was one report of Guillain-Barrè syndrome in an elderly person and one death. The most frequently reported adverse events were: allergic reaction ($n = 79$, 26%); headache ($n = 60$, 20%); fever ($n = 53$, 17%); and injection site reaction ($n = 40$, 13%) (Figure 5). There were 10 reports coded as serious and no cases of anaphylaxis.

AEFIs following other vaccines

The most frequently reported adverse events following receipt of all vaccines other than pH1N1 (alone or in combination with other vaccines) were: injection site reaction ($n = 44$, 30%); allergic reaction ($n = 32$, 22%); fever ($n = 24$, 17%); headache ($n = 10$, 7%); convulsions ($n = 7$, 5%); anaphylaxis ($n = 3$, 2%); and hypotonic-hyporesponsive episodes ($n = 2$, 1%).

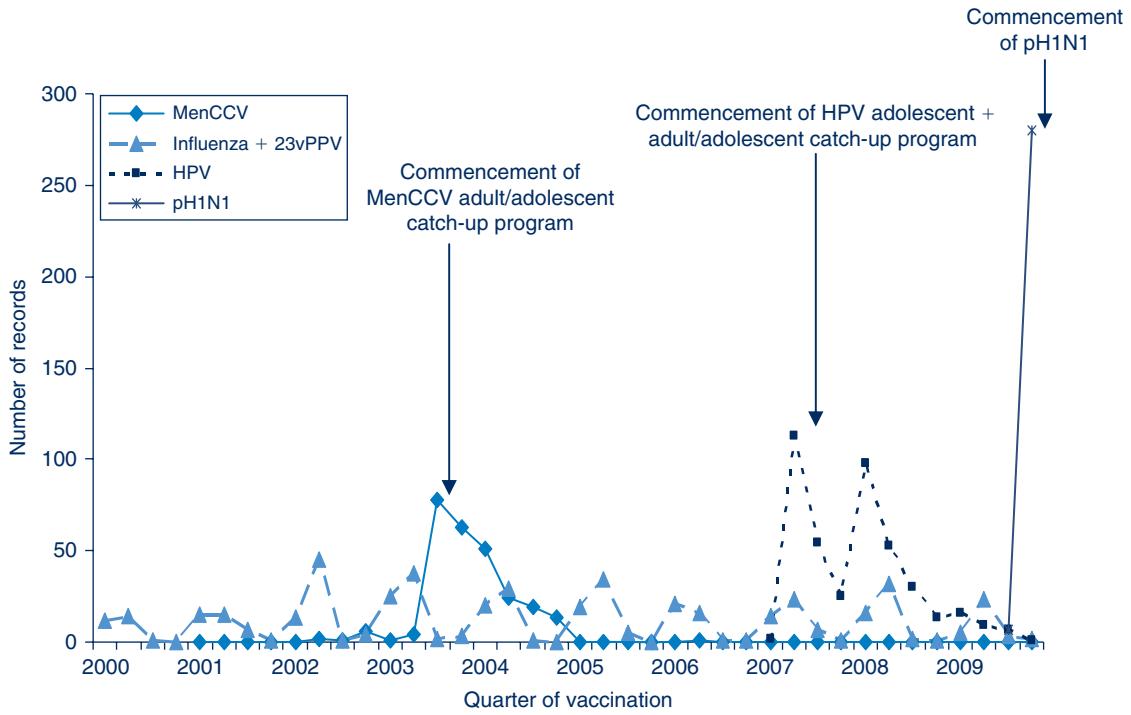

Figure 3. Adverse events following immunisation for individuals aged more than 7 years in frequently suspected vaccines (including MenCCV, influenza and 23vPPV administered together, HPV and pH1N1), NSW, 2000–2009, by quarter of vaccination.
Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

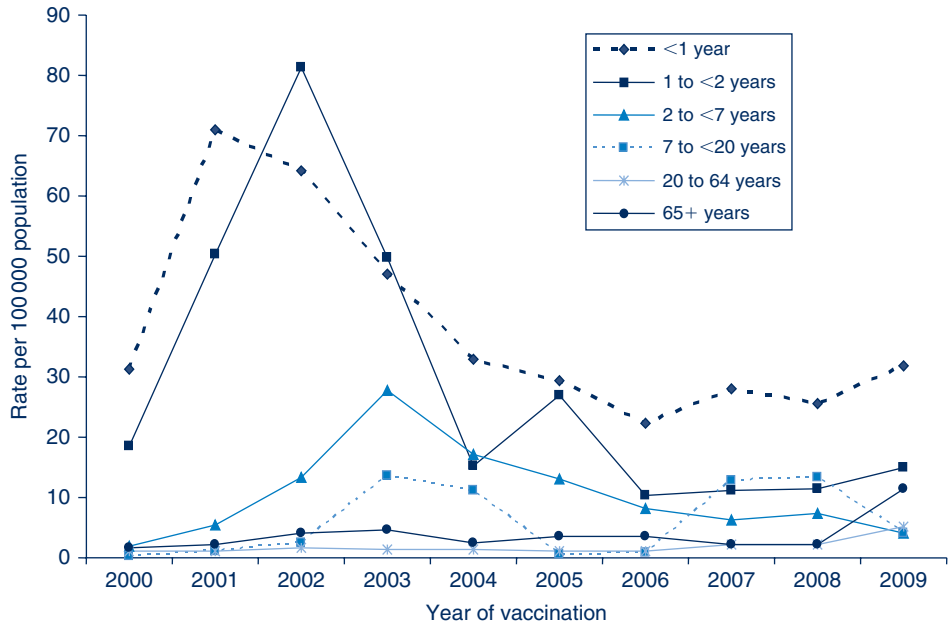

Figure 4. Reporting rates of adverse events following immunisation for NSW per 100 000 population, 2000–2009, for six age groups and by year of vaccination.
Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

Severity of outcomes

Six percent of events were defined as 'serious' (i.e. recovery with sequelae, requiring hospitalisation, experiencing a life-threatening event or death), lower than observed in previous years. Fewer 'serious' AEFIs were assigned 'certain' or 'probable' causality ratings compared with 'non-serious' AEFIs (7% versus 14%) (Table 3). Numbers of reported events and events with outcomes defined as 'serious' are shown in Table 1.

Seventeen percent of records were recorded as not fully recovered at the time of reporting; 68% of these were

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, 2009

Vaccines[a]	AEFI records[b] *n*	'Serious' outcome[c] *n*	'Serious' outcome[c] %	Vaccine doses[d] *n*	Reporting rate per 100 000 doses[e] (95% CI) 2009
<7 years					
DTPa-IPV	14	3	21	97 907	14.3 (7.8–24.0)
Hexavalent (DTPa-IPV-HepB-Hib)	20	2	10	269 574	7.4 (4.5–11.5)
Haemophilus influenzae type b	4	0	0	90 898	4.4 (1.2–11.3)
Measles-mumps-rubella	14	2	14	190 257	7.4 (4.0–12.3)
Rotavirus	18	2	11	171 292	10.5 (6.2–16.6)
7vPCV	21	2	10	270 740	7.8 (4.8–11.9)
Varicella	3	2	67	90 084	3.3 (0.7–9.7)
MenCCV	6	0	0	93 960	6.4 (2.3–13.9)
pH1N1	10	0	0	n/a	n/a
Age group within <7 years group					
<1 year	31	3	10	728 836	4.3 (2.9–6.0)
1 to <2 years	13	2	15	331 232	3.9 (2.1–6.7)
2 to <7 years	18	3	17	214 644	8.4 (5.0–13.3)
12–17 years					
HPV	27	2	7	96 215	28.1 (18.5–40.8)
dTpa	3	0	0	59 215	5.1 (1.0–14.8)
Hepatitis B	9	1	11	98 430	9.1 (4.2–17.4)
Varicella	3	0	0	29 567	10.2 (2.1–29.7)
Influenza	3	0	0	n/a	n/a
pH1N1	13	0	0	n/a	n/a
18–64 years					
Influenza	13	2	15	n/a	n/a
23vPPV	5	0	0	n/a	n/a
pH1N1	177	3	1.7	n/a	n/a
≥65 years					
Influenza	2	0	0	718 863	0.3 (0.0–1.0)
23vPPV	13	2	15	110 899	11.7 (6.2–20.0)
pH1N1	97	6	6	n/a	n/a

AEFI = adverse event following immunisation.
[a]Records where at least one of the vaccines shown in the table was suspected of involvement in the reported adverse event. AEFI category includes all records (i.e. total), those assigned 'certain' or 'probable' causality ratings, and those with outcomes defined as 'serious'. Causality ratings were assigned using the criteria described previously.[17] A 'serious' outcome is defined as recovery with sequelae, hospitalisation, life-threatening event or death.[17]
[b]Number of AEFI records in which the vaccine was coded as 'suspected' of involvement in the reported adverse event and the vaccination was administered between 1 January and 31 December 2009. 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 2009.
[e]The estimated AEFI reporting rate per 100 000 vaccine doses recorded.
Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

following receipt of pH1N1 vaccine. Information on severity could not be determined for 47% ($n = 211$) of records; 83% of these were following receipt of pH1N1 vaccine and 50% of these reports came from members of public with little specific information provided. None were reported through NSW Health. Of those without information describing severity, the most commonly reported adverse reactions were: allergic reactions (22%); fever (18%); headache (17%); injection site reaction (16%); malaise and myalgia (11% each); nausea (9%); abdominal pain and dizziness (6% each); and weakness (4%).

