NCIRS National Centre for Immunisation Research and Surveillance

FactSheet

Pneumococcal vaccines for Australians

This fact sheet provides information for immunisation providers on pneumococcal disease and the use of pneumococcal vaccines in Australia. For frequently asked questions, refer to NCIRS Pneumococcal vaccines for Australians – FAQs.

Disease and epidemiology

- Pneumococcal disease is the collection of clinical conditions caused by the bacterium *Streptococcus pneumoniae* (also called pneumococcus).
- Conditions where pneumococcus is found in normally sterile body sites are called 'invasive pneumococcal disease' (IPD). Clinically, meningitis, septicaemia and bacteraemic pneumonia are how most IPD present.
- Non-invasive pneumococcal disease, where there is localised mucosal infection that leads to clinical presentation like otitis media and pneumonia without bacteraemia, is generally less serious and more common than IPD.
- Overall pneumococcal disease predominantly affects the very young and the elderly.
- Aboriginal and Torres Strait Islander people have a higher risk of pneumococcal disease than non-Indigenous Australians.
- People who have certain underlying medical conditions, including those that cause immunocompromise, as well as people who smoke tobacco and consume alcohol excessively are more vulnerable to pneumococcal disease.

Who should be vaccinated

- Vaccination to prevent pneumococcal disease is recommended and funded for:
  - all Australian infants
  - older adults – from age 50 years if they are Aboriginal and Torres Strait Islander and from age 70 years if they are non-Indigenous.
- There are also specific pneumococcal vaccination recommendations for those who are at high risk of pneumococcal disease because of underlying medical and behavioural conditions or the state/territory where they live.
- The dosage schedule and the type of pneumococcal vaccine to use depend on the individual's age and the number and the type of pneumococcal vaccines they have already received.

Vaccines

- There are two major types of pneumococcal vaccines: a pure polysaccharide vaccine (PPV) and a polysaccharide conjugate vaccine (PCV). Vaccines vary in the number of pneumococcal serotypes they cover, that is, 'valency'.
- The two vaccines currently used in the National Immunisation Program (NIP) are 13-valent polysaccharide conjugate vaccine (13vPCV) and 23-valent pure polysaccharide vaccine (23vPPV).
- Studies in Australia show that each of these vaccines is effective in preventing IPD caused by serotypes they cover – around 90% effectiveness for 13vPCV in young children and over 60% for 23vPPV in non-Indigenous adults.
- Both 13vPCV and 23vPPV are safe and well tolerated, with most commonly reported side effects being mild and transient injection site reactions. Revaccination with 23vPPV is seen to cause more local side effects than the initial vaccination.

The disease

Pneumococcal disease is the collection of clinical conditions caused by the bacterium S*treptococcus pneumoniae* (also called pneumococcus).

Causative agent

S*treptococcus pneumoniae* is an encapsulated Gram-positive coccus. There about 97 different serotypes of pneumococci detected so far, each with its immunologically distinct polysaccharide capsule.[1-3] Pneumococci reside in the nasopharynx, mostly in children, without causing symptoms or disease (known as asymptomatic nasopharyngeal carriage or colonisation). Some pneumococcal serotypes are more common in carriage than others.[4,5] Carriage plays a vital role in the spread of pneumococci to cause disease. Worldwide, only a limited number of serotypes account for most cases of pneumococcal disease. The main serotypes that cause disease vary among geographical areas.[6] Pneumococcal vaccines are developed to target serotypes that commonly cause the most disease.[7]

Transmission

The transmission of pneumococci occurs primarily from direct contact with respiratory secretions, particularly droplets, of someone carrying the organism. In most cases, after this acquisition, pneumococci are carried typically for weeks to months in the nasopharynx before being cleared by the immune system.[8,9]

Clinical features

The organism may spread from the nasopharynx to the sinuses or middle ear cavity to cause localised mucosal infections such as sinusitis, otitis media or pneumonia. It may also enter the blood stream to cause systemic (invasive) infections, including bacteraemia, meningitis and bacteraemic pneumonia. The conditions where pneumococci are detected in normally sterile body sites (such as the bloodstream, cerebrospinal or pleural fluid) are grouped together as invasive pneumococcal disease (IPD).[10] Pneumococcal pneumonia, meningitis and febrile bacteraemia are associated with a high risk of morbidity and mortality. Non-invasive pneumococcal infections such as otitis media and sinusitis are less serious but more common.