The more severe reported AEFIs were: convulsion ($n = 9$), including two febrile convulsions; hypotonic-hyporesponsive episode ($n = 2$); Guillain-Barré syndrome ($n = 1$); and death ($n = 1$). Of the nine cases of convulsion,

Table 2. Reaction categories of interest mentioned in records of adverse events following immunisation for two age groups (<7 and ≥7 years), NSW, 2009

Reaction category[a,g,h]	AEFI records	'Serious' outcome[b]		Only reaction reported[c]		Age group[b]			
						<7 years		≥7 years	
	n	*n*	%	*n*	%	*n*	%	*n*	%
Allergic reaction[d]	111	6	5	16	14	17	15	93	84
Injection site reaction	84	4	5	24	29	15	18	68	81
Fever	77	4	5	5	6	20	26	56	73
Rash[e]	19	0	0	9	47	3	16	14	74
Arthralgia	16	2	13	0	0	0	0	13	100
Convulsions	9	4	44	4	44	4	44	5	56
Abnormal crying	8	1	13	1	13	8	100	0	0
Syncope	8	1	13	2	25	1	13	7	87
Lymphadenopathy/itis[f]	7	0	0	0	0	0	0	7	100
Anaphylactic reaction	3	1	33	1	33	0	0	3	75
Abscess	2	0	0	0	0	0	0	2	100
Arthritis	2	0	0	1	50	0	0	2	100
Hypotonic-hyporesponsive episode	2	0	0	1	50	2	100	0	0
Brachial neuritis	2	1	50	1	50	0	0	1	50
Death	1	1	100	1	100	0	0	1	100
Guillain-Barré syndrome	1	1	100	1	100	0	0	1	100
Orchitis	1	1	100	0	0	0	0	1	100
Headache	70	2	3	1	1	0	0	67	96
Malaise	39	1	3	0	0	6	15	33	85
Myalgia	37	0	0	1	6	1	3	35	95
Nausea	31	1	3	0	0	0	0	31	100
Dizziness	24	1	4	2	8	0	0	24	100
Reduced sensation	22	1	5	7	32	0	0	21	95
Abdominal pain	21	1	5	0	0	4	19	17	81
Pain	16	0	0	0	0	0	0	16	100
Weakness	12	2	17	1	8	0	0	12	100
Respiratory rate/rhythm change	11	1	9	0	0	1	9	10	91
Erythema	10	1	10	0	0	3	30	7	70

AEFI = adverse event following immunisation.
[a]Reaction categories were created for the AEFI of interest listed and defined in *The Australian Immunisation Handbook* (9th edition, pp. 58–65 and 360–3)[14] as described in Methods section. The bottom part of the table shows reaction terms not listed in *The Australian Immunisation Handbook*[10] but included in AEFI records in the Adverse Drug Reactions Advisory Committee database.
[b]Not shown if neither age nor date of birth were recorded.
[c]AEFI records where only one reaction was reported.
[d]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.[10]
[e]Includes general terms of rash but does not include rash pruritic.
[f]Includes lymphadenitis following BCG vaccination and the more general term of 'lymphadenopathy'.
[g]Reaction categories like flushing, increased sweating and oedema – each had nine reports; irritability and somnolence had eight reports each; gastrointestinal related to rotavirus and heart rate/rhythm change had seven reports each; tremor had six reports and pallor had five reports.
[h]There were no reports for the reaction categories like acute flaccid paralysis, meningitis, orchitis, osteitis, osteomyelitis, sepsis, toxic shock syndrome, abscess and parotitis.
Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

four were children aged less than 7 years. The most commonly suspected vaccines were: HPV ($n = 3$); pH1N1 ($n = 2$); hexavalent and pneumococcal ($n = 2$); dTpa ($n = 1$); and varicella ($n = 1$). Both reports of hypotonic-hyporesponsive episodes were from children aged less than 7 years following administration of DTPa/IPV and HepB vaccines.

There was a report of one death – a middle-aged man who had been vaccinated 1 day prior – which was recorded as temporally associated with receipt of pH1N1 vaccine. The man was well when seen approximately 8 hours post-vaccination and no other reactions were observed or reported. He had suffered an inferior myocardial infarct 3 months before receipt of the vaccine and was diagnosed

Table 3. Outcomes of adverse events following immunisation for two age groups (<7 and ≥7 years), NSW, 2009

Outcome	AEFI records		'Certain' or 'probable'[b]		Age group			
					<7 years		≥7 years	
	n	%[a]	*n*	%[c]	*n*	%[c]	*n*	%[c]
Non-serious	135	30	19	14	31	23	102	76
Not recovered at time of report	75	17	8	11	9	12	64	85
Unknown[d]	211	47	10	5	14	7	193	91
Serious:	29	6	2	7	8	28	20	69
recovered with sequelae	0		0		0	n/a	0	n/a
hospital treatment – admission	27		2		8	30	18	67
life-threatening event	1		0		0	0	1	100
death (maybe drug)[e]	1		0		0	0	1	100
Total	450	100	39	9	62	14	379	84

AEFI = adverse event following immunisation.
[a]Percentages relate to the total number of AEFI records (*N* = 450).
[b]Causality ratings were assigned to AEFI records using criteria described previously.[17]
[c]Percentages relate to the number of AEFI records with the specific outcome (e.g. of 135 AEFI records with a 'non-serious' outcome, 14% had causality ratings of 'certain' or 'probable' and 23% were for children aged under 7 years).
[d]'Unknown' outcome relates to the number of AEFI records which are not serious and with unknown outcome.
[e]It is regarded as unlikely that the vaccine had any role in this patient's death.
Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

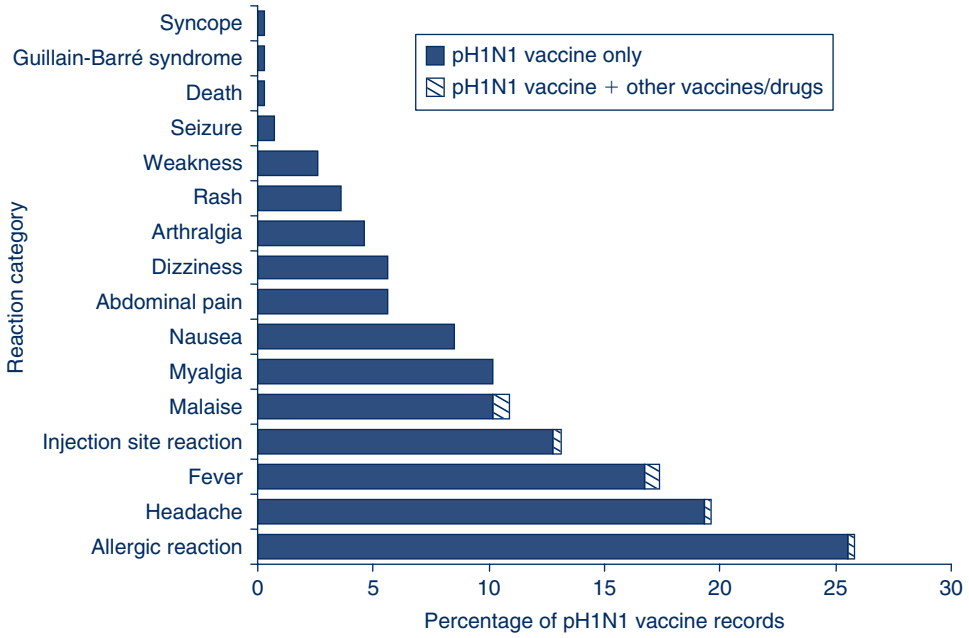

Figure 5. Most frequently reported adverse events following pH1N1 immunisation,[a] 2009, by number of vaccines suspected of involvement in the reported adverse event.

[a]Percentage of 305 AEFI records where pH1N1 vaccine was listed as suspected of involvement in the reported adverse event following immunisation.

Source: Adverse Drug Reactions Advisory Committee database, Therapeutic Goods Administration.

with double vessel coronary disease. It is regarded as unlikely that the vaccine had any role in this patient's death.

Discussion

The increase of both the AEFI records and population-based reporting rates in 2009 is likely due to the introduction of the pH1N1 vaccine in September 2009. Immunisation providers are more likely to report milder, less serious AEFIs for vaccines they are not familiar with. Historical data show that initial high levels of AEFI reporting occur each time a new vaccine is introduced (MenCCV in 2003 and HPV in 2007), followed by a reduction and stabilisation of reporting over time (Figure 3).

Box 1. Glossary of the abbreviations of vaccine types used in this report

BCG	Bacillus of Calmette and Guérin (i.e. tuberculosis)
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
pH1N1	pandemic (H1N1) 2009 influenza
7vPCV	7-valent pneumococcal conjugate vaccine
23vPPV	23-valent pneumococcal polysaccharide vaccine

This tendency to report newer vaccines increases the sensitivity of the system to detect signals of serious, rare or previously unknown events, but also complicates the interpretation of trends. However, the large number of reports from members of the public in comparison to previous years indicates a high level of public interest in the pH1N1 vaccine. The enhanced reporting of AEFIs from members of the public is also likely because the H1N1 influenza vaccination program used strategies to encourage consumers and health professionals to report adverse events to allow the Therapeutic Goods Administration to closely monitor the safety of the vaccine.[24]

The safety of the pH1N1 vaccine has been examined closely both nationally and internationally. The World Health Organization reports that approximately 30 different pH1N1 vaccines have been developed using a range of methods.[25] All progressed successfully through vaccine trials to licensure, showing satisfactory safety profiles. However, these clinical trials were not large enough to detect rare adverse vaccine reactions which occur with a frequency of less than one in one thousand. In general the safety profile, including that for the Australian vaccine, has been similar to those of seasonal influenza vaccines, with predominantly mild transient events and a small number of serious reactions reported.[26] The NSW data presented here include very few reports from children, as the pH1N1 vaccine was only licensed for children in December 2009. However, the data presented here on adults are consistent with previous data. While Guillain-Barré syndrome has been associated with a previous swine influenza vaccine in 1976,[27] international assessment of the current vaccines have found either no association,[25] or a slightly higher rate in vaccinees (one per million vaccine doses) consistent with estimates for seasonal influenza vaccine.[28] Initial national analysis by the Therapeutic Goods Administration has shown no indication of an increased rate of Guillain-Barré syndrome, or anaphylaxis (another serious reaction of concern) associated with the pH1N1 vaccine in Australia.[29]

Conclusion

There was a 32% higher rate of AEFIs reported from NSW in 2009 compared with 2008. This increase is attributable to a large number of reports following receipt of the pH1N1 vaccine. A large proportion of these events were reported directly to the Therapeutic Goods Administration by members of the public. However, the reports were of mild transient events, consistent with experience in other countries and similar to the well-established safety profile of seasonal influenza vaccines.

Acknowledgments

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The role of the Immunisation Adverse Events Clinic at The Children's Hospital at Westmead

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Abstract: Specialist immunisation clinics review and manage children who have experienced an adverse event following immunisation and provide advice to parents and health care providers regarding the revaccination of these children. Information collected by these clinics supplement passive surveillance data and allow the investigation of suspected safety signals associated with the delivery of immunisation programs. This paper reviews the role and experience of the Immunisation Adverse Events Clinic at The Children's Hospital at Westmead and identifies areas for development.

A clinical service to evaluate and manage children who have experienced an adverse event thought to be associated with immunisation was first established in New South Wales (NSW) at The Children's Hospital at Westmead in 1996.[1] Similar clinics exist elsewhere in Australia and the United Kingdom, while the United States network of Clinical Immunization Safety Assessment Centers was established in 2001.[2,3] These clinics assume an important role given community and health care provider concern about adverse events following immunisation. They also collect detailed post-marketing (post-marketing – the vaccine has been approved by regulatory authorities for marketing) clinical data on adverse events following immunisation and advise parents and health care providers on revaccination.[4,5]

Clinic aim and function

The purpose of the Immunisation Adverse Events Clinic at the Children's Hospital at Westmead (the Clinic) is to clinically review children who have had suspected adverse events following immunisation when telephone advice is insufficient and/or where continuation of the routine immunisation schedule is in question. Following review – and if indicated – children are vaccinated in the Clinic under supervision. Where there is a risk of a serious adverse event or where there is significant parental anxiety, vaccination is given in hospital as either a day or overnight admission. Some of these parents would have been unwilling to continue the immunisation schedule of their child without the option of hospital observation. Children vaccinated at the Clinic are routinely followed-up by telephone after 72 hours. All adverse events confirmed during consultations are reported to the NSW Department of Health.

Clinic experience

A total of 809 children were reviewed at the Clinic from January 1997 to December 2009 (Figure 1). Referrals were predominantly from metropolitan Sydney, with only 5% from rural areas. Of these, approximately three-quarters ($n = 649$) were referred because of a suspected adverse event. The remainder ($n = 158$) were mainly seen for advice concerning future vaccination (e.g. measles-mumps-rubella vaccination in the presence of egg allergy) or due to a chronic medical illness. In some cases, children referred for suspected adverse events were assigned an alternate diagnosis after review in the Clinic. The median age of attendees was 1 year, with one-third aged less than 6 months; half (48%) were girls.

The Clinic has seen a reduction in adverse events more commonly associated with whole cell pertussis vaccine (hypotonic-hyporesponsive episodes ($n = 85$), seizures ($n = 41$) and large injection site reactions ($n = 131$)) following the introduction of acellular pertussis vaccines (Figure 2). Similar to other Australian clinics, revaccination with acellular pertussis vaccine has been successfully completed in children who had experienced severe adverse events such as hypotonic-hyporesponsive episodes, seizures and apnoea.[6,7] One case of Bell's palsy was seen following human papillomavirus (HPV) vaccination in an adolescent, while most HPV adverse events ($n = 18$) involved non-specific generalised symptoms such as headache, joint pain and syncope.

The Clinic has investigated suspected safety signals such as anaphylaxis and severe allergy following HPV vaccination of adolescents (2007) and fever/febrile convulsions associated with the seasonal influenza vaccine (2010).[8] In the case of the increased rate of allergic reactions following HPV vaccination, adolescents were referred for skin-prick testing using a panel of routine allergens to further investigate their reaction and guide future vaccination.[8] The Clinic contacted parents of children vaccinated with the

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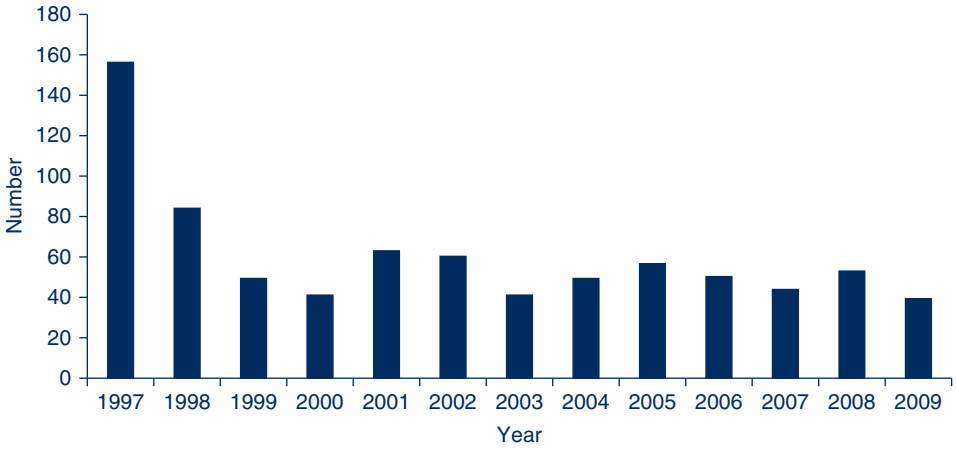

Figure 1. Number of children attending the Immunisation Adverse Events Clinic at The Children's Hospital at Westmead each year for the period 1997–2009.
Source: The Children's Hospital at Westmead Immunisation Adverse Events Clinic database.

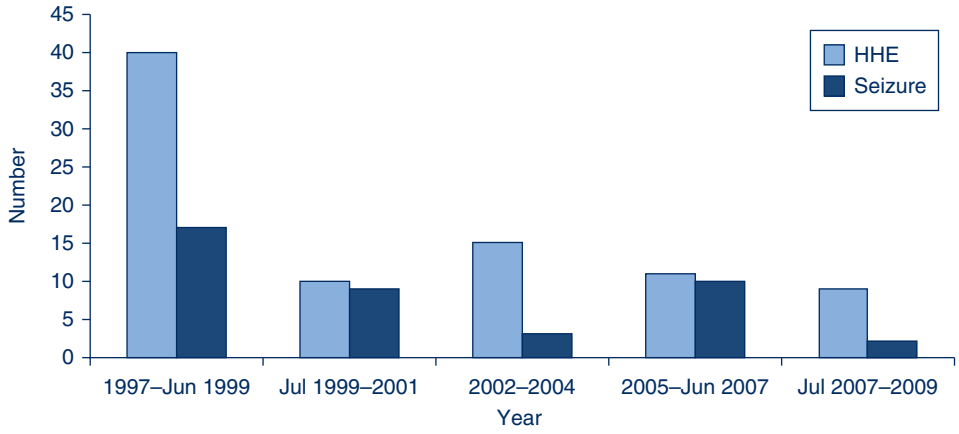

Figure 2. Number of children experiencing vaccine-related hypotonic-hyporesponsive episodes (HHE) or seizure attending the Immunisation Adverse Events Clinic at The Children's Hospital at Westmead each year for the period 1997–2009.
Source: The Children's Hospital at Westmead Immunisation Adverse Events Clinic database.

2010 seasonal trivalent flu vaccine to measure reported fever, febrile convulsions and medically attended illness; this additional data has supported national investigations.

Future development

Clinical adverse events services for adults and ready access for clinicians and patients outside the Sydney metropolitan area are limited. At present, advice to health care providers concerned about adverse events in adults or for people from regional areas is available by telephone through the Clinic. One group for whom this service is particularly useful is health care workers, given the recent mandatory vaccination program in NSW, as well as parents, for whom there are specific targeted campaigns such as pertussis booster vaccines. A network of relevant medical sub-specialists for clinical review and management of suspected adverse events in older adolescents and adults is under development and will include adult infectious diseases physicians, neurologists, geriatricians and rheumatologists.

Clinical protocols for the management of serious adverse events following immunisation need to be developed. Other plans include: research to examine risk factors for adverse events; long-term follow-up of children who have experienced adverse events; and the training of staff involved in immunisation programs.[6,9]

Conclusion

The Clinic currently provides an enhanced service at the individual level, promotes parent and provider confidence in continuing the vaccine schedule, reviews those who are in high-risk groups and continues to see parents who are reluctant to pursue vaccination of their children because of fears of adverse events.

For further information contact the Immunisation Clinical Nurse Consultant, Immunisation Adverse Events Clinic, The Children's Hospital at Westmead on (02) 9845 1433.

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School-based vaccination in NSW

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Abstract: Over the past decade the number of recommended and funded vaccines for adolescents has increased, becoming a substantial part of the National Immunisation Program in Australia. In response, NSW has implemented disease-specific vaccination campaigns for both children and adolescents and more recently established a routine high school-based vaccination program to administer vaccines to this often hard to reach group. This paper outlines the history of school-based vaccination in NSW from its commencement in 1971 to coverage from early disease-specific programs, and describes the implementation of the current program of routine vaccination. Substantial coverage has been achieved across the age spectrum 5–17 years, highlighting the effectiveness of the school-based vaccination program in reaching large numbers of adolescents.

Schools are a high risk setting for disease transmission and outbreaks due to the close contact of relatively large numbers of children at an age when many have not been previously exposed to common infections. School-aged children commonly suffer high rates of many infectious diseases and they transmit disease to other age groups who are more vulnerable to serious morbidity, such as infants and the elderly.[1–7] Therefore, school-aged children have been an important target for vaccination programs in Australia and overseas, and in recent years adolescent vaccination programs have become well established in Australia. This report describes the development of the New South Wales (NSW) Adolescent Vaccination Program, its current operation and the vaccination coverage achieved.

History

The earliest recorded national school-based vaccination services in Australia provided the diphtheria toxoid vaccine from 1932–1936. This was followed by the introduction of the Bacillus of Calmette and Guérin vaccine (BCG for tuberculosis) which was provided through school-based vaccination programs in some jurisdictions from the late 1940s to the mid-1980s. Polio vaccine was also provided in some schools during the 1950s and 1960s as part of larger mass vaccination programs.[1,8]

More recently, school-based vaccination services commenced in NSW in 1971 when the monovalent rubella vaccine was administered to girls in the first year of high school (Table 1).[8,9] The schoolgirl rubella program was implemented in rural areas by community health staff, while in metropolitan areas an independent team of two school immunisation nurses provided this service. This model continued into the late 1990s, providing the platform for the change to measles-mumps-rubella (MMR) vaccine from 1994 and the vaccination of boys from 1996.[8,9] The National Measles Control Campaign in 1998 brought the second dose of MMR vaccine forward to 4–5 years of age, necessitating a one-off catch-up campaign for the whole of primary school (5–12 years of age).[10,11] The school-based program for MMR vaccine was then disbanded due to lack of resources.

The National Health and Medical Research Council recommended National Hepatitis B Vaccine Program for children aged 10–13 years was implemented through general practice in NSW from 1999 until it was incorporated into the Adolescent Vaccination Program in 2004.[12] An evaluation undertaken in 2001 found high levels of awareness and support among parents but low coverage (18%) through private sector service provision.[12,13]

The National Meningococcal C Vaccination Program targeted all children and young people aged 12 months to 19 years and commenced in January 2003.[14,15] In NSW, this was implemented through a whole of high school vaccination program in 2003 and a whole of primary school program in 2004. This was the catalyst for the re-establishment of routine school-based vaccination in NSW through the Adolescent Vaccination Program.

Due to increased pertussis notifications in high school-aged children a whole of high school vaccination program with diphtheria-tetanus-pertussis (dTpa) vaccine was conducted across NSW in 2004,[16] and continued in 2005 targeting Year 7 students only. The dTpa vaccine was reintroduced for Year 10 students in 2009 and, following a recommendation by the Australian Technical Advisory Group on Immunisation, routine vaccination of Year 7 students commenced in 2010 with catch-up of students in

Table 1. History of vaccines delivered through universal school-based vaccination programs in NSW

Year	Vaccine	School year
1971–1994	Rubella (monovalent) (single dose)	Year 7 (Girls only)
1994–1997	Measles-mumps-rubella (MMR) (single dose)	Year 7 (Girls only in 1994 and 1995)
		(Both boys and girls in 1996 and 1997)
1998	Catch-up MMR (single dose)	Whole of primary school (Years K–6)
1999–2003	Hepatitis B (3 dose)	Delivered through general practitioners
2003–2004	Meningococcal C (single dose)	Whole of high school (2003) (Years 7–12)
		Whole of primary and high school (2004) (Years K–12)
2004–2005	Diphtheria-tetanus-pertussis (dTpa) (single dose)	Whole of high school (2004) (Years 7–12)
		Year 7 only (2005)
2004–2012	Hepatitis B (2 dose)	Year 7[a]
2006–ongoing	Varicella zoster (VZV) (single dose)	Year 7[b]
2007–ongoing	Human papillomavirus (HPV) (3 dose)	Years 10–12 (2007)
		Years 7–10 (2008)
		Year 7 only (from 2009)
2009–ongoing	Diphtheria-tetanus-pertussis (dTpa) (single dose)	Year 10 (2009–2012)
		Year 7 (from 2010)

[a]Hepatitis B vaccine is recommended for all children aged 10–13 years unless they have already received a course of the vaccine.
[b]Varicella vaccine is recommended for all children aged 12–13 years unless they have already received the vaccine or have had a clinical history of chickenpox.

Years 8–10 to be conducted over a 2-year period (2010–2012). Hepatitis B vaccine was also introduced in 2004 for Year 7 students, and will continue until the end of 2012 when all children of that age will have been vaccinated as infants. Varicella zoster vaccine was introduced in 2006 for students in Year 7 with no prior history of varicella vaccination or disease.

The National Human Papillomavirus (HPV) Program targeted females aged 12–26 years. Between 2007 and 2009 this consisted of a time-limited catch-up program delivered through schools, general practices and community immunisation services.[17] In NSW, the school-based catch-up program commenced in April 2007 for girls in Years 10–12 and continued in 2008 for girls in Years 7–10. Since 2009, HPV vaccine has been provided routinely through the Adolescent Vaccination Program for girls in Year 7 (Table 1).

Current NSW Adolescent Vaccination Program

The Australian Government provides funding to each state and territory for the purchase of vaccines on the National Immunisation Program, including all vaccines administered through the NSW Adolescent Vaccination Program. It also provides a contribution to service provision. The NSW Government provides funding for training and service delivery to enable the implementation of the Adolescent Vaccination Program in all public and private high schools. Overall coordination is provided by the NSW Department of Health Immunisation Unit, while delivery is conducted through the area health services (AHSs).[18]

A minority of high schools refuse to participate due to a philosophical objection to vaccination. These schools are provided with information about the program to distribute to parents; those parents who would like for their child to be vaccinated are advised to visit their general practitioner.[19]

Each high school holds 3–4 vaccination clinics during each school year. Scheduling of vaccines is based around the 3-dose HPV course with other vaccines organised to minimise the number of injections per visit and to meet required dose intervals. Clinic dates are organised by AHSs in the year prior to implementation. Each school is contacted 2–3 days prior to a clinic to ascertain the approximate numbers of students requiring vaccination and to discuss logistical arrangements.

All registered nurses who administer vaccines in the NSW Adolescent Vaccination Program are authorised nurse immunisers. They have completed specialist training and attend annual cardiopulmonary resuscitation training and seminars to ensure they are up to date with best practice immunisation policy.[20] Since 2007 in most AHSs, school immunisation nurses have been supported by St John Ambulance (NSW) Immunisation Program volunteers who assist students both prior to and after vaccination.[21] Each school clinic is staffed by a minimum of two authorised nurse immunisers, a team leader/coordinator and rostered St John Ambulance (NSW) volunteers if they are available. In addition, a number of school staff members are required to distribute consent forms and supervise the students.

Since 2003, AHSs have provided adolescent vaccines in Intensive English Centres in Sydney metropolitan areas. These centres provide tuition and welfare programs to high school-aged students who have recently arrived in Australia and whose first language is not English.[22] The services differ slightly from the routine program, as Intensive English Centres are visited each term and all students are offered catch-up vaccination for varicella, hepatitis B, meningococcal C and MMR, as well as dTpa and HPV as per the Adolescent Vaccination Program cohorts.

The *NSW Adolescent Vaccination Program 2010 Protocols*[18] provide the policy framework for the consistent, safe and effective implementation of the NSW Adolescent Vaccination Program. This includes detailed vaccine management, catch-up and post-vaccination care procedures for school-based clinics. The transport and storage of vaccines for the NSW Adolescent Vaccination Program is undertaken in accordance with *National Vaccine Storage Guidelines – Strive for Five 2005*.[23] Vaccinated students must remain in the vicinity of the place of vaccination and under adult supervision for at least 15 minutes following vaccination. School-based immunisation nurses are required to remain at the school for 15 minutes after the last student has been vaccinated. Students who miss a dose through illness or absenteeism are offered catch-up vaccination through AHSs or general practice.

Consent

NSW education authorities have advised that all students, including those aged 18 years and over, require written vaccine-specific consent signed by their parent/guardian. Students can refuse vaccination even if prior written consent has been provided by their parent/guardian.

Resources

Program resources, including parent information kits, templates of letters and newsletter articles, are developed by the NSW Department of Health for use by AHSs. These resources are designed to assist AHSs in communicating with schools about the Adolescent Vaccination Program. A Parent Information Kit for each type of vaccine is provided in a colour-coded envelope and contains: questions and answers about the vaccine/disease; a consent form with a record of vaccination; a privacy leaflet; and contacts for all NSW public health units. A Student Advice Card is distributed immediately prior to vaccination, outlining what students should expect in the vaccination encounter. Additionally, the Adolescent Vaccination Program section of the NSW Health website has general information for both parents and students.[19] Some AHSs may develop additional communication and/or promotional materials for use in their area.

Reporting

From 2003, vaccines provided through the NSW Adolescent Vaccination Program have been recorded on a disease-specific record of vaccination. This is provided to students following vaccination with a duplicate copy kept at the AHS. Data are aggregated by the AHS and forwarded to NSW Health each quarter. To enhance data accessibility and useability, scannable consent/vaccination record forms have been phased in since 2009.

NSW Health has developed an interim state-based immunisation register to record HPV vaccines administered in NSW schools. This has allowed the electronic transfer of data to the National HPV Register. As part of the NSW National Notifiable Diseases Database upgrade, NSW Health is developing a web-based, statewide immunisation register, primarily to record all adolescent vaccines administered in schools. The register is expected to be fully operational by mid-2011.

Adverse events following immunisation are closely monitored by immunisation teams at schools and notified immediately to the public health unit. AHSs are required to report all serious adverse events to the NSW Department of Health.[18] An overview of the national assessment and reporting processes for adverse events following immunisation notified by public health units is published in the accompanying paper in this issue[24] as well as in other national publications.[25]

Vaccine wastage is recorded for each school clinic. Data are aggregated at an AHS level and provided quarterly to the NSW Department of Health Immunisation Unit.

Coverage

The earliest available data describing vaccine coverage for NSW adolescents is from the National Hepatitis B Vaccine Program (1999–2000). Coverage from this general practice program was measured through a telephone survey of the parents/carers of NSW children aged 10–13 years and was estimated as 18%.[12]

Coverage achieved by the National Measles Control Campaign was measured through standardised data collected at the time of vaccination. Coverage for NSW primary school-aged children was estimated as 75.4%. More detailed results of this campaign are reported elsewhere.[11]

Coverage for early disease-specific and time-limited school-based vaccination programs in NSW (meningococcal C and dTpa) are presented in Table 2. During the 2003–2004 National Meningococcal C Vaccination Program, 3186 NSW schools were visited and a total of 823 197 students were vaccinated. The first year of school (Kindergarten) had significantly lower coverage

Table 2. Coverage for National Meningococcal C (2003–2004) and diphtheria, tetanus, pertussis (dTpa) (2004) school-based vaccination programs, NSW

School year	Age (years)	Coverage Meningococcal C (2003–2004)[a] % N = 823 197	Coverage dTpa (2004) % N = 274 364
Kindergarten			
	5	44	n/a
Primary school			
1	6	71	n/a
2	7	74	n/a
3	8	76	n/a
4	9	77	n/a
5	10	80	n/a
6	11	76	n/a
High school			
7	12	79	64
8	13	79	64
9	14	78	62
10	15	76	56
11	16	75	41
12	17	67	41

[a]As the Meningococcal C program took place over a 2-year period, the number of students vaccinated has been amalgamated across two grades based on their grade in 2003 (i.e. students vaccinated in Year 8 in 2004 are included in the figure for students vaccinated in Year 7 in 2003).

(44%, 72 076) than primary (76%, 401 363) and secondary schools (76%, 349 758) ($p < 0.001$) as many children aged 4–5 years were vaccinated by general practitioners. In primary schools there was a statistically significant trend of coverage increasing with increasing school year ($p < 0.001$), while in high school this trend was reversed ($p < 0.001$). When examined by AHS, combined coverage of both primary and high schools was significantly higher in the rural AHSs (80%) compared with metropolitan AHSs (73%) ($p < 0.001$), ranging from 69% to 85% (Table 2).

During the 2004 dTpa vaccination program, 274 364 (56%) eligible children were vaccinated. Coverage varied by AHS, ranging from 48% to 63%. As there were no program delivery issues unique to any AHS, the variation in coverage is likely to have occurred due to differences in the demographics of the population in that area, such as conscientious objection, which affect coverage in other age groups.[26] Coverage may also have been affected by the National Health and Medical Research Council recommendation that children who had received dT vaccine in the previous 5 years were not eligible to receive dTpa vaccine through this program. Coverage was similar in metropolitan and regional schools (56% and 55% respectively) and only slightly lower in remote schools (49%), although this difference was statistically significant ($p < 0.001$). There was a statistically significant association between school type and immunisation coverage ($p < 0.001$), with higher coverage seen in Catholic schools (60%) compared with government (55%) and independent schools (50%). This association was not confounded by school location or the socioeconomic status of the local area. Immunisation coverage was similar in schools of varying size. Coverage decreased with higher school years, particularly in Years 11 and 12, with a statistically significant inverse trend in coverage and school year ($p < 0.001$).

The re-introduction of dTpa into the Adolescent Vaccination Program from 2009 resulted in 68% coverage of eligible Year 10 students with coverage higher than the 2004 program across all AHSs (range 61–71%). Other vaccines delivered through the Adolescent Vaccination Program in 2009 targeted Year 7 students, with statewide coverage ranging from 34% for varicella vaccine (in students with no previous clinical disease) to 80% for HPV (dose 1). Coverage is consistently higher for the first dose of both hepatitis B (63% versus 50%) and HPV (80% versus 77% versus 69%) vaccines which require multiple doses.[27] Further detail on coverage for the 2009 Adolescent Vaccination Program is presented in the accompanying paper in this issue.[27]

Discussion

There are many challenges in vaccinating adolescents in comparison to younger age groups, including their increased mobility, limited visits to general practice and the need to obtain consent from parents who are not present

at the vaccination.[28,29] Despite these challenges, school-based vaccination in NSW has achieved high coverage, which is similar to or better than that achieved in other Australian jurisdictions[30–33] and higher than in settings where adolescent vaccines are implemented through primary care.[34,35] The higher coverage consistently achieved in the early high school years has resulted in a transition towards delivering the majority of routine vaccines in Year 7. The implementation of the statewide adolescent vaccination register will be another substantial improvement to the program as it will improve access to individual vaccination records and enhance accuracy of coverage data used to monitor program effectiveness.

Conclusion

The NSW Adolescent Vaccination Program has evolved considerably over the last decade in response to available evidence and increased availability of and recommendations for adolescent vaccines. Integral to its success is the collaborative and coordinated approach to service delivery, the cooperation of the NSW education authorities and school principals, and the highly skilled workforce involved in its implementation.

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Making influenza vaccination mandatory for health care workers: the views of NSW Health administrators and clinical leaders

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Abstract: The challenges of maintaining high influenza vaccination rates in health care workers have focused worldwide attention on mandatory measures. In 2007, NSW Health issued a policy directive requiring health care workers to be screened/vaccinated for certain infectious diseases. Annual influenza vaccine continued to be recommended but not required. This paper describes the views of NSW Health administrators and clinical leaders about adding influenza vaccination to the requirements. Of 55 staff interviewed, 45 provided a direct response. Of these, 23 supported inclusion, 14 did not and eight were undecided. Analysis of interviews indicated that successfully adding influenza vaccination to the current policy directive would require four major issues to be addressed: (1) providing and communicating a solid evidence base supporting the policy directive; (2) addressing the concerns of staff about the vaccine; (3) ensuring staff understand the need to protect patients; and (4) addressing the logistical challenges of enforcing an annual vaccination.

Influenza causes substantial morbidity and mortality in Australia. In the non-pandemic period 2000–2002, 6275 hospitalisations and 87 deaths from influenza were reported.[1] During the 2009 H1N1 pandemic period there were 1214 hospitalisations, 255 admissions to intensive care and 48 deaths in New South Wales (NSW) alone.[2] Nosocomial transmission of influenza places significant burden on patients, staff and the health care system. One study found that over a quarter of influenza infections that resulted in admission to intensive care or death were hospital acquired.[3]

Vaccinating health care workers has been associated with reduced mortality among long-term care patients, decreased rates of nosocomial influenza in hospitalised patients, reduced staff absenteeism, and cost savings.[4–6]

Maintaining high immunisation rates among health care workers remains a significant challenge. Previously documented coverage levels in Australian hospital settings have been poor and, depending on the setting, have ranged from 18 to 58%.[7–10] Health care workers hold misconceptions about the risk and severity of influenza and the safety and efficacy of the vaccine.[11–13] While addressing psychological and other barriers can make voluntary programs to increase uptake of the vaccine by health care workers more successful, these programs appear difficult to sustain.[14–16] This has resulted in widespread interest in mandatory influenza vaccination of health care workers in institutional settings.[17–22]

In February 2007, NSW Health introduced a unique policy directive requiring employees to be vaccinated against specified vaccine-preventable diseases. Required vaccines include measles, mumps, rubella, varicella, hepatitis B, diphtheria, tetanus and pertussis.[23] Annual influenza A vaccine is recommended but not mandatory. Health care workers who do not comply with policy directive requirements must acknowledge this in writing and subsequently engage with the employer to determine whether restrictions on the nature of work undertaken are required.[23]

We conducted a qualitative investigation with key personnel involved in the implementation of the policy directive. Among the study's aims was one to ascertain views about the feasibility of including influenza vaccine within the existing mandatory provisions. These findings form the subject of this paper.

Methods

The study was carried out from February to June 2009. Participants were selected, via stratified purposeful sampling,[24] for qualitative semi-structured interviews. We

selected from four groups of staff closely involved with policy directive development and/or implementation. These groups were: (1) staff from the NSW Department of Health; (2) the NSW Health Implementation Group (a policy implementation group specifically formed in relation to this policy and consisting of representatives from each area health service); (3) staff of NSW public hospitals; and (4) staff of professional associations and university student liaison groups.

This study was approved by the NSW Health Population Health Research Ethics Committee and individual hospital sites from which participants were recruited. Participation was voluntary and written consent was obtained. The Chief Executive of each hospital approved participation. We then approached individuals from each of the groups confidentially.

A single interviewer (CH) conducted all interviews and each lasted between 40 and 60 minutes. While concentrating on questions about barriers and facilitators to policy directive implementation, the following question was also asked of participants from groups 1, 2 and 3 above: '*What are your views on a similar policy directive which includes yearly influenza vaccination for staff?*' Participants from group 4 were asked about the impact such a requirement would have on their organisation. Interviews were digitally recorded and transcribed.

All interviews were read and a list of themes developed, compared and re-developed by the authors. The agreed themes were coded using NVivo software Version 8 (QSR International, Cambridge, USA). These findings were compared across hospital types and professional groups to identify if a professional/workplace role or circumstance influenced opinions. Given the large number of interviewees, we were able to quantify responses according to whether the participant's answer indicated they supported, did not support, or were undecided about including mandatory influenza vaccination under the current policy directive. This was done with participant groups 1, 2 and 3.

Interpretation was undertaken by authors with differing positions on mandatory vaccination for health care workers.[25,26]

Results

Fifty-eight participants were interviewed: eight from the NSW Department of Health; five from the NSW Health Implementation Group; 37 from a range of public hospitals (administrative leaders, clinical managers and clinicians); and eight from unions and professional associations.

Of the 45 participants providing a direct response to the question, 23 (51%) favoured mandatory influenza vaccination inclusion in the policy directive, 14 (31%) were not supportive and eight (17%) were undecided.

Support for mandating influenza vaccination

Supportive participants felt that mandating influenza vaccination would provide extra 'teeth' to their current efforts to vaccinate staff each influenza season, with many feeling that existing efforts struggled to attain even 50% (and sometimes as low as 25%) influenza vaccination coverage.

Reducing absenteeism and protecting patients both rated as rationales for support. Staff protection also factored in, but was less compelling as a rationale because many felt that staff did not see themselves to be at risk. One occupational health service manager commented on the incongruity of their department potentially driving a policy that was essentially about patient protection:

> I think it has to happen but I don't think it'll come from us … it'll come from a public health [standpoint, as a] patient safety issue.
> (Hospital clinical manager)

Participants at higher administrative levels tended to have more support than those at a clinical management level. Four of the five infectious disease specialists interviewed supported mandatory influenza vaccination. When asked about the impact on their organisations, participants representing unions did not voice any major concerns; as one put it: 'I don't think that there would be a big backlash.'

Potential barriers to mandating influenza vaccine

Regardless of whether or not participants supported influenza vaccine inclusion in the policy directive, they cited similar barriers to such an inclusion. The more commonly cited barriers tended to be unique to influenza vaccination and centred on: the logistics of mandating and enforcing a yearly vaccination (mentioned by 17 participants); the persistence of staff resistance to influenza vaccination based on misunderstandings of the vaccine's necessity, safety and efficacy (mentioned by 19 participants); and the felt need of some staff for better evidence to support influenza immunisation of health care workers (mentioned by eight participants).

Logistics

Experiences with the current policy directive had brought to the forefront the challenges of implementing such a requirement. Staff acknowledged that vaccinating a large number of staff within a short period of time and enforcing such a requirement would necessitate a significant amount of money and resources, such as trained staff and immunisation clinics, and more active approaches to immunise

staff, such as ward visits. A few participants were concerned about the ability to enforce such a requirement. A few felt the resources necessary for influenza vaccination's full inclusion would make overall compliance with the policy directive an unattainable goal.

> I'd support it – in principle. In actual operational terms it would be a logistical nightmare. We're talking about getting the entire staff of a hospital influenza-vaccinated within a 4-week period instead of over a whole year or over a whole lifetime, and we would have to do that each and every year.
> (Hospital clinical manager)

The following comment from a hospital clinical manager encapsulates the struggle – evident in many supportive participants – between the logistical challenges and the potential support such an inclusion might engender:

> My views are that philosophically it should happen. Practically, I think it may be a bit of a nightmare, particularly until the [existing policy directive is] embedded, much more adequately resourced and [there are] better data collection systems. Having said that, a lot of effort goes into encouraging influenza vaccination each season and I suspect if it were mandatory less effort would be required to encourage people, if it became more or less an automatic thing.
> (Hospital clinical manager)

Staff resistance

Much of the concern about logistical challenges came in the context of a perception that staff would resist the mandate. Many participants, regardless of their support, felt there was a history of staff not wanting to receive influenza vaccination because of reservations around the efficacy, necessity and safety of the vaccine. Some participants spoke of a 'backlash', 'resentment' and 'opposition' from staff, as well as 'stigma' surrounding the vaccine. They anticipated this based on previous experience and two participants who themselves believed the vaccine caused a respiratory illness:

> A lot of people get reactions to the flu vax [vaccination]. The first flu vax they have they get a very bad cold and they nearly die.
> (Hospital clinical manager)

In addition to the perceived staff backlash against mandatory influenza vaccination, some participants mentioned that staff did not need to be vaccinated because they were not at risk of influenza and 'didn't get sick'. This belief, also held by a few of the participants, appeared to be underscored by an assumption that influenza vaccination is primarily to protect staff, not patients.

Need for evidence

In particular, medical specialists wanted clearer epidemiological and disease modelling evidence about the impact of influenza vaccination in health care settings to justify the policy.

> If you're mandating something then you really have to show that the efficacy of that is almost universal.
> (Administrative leader)

Other needs

The interviews offered an opportunity to explore what participants felt was needed to enable influenza vaccine to be a requirement rather than a recommendation. Along with the desire for more evidence, various individuals mentioned the need for 'political will', a consultative and 'critical dialogue with health professionals and the broader community', and 'innovative' campaigns. Others mentioned wanting information on the best way to implement such a policy. One participant felt that a lifelong vaccine would help greatly by eliminating the annual requirement.

Discussion

This study of staff involved with policy implementation demonstrates mixed attitudes towards adding influenza vaccine to an existing state mandatory immunisation program for health care workers. NSW Health currently has no specific plan to include influenza vaccination under the policy directive. However, the issue may arise in the future, particularly in light of public concern about pandemic (H1N1) 2009 influenza and several recently published implementation reports of success with mandatory approaches to influenza immunisation in United States hospital workers.[17,19,20]

This investigation has provided insight into issues that it would be helpful to address should a mandatory influenza immunisation policy for health care workers be considered in the future. While the study is not a representative sample of all health care workers in NSW, it provides insights from people with experience in developing and implementing a mandatory program. For them, the primary issues were:

- *Providing and communicating a solid evidence base.* This was particularly important for infectious diseases physicians, who are ideally placed to champion such a policy. The evidence base could also include continuous feedback of current data on the success of the NSW mandatory policy directive and careful monitoring of ongoing mandatory health care worker influenza immunisation programs in the United States.
- *Addressing the concerns of staff about influenza vaccine safety and efficacy*. Many participants felt staff would not accept this vaccine. Anticipated staff resistance to influenza vaccination appeared to be a barrier to

participants' sense of confidence and competence (self-efficacy) to successfully implement and enforce such a requirement. Therefore, any campaign efforts would need to increase staff support for the vaccine and provide evidence of protection of this support to those implementing the mandate.

- *Ensuring staff understand the need to primarily protect patients.* It appears there is a belief that vaccinating staff against influenza is primarily to protect staff. Protecting patients by reducing the risk of transmission needs to be a clear message and is likely to appeal to an underlying professional value of duty of care. This would be particularly relevant for staff working with patients at high risk of complications from influenza including the immunocompromised and those with cardiorespiratory disease. For administrators, the role of staff vaccination in assuring full staffing in health care settings in influenza epidemics could also be emphasised.
- *Addressing the logistical challenges.* Challenges include capacity to execute and enforce vaccination of a large number of staff within a short period of time and feasible options for management of non-compliant staff.

Conclusion

The unique nature of influenza vaccination, its yearly requirement and staff beliefs about its safety and efficacy makes mandating it as part of the current policy directive challenging, but not insurmountable. More broadly, institutions or jurisdictions which consider mandatory influenza vaccination as part of their future efforts to improve uptake must recognise and address the potential barriers to such a measure, including those identified above.

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The plague: not just an historical curiosity

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The Gram-negative bacterium *Yersina pestis* is the causative agent of the infectious disease classically referred to as the plague. Wild rodents, especially ground squirrels and prairie dogs, are the natural reservoir of the organism. The organism can occasionally be transmitted to people who are bitten by an infected animal or infected fleas that feed on those animals. Currently, *Y. pestis*-infected rodents are present on every continent except Australia and Antarctica. Plague is endemic in animals in many countries in Africa, the Americas and Asia and sporadic infections occur, at varying rates, in humans. In 2003, nine countries reported 2118 cases and 182 deaths from plague: 99% of those cases and deaths were reported from Africa.[1]

The distribution of human plague coincides with the geographical distribution of infection in animals. Genome studies show that *Y. pestis* was a redundant pathogen of the intestine that acquired virulence genes from other bacteria and viruses approximately 1500 years ago.[2] The ability of *Y. pestis* to change its genes to suit the environment suggests that it may provide insight into ways in which highly virulent pathogens evolve.

Clinical features

Plague can present in three ways. Bubonic plague occurs following a bite by an infected flea allowing entry of the bacillus to the lymphatic system causing a bubo. The usual clinical presentation of the bubonic plague is inflammation of the inguinal lymph nodes. The bubonic disease can progress to the septicaemic form of the plague where it enters the bloodstream causing bacteraemia. The third form of the plague is pneumonic plague which results from exposure to a patient with pneumonic plague or a deliberate aerosolisation of the pathogen. The symptoms of pneumonic plague include fever and a productive cough which may produce blood-stained sputum. The mortality rate ranges from 50 to 60% for untreated bubonic plague and nearly 100% for untreated pneumonic plague. However, early diagnosis and commencement of antibiotic treatment within 24 hours can reduce the mortality rate to less than 5%.

CCR5 mutation

The human genome contains remnants of our past battles with pathogens. One of these is a gene mutation called chemokine receptor (CCR)-5. In 1998, scientists tested samples of British descendents of the plague survivors and found a high frequency of a gene mutation called CCR5-Δ32. In some parts of Europe today, up to 20% of the population can carry at least one copy of the protective gene.[3]

Public health response

Urgent priority must be given to a suspected case of *Y. pestis* infection. Hospitals and laboratories are required to notify immediately when the diagnosis is suspected and the New South Wales (NSW) Department of Health is to be notified on the day of the case detection. However, the presenting features of plague are often nonspecific and the diagnosis is unlikely to be suspected until an unusual Gram-negative bacillus is isolated from a blood culture or sputum. Identification of *Y. pestis* requires specialised testing in a reference laboratory accredited to handle security-sensitive biological agents.

Household and other face-to-face contacts of patients with pneumonic plague should be given chemoprophylaxis and placed under surveillance. Strict isolation is only required for patients with pneumonic plague; for patients with bubonic plague with no cough and a negative chest X-ray, effective antibiotic treatment is sufficient.[4] In endemic areas, control of rats is the primary means for managing plague outbreaks followed by basic environmental sanitation.

The plague in Sydney, 1900–1907

John Ashburton Thompson was the first Chief Health Officer in NSW, architect of the first *Public Health Act* in NSW and an accomplished epidemiologist. His epidemiological investigations in both rats and humans provided the first real evidence for the role of the rat flea in the transmission of plague. He was instrumental in identifying rat control as the foundation of the public health response to plague outbreaks and the success of that response, first in Sydney and then internationally.

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10.1071/NB10034

Promoting the generation and effective use of population health research in NSW: a Strategy for NSW Health 2011–2015

Public consultation on draft Strategy 26 October–22 November 2010

Background

The Population Health Division, NSW Department of Health is developing a Strategy to support the generation and use of population health research within NSW Health.

The main purpose of the document is to describe how the Division will facilitate the conduct of high-quality, relevant, population health research and the use of research evidence in policy and practice in NSW Health.

The Strategy (and its implementation) will support population health research that is undertaken, commissioned, supported or used by NSW Health (at the state and local level). The Population Health Division makes a significant investment in supporting population health research. The Strategy identifies ways that the Division can manage this investment more strategically and collaboratively.

Development of the draft Strategy

The Population Health Division has prepared a draft Strategy in consultation with the Strategic Directions for Population Health Research Advisory Committee and informed by three separate investigations:

- a review of existing strategic documents that support decision-making in population health and/or health research from other jurisdictions and countries
- interviews with stakeholders regarding current population health research practice, issues with current practice and the proposed content of the NSW Strategy
- a review of strategies to increase the use of evidence from research in population health policy and programs.

Public consultation

This public consultation aims to provide an open and transparent process allowing stakeholder input on the draft Strategy.

Key stakeholders across NSW are invited to provide input on the draft Strategy.

The draft Strategy is available on the NSW Health Research website: www.health.nsw.gov.au/research/index.asp

Please provide comments on the draft Strategy in relation to the following questions:

a. Do you have any comments on the framework (page 8), including the key strategies?
b. Are there any other 'current actions' that NSW Health (Department of Health or area health services) is involved in that should be included under each of the strategies in the document?
c. Are the proposed actions listed under 'what we will do' relevant, useful and comprehensive, given the resource-neutral nature of the Strategy?

Comments must be provided by email to Beth Stickney (bstic@doh.health.nsw.gov.au) by 5pm on **Monday 22 November 2010**.

Communicable Diseases Report, NSW, July and August 2010

Communicable Diseases Branch
NSW Department of Health

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

Figure 2 and Tables 1 and 2 show reports of communicable diseases received through to the end of July and August 2010 in New South Wales (NSW).

Enteric infections

Outbreaks of foodborne disease

Ten outbreaks of suspected foodborne disease were investigated in July and August 2010. In three of these outbreaks (one of which occurred in an aged-care facility) stool specimens tested positive for *Salmonella* Typhimurium. In one, samples of the fried ice-cream that the affected people had consumed in a restaurant also tested positive for *S.* Typhimurium. In the other two, environmental samples and food samples tested negative for any pathogens. In the remaining seven outbreaks none of the cases submitted a stool specimen for testing so the causative pathogen could not be identified. Several of these outbreak investigations are ongoing.

Outbreaks of gastroenteritis in institutional settings

One hundred and sixty-seven outbreaks of gastroenteritis in institutions were reported in July and August 2010, affecting 2795 people. Eighty-six outbreaks occurred in aged-care facilities, 45 in child-care centres, 33 in hospitals, one in a military institution and two in other institutions (a physical disability facility and a mental health facility). All outbreaks appeared to have been caused by person-to-person spread of a viral illness. In 60 outbreaks (36%) stool specimens tested positive for norovirus, and in 5 outbreaks (3%) stool specimens tested positive for rotavirus. Test results for several outbreaks may still be pending.

Viral gastroenteritis tends to peak in winter months, when around 15 outbreaks per week are reported.

Gastroenteritis in the community

The number of patients presenting with gastrointestinal illness to 56 of the largest emergency departments in NSW increased slightly but remained within the usual range for the time of year (Figure 1).

Respiratory and other infections

Legionnaires' disease

Nine cases of Legionnaires' disease were reported in NSW in July and August 2010, including two cases due to *Legionella longbeachae* and seven cases due to *L. pneumophila*. For the same period in 2009, 15 cases of *L. longbeachae* and two of *L. pneumophila* infection were reported.

Two of the individuals with *L. pneumophila* reported spending time in the Sydney Olympic Park area during the incubation periods for their illness. Following an environmental investigation of the Sydney Olympic Park area on 28 August, water specimens collected from a cooling tower system in one of the stadiums tested positive for *L. pneumophila*. The contaminated cooling tower system was closed down until it could be cleaned and disinfected. While this cooling tower system could not be definitively linked to the two cases, NSW Health alerted general practitioners and respiratory doctors by fax, encouraging them to consider the the issue when diagnosing people who had visited the Sydney Olympic Park area during August. The public were also alerted via the media.

Influenza

In July and August 2010, influenza activity in NSW (as measured by the number of people who presented to 56 of the state's largest emergency departments with influenza-like illness and the number of patients who tested positive for influenza at diagnostic laboratories) was low.

- There were 220 presentations (1.3 per 1000 presentations) for July and 236 presentations (1.7 per 1000 presentations) for August to 56 of the largest emergency departments in NSW of people with influenza-like illness.

10.1071/NB10070

- There were 33 cases of laboratory-confirmed influenza (including 19 of pandemic (H1N1) 2009) reported in July and 110 (including 83 of pandemic (H1N1) 2009) in August.
- Ten people with influenza were admitted to hospital intensive care units in July and 11 in August.

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

Measles

Eight cases of measles associated with an outbreak on the NSW North Coast were reported in July and August. The index case was an unimmunised student who had acquired the infection overseas. Six of the cases had close contact with this child at school; one further case occurred in a student attending different classes at the school.

The proportion of children who are reported to be fully vaccinated at 5 years of age in some North Coast communities is lower (61–93%) than in other parts of NSW (89–93%).

Three cases of measles were reported on the NSW Central Coast in August. The first case occurred in an unimmunised child who had acquired the infection overseas. Two subsequent cases occurred: one in an unimmunised sibling of the child and the other in a community contact of the child.

As previously reported, many people who were born after 1965 may not be immune to measles because they have neither acquired the measles infection nor received two doses of a measles vaccine. Measles vaccine is now routinely given to infants at 12 months and at 4 years, and this confers long-lasting immunity in 99% of recipients. These recent outbreaks highlight the importance of complete measles immunisation, particularly prior to overseas travel.

Meningococcal disease

Sixteen cases of meningococcal disease were reported in NSW in July and August. The ages of the affected people ranged from 0 to 67 years (six were aged less than 5 years). Six cases were caused by serogroup B, while serogroups C and Y caused one case each. For the remaining eight cases the serogroup was unknown.

Twenty-three confirmed cases and three clinically diagnosed cases were reported in the same period in 2009.

A free vaccine for serogroup C meningococcal disease is available for infants at 12 months of age. Consequently, serogroup C meningococcal disease is now mainly seen in adults and in unimmunised children. In NSW in 2009, 80% of cases of meningococcal disease (where the serogroup was known) were caused by serogroup B, for which there is no vaccine.

Pertussis (whooping cough)

During July and August, 862 cases of pertussis were reported in NSW. This is significantly lower than the number of cases reported for the same period in 2009 (1250 cases), however this total represents an increase in notifications over May and June 2010 when 684 cases were notified in NSW.

A free vaccine is available for infants at 2, 4 and 6 months (the first dose can be given as early as 6 weeks of age) with a booster dose at 4 years (which can be given from 3 years and 6 months of age). Immunisation reduces the risk of infection, however the vaccine does not provide lifelong protection, and re-infection can occur. Because pertussis immunity wanes over time, many older children and adults are susceptible to infection and can be the source of new infections in infants. For a limited time, free pertussis (dTpa) vaccine is available for all new parents, grandparents and any other adults who will regularly care for

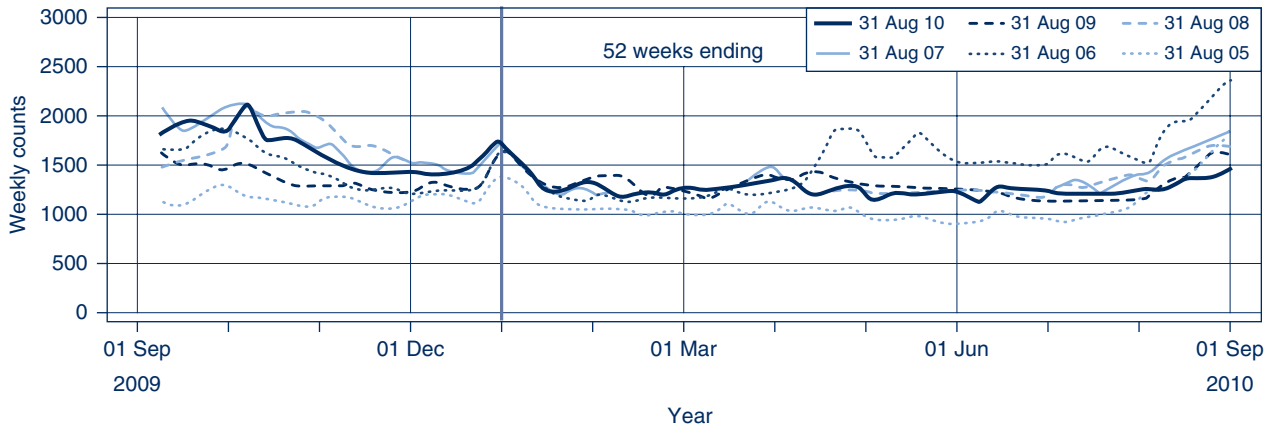

Figure 1. Total weekly counts of emergency department visits for gastrointestinal illness, for the 12 months to 31 August 2010 (thick line), compared with each of the 5 previous years (thin lines) (includes data from 56 of the largest NSW emergency departments).

infants less than 12 months of age. Free vaccine is also provided to Year 7 and Year 10 students as part of the NSW School-based Vaccination Program from 2010.

Haemophilus influenza *type b invasive infection*

Three cases of *Haemophilus influenza* type b invasive infection (Hib) were reported in NSW in July and August. One case occurred in an infant too young to be fully immunised, while the other cases occurred in adults. For the same period in 2009, there were no cases of Hib reported in NSW in any age group.

Sexually transmissible infections

Lymphogranuloma venereum

So far this year, 29 cases of lymphogranuloma venereum (LGV) have been reported in NSW, including five cases with onset in July and seven cases with onset in August. Gay men living in inner metropolitan Sydney have been most affected and the majority of cases have been acquired locally. Most patients have presented with moderate to severe proctitis. LGV in this outbreak is being caused by *Chlamydia trachomatis* serogroup L2b.

LGV is a rare sexually transmitted chlamydial infection that spreads through unprotected vaginal, anal or oral sexual contact, especially if there is trauma to the skin or mucous membranes. Men who have sex with men, especially those that have unprotected anal sex, are at greatest risk. The bacteria that cause LGV are rare types of chlamydia, however LGV infection is a more aggressive disease than common chlamydial infections. The infection is treated with an extended course of antibiotics.

In response to an increased number of cases reported in May, NSW Health issued an alert to general practitioners in inner Sydney. This alert included information on clinical presentation, diagnosis, treatment and public health management (including contact tracing). Since this time, laboratories have reported increased testing requests for LGV. Information about LGV was also included in the gay press.

Co-infection with other sexually transmissible infections occurs frequently in gay men with LGV and a large proportion of cases overseas have been reported to have HIV. The outbreak in NSW is likely to also include a large proportion of HIV positive men. Active case finding is an important part of a comprehensive management plan and this should include notification and assessment of all sexual partners of the index patient from 1 month prior to their first symptoms.

Figure 2. Reports of selected communicable diseases, NSW, January 2004 to August 2010, 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 infection; 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 & hospitals than by other institutions.

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

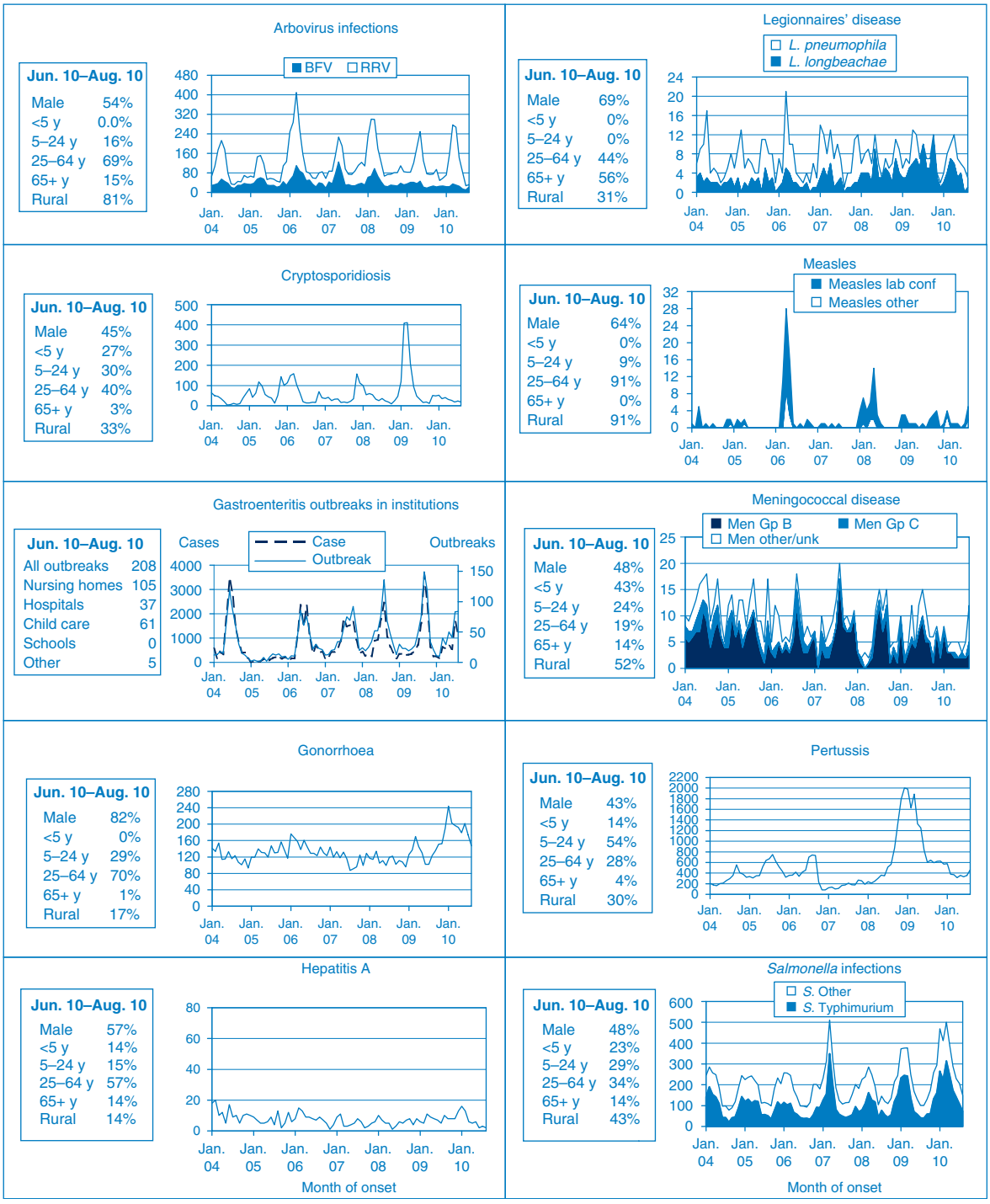

Table 1. Reports of notifiable conditions received in July 2010 by area health services

	Area Health Service (2010)																		Total	
	Greater Southern		Greater Western			Hunter New England		North Coast		Northern Sydney Central Coast		South Eastern Sydney Illawarra		Sydney South West		Sydney West			For	Year
Condition	GMA	SA	FWA	MAC	MWA	HUN	NEA	MNC	NRA	CCA	NSA	ILL	SES	CSA	SWS	WEN	WSA	JHS	July[b]	to date[b]
Bloodborne and sexually transmitted																				
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	73	43	30	14	40	233	41	48	75	58	102	87	250	112	86	55	130	12	1518	10737
Gonorrhoea[a]	6	5	1	1	4	17	7	4	2	5	16	9	32	–	–	11	18	–	138	1429
Hepatitis B – acute viral[a]	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	22
Hepatitis B – other[a]	7	–	6	–	3	10	5	3	2	1	24	10	46	49	60	6	56	9	304	1842
Hepatitis C – acute viral[a]	–	–	–	2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	3	26
Hepatitis C – other[a]	8	11	9	4	9	30	5	18	23	11	15	17	52	32	47	19	25	40	379	2853
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	3
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	–	1	–	4	–	2	–	–	–	7	22
Syphilis	–	1	2	–	1	–	1	1	1	–	6	–	18	8	3	–	1	–	44	437
Vectorborne																				
Barmah Forest virus[a]	–	2	–	1	–	2	1	2	3	–	–	1	–	–	–	–	–	–	12	166
Ross River virus[a]	7	–	1	2	2	3	–	2	3	2	–	–	–	1	–	1	1	–	25	874
Arboviral infection (other)[a]	–	–	–	1	–	5	–	1	3	–	1	1	5	2	–	–	2	–	21	77
Malaria[a]	1	–	–	–	–	–	–	–	–	–	2	1	–	–	–	–	3	–	8	53
Zoonoses																				
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Brucellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Leptospirosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Q fever[a]	1	1	–	–	–	2	2	–	2	–	–	1	–	–	2	1	1	–	14	75
Respiratory and other																				
Blood lead level[a]	3	–	–	4	–	–	–	–	–	–	–	–	–	1	1	1	–	–	10	91
Invasive pneumococcal infection[a]	2	2	–	–	1	8	2	1	–	2	13	2	13	2	5	7	5	–	65	272
Legionella longbeachae infection[a]	–	–	–	1	–	–	1	–	–	–	–	1	–	–	–	–	1	–	4	30
Legionella pneumophila infection[a]	–	–	–	–	–	1	–	–	–	–	2	–	1	–	–	–	–	–	4	26
Legionnaires' disease (other)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Meningococcal infection (invasive)[a]	–	–	–	–	–	1	–	–	–	1	–	–	–	–	1	1	1	–	5	33
Tuberculosis	1	1	–	–	–	–	–	–	–	–	–	–	4	5	–	1	3	–	15	166
Vaccine-preventable																				
Adverse event after immunisation	3	–	–	4	–	–	–	–	–	–	–	–	–	1	1	1	–	–	10	110
H. influenzae b infection (invasive)[a]	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1	–	–	2	4
Measles	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8
Mumps[a]	–	–	–	–	–	–	–	–	–	–	1	–	–	1	2	–	–	–	4	21
Pertussis	16	19	9	1	14	28	3	4	–	11	62	13	46	21	35	23	49	–	356	2748
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	8
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Enteric																				
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cryptosporidiosis[a]	5	–	–	1	–	2	4	–	1	1	2	1	3	2	–	1	1	–	25	231
Giardiasis[a]	6	5	1	1	4	17	7	4	2	5	16	9	32	–	–	11	18	–	138	1456
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Hepatitis A[a]	–	–	–	–	–	–	–	–	–	–	2	–	1	–	1	–	1	–	5	59
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	9
Listeriosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19
Rotavirus[a]	3	1	–	–	–	15	–	1	3	4	14	3	12	2	5	5	1	–	69	388
Salmnellosis[a]	6	5	3	6	3	24	9	5	9	14	34	11	28	11	22	9	22	–	227	2545
Shigellosis[a]	–	–	–	–	–	2	–	–	–	–	–	–	4	1	1	–	1	–	9	55
Typhoid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	26
Verotoxin producing *E. coli*[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9
Miscellaneous																				
Creutzfeldt–Jakob disease	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1

[a]Laboratory-confirmed cases only. [b]Includes cases with unknown postcode.
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Table 2. Reports of notifiable conditions received in August 2010 by area health services

Condition	Area Health Service (2010)																		Total	
	Greater Southern		Greater Western			Hunter New England		North Coast		Northern Sydney Central Coast		South Eastern Sydney Illawarra		Sydney South West		Sydney West			For August[b]	Year to date[b]
	GMA	SA	FWA	MAC	MWA	HUN	NEA	MNC	NRA	CCA	NSA	ILL	SES	CSA	SWS	WEN	WSA	JHS		
Bloodborne and sexually transmitted																				
Chancroid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamydia (genital)[a]	56	30	19	15	26	187	53	32	29	92	72	69	131	131	116	53	115	10	1267	12004
Gonorrhoea[a]	1	3	–	–	–	15	2	3	2	5	8	4	75	31	16	3	14	1	189	1618
Hepatitis B – acute viral[a]	1	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	3	25
Hepatitis B – other[a]	1	2	1	2	–	5	1	3	–	–	17	5	40	29	43	3	50	7	221	2063
Hepatitis C – acute viral[a]	1	–	–	–	–	–	–	1	–	–	–	–	–	1	1	–	–	–	4	30
Hepatitis C – other[a]	9	11	1	2	9	20	6	13	12	13	15	13	20	33	55	14	26	28	307	3160
Hepatitis D – unspecified[a]	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	4
Lymphogranuloma venereum	–	–	–	–	–	–	–	–	–	–	1	–	3	1	–	–	1	–	7	29
Syphilis	–	–	–	–	–	–	1	1	–	–	1	–	5	2	–	1	–	–	12	449
Vectorborne																				
Barmah Forest virus[a]	–	–	–	–	–	2	–	5	4	–	–	–	–	–	–	–	–	–	11	177
Ross River virus[a]	2	–	–	1	–	5	2	4	5	2	–	–	1	–	–	–	–	–	23	897
Arboviral infection (other)[a]	–	–	–	–	–	–	1	–	–	–	3	–	3	1	2	–	–	–	10	87
Malaria[a]	–	–	–	–	–	4	1	–	2	–	2	–	1	2	1	1	4	–	19	72
Zoonoses																				
Anthrax[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Brucellosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Leptospirosis[a]	1	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	3	13
Lyssavirus[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psittacosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Q fever[a]	–	1	1	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	6	81
Respiratory and other																				
Blood lead level[a]	–	–	–	–	–	1	–	–	–	–	–	–	–	2	1	–	–	–	4	95
Invasive pneumococcal infection[a]	1	3	–	2	3	4	3	2	1	2	4	4	8	5	7	3	5	–	58	330
Legionella longbeachae infection[a]	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	31
Legionella pneumophila infection[a]	–	–	–	–	–	–	–	–	–	–	1	–	–	1	1	1	–	–	4	30
Legionnaires' disease (other)[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	3
Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Meningococcal infection (invasive)[a]	–	–	–	–	1	2	–	1	–	–	–	2	1	1	1	1	–	–	10	43
Tuberculosis	–	–	–	–	–	1	–	–	–	2	–	–	5	–	–	1	4	–	14	180
Vaccine-preventable																				
Adverse event after immunisation	–	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	–	3	113
H. Influenzae b infection (invasive)[a]	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	5
Measles	–	–	–	–	–	–	–	–	7	1	–	–	–	–	–	–	–	–	9	17
Mumps[a]	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	2	23
Pertussis	16	17	14	4	23	25	6	7	5	8	128	19	73	36	56	14	69	–	523	3271
Rubella[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8
Tetanus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Enteric																				
Botulism	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cholera[a]	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	2	2
Cryptosporidiosis[a]	–	–	–	–	1	1	–	–	1	1	5	1	5	2	4	–	5	–	26	257
Giardiasis[a]	5	3	1	–	3	17	3	4	1	6	12	8	35	–	–	8	13	–	120	1576
Haemolytic uraemic syndrome	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Hepatitis A[a]	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	2	61
Hepatitis E[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2	11
Listeriosis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19
Rotavirus[a]	10	4	–	–	1	29	1	1	3	9	11	2	17	11	3	4	10	–	116	504
Salmnellosis[a]	7	4	–	1	2	21	4	3	7	5	29	9	41	22	13	5	25	–	200	2745
Shigellosis[a]	–	–	–	–	–	–	–	–	1	–	–	–	6	–	3	–	2	–	12	67
Typhoid[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	2	28
Verotoxin producing *E. coli*[a]	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	10
Miscellaneous																				
Creutzfeldt–Jakob disease	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	8
Meningococcal conjunctivitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1

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NSW HEALTH

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