In young children, bacteraemia without focus is the most common presentation of IPD (approximately 70% of cases), followed by bacteraemic pneumonia and meningitis.[11] Among adults, pneumonia is the most common presentation of pneumococcal disease. Also, among older Australians the most commonly identified aetiology of community-acquired pneumonia is pneumococcus.[12] It is estimated that annually among Australians aged ≥75 years there are about 51,000 visits to general practice and about 32,000 hospitalisations for community-acquired pneumonia.[13] Of these pneumonia episodes, at least 14% are due to pneumococcus.[12]

Diagnosis

IPD is diagnosed by the isolation of the organism from the affected body sites by culture or a nucleic acid test such as PCR.[10] In other cases pneumococcal disease diagnosis is largely presumptive: this may be based on testing for *S. pneumoniae* antigen in urine, isolation of *S. pneumoniae* from a non-sterile site and/or characteristic clinical or radiological features.[14]

Treatment

Typical treatment for pneumococcal disease is administration of appropriate antibiotics. However, some serotypes have developed resistance to commonly used antibiotics.

Epidemiology

IPD is a nationally notifiable disease in Australia since 2001.[15] In 2018 the total number of IPD cases notified to the National Notifiable Disease Surveillance System (NNDSS) was 2,032, translating to an incidence rate of 8 per 100,000 population.[16] 131 deaths due to IPD were reported in 2018, most among elderly adults. The incidence rate of IPD is highest in extremes of age, with about 18 per 100,000 population in children under 2 years of age and 25 per 100,000 population in adults over 85 years of age.[17] Pneumococcal disease affects the Aboriginal and Torres Strait Islander people disproportionately.[18-20] Of all IPD notifications in 2018, 11% were in Aboriginal and Torres Strait Islander people, who make up about 3% of the Australian population.[16] Overall pneumococcal disease has a seasonal pattern, with peak levels seen in the winter months.[16,21]

From 2005, when universal pneumococcal vaccination for all Australian children and adults was introduced, to 2016 the total IPD incidence rate declined by 40%.[19] Among infants the decline in IPD incidence rate was 80%. In adults aged ≥65 years the decline was 32% because of the herd effect of the childhood PCV programs and the direct impact of 23vPPV program. The pneumococcal vaccination programs have also led to a reduction in hospitalisations due to pneumonia and otitis media in Australia.[18,19,22,23] However, the impact of pneumococcal vaccination programs has been lesser on Aboriginal and Torres Strait Islander people as well as people with underlying medical conditions that increase their susceptibility to pneumococcal disease.[24,25]

In 2018, the pneumococcal vaccination schedule used for Australian children changed from 3+0 schedule (3 primary doses) to 2+1 schedule (2 primary doses + 1 booster dose) to further improve disease prevention.[26] This change is expected to improve the protection of vaccinated children beyond 12 months of age and also lead to a greater reduction in carriage, which, in turn, would lead to better herd protection.

Who should be vaccinated

In Australia, the population groups listed below are recommended to receive vaccination against pneumococcal disease:

- all infants
- non-Indigenous adults aged ≥70 years
- Aboriginal and Torres Strait Islander adults aged ≥50 years
- children, adolescents and adults with increased risk for pneumococcal disease.

All these groups are recommended to receive 13vPCV, with the number of doses based on the age of an individual at presentation and doses they have already received. Some of these groups are recommended to receive 23vPPV following 13vPCV, with the total number of lifetime doses of 23vPPV now limited to two.

Most of these groups are now eligible to receive their recommended pneumococcal vaccine doses fully funded under the NIP, including those at-risk groups that were previously eligible to only receive pneumococcal vaccine doses subsidised under the PBS. However, people with risk conditions where the rate of pneumococcal disease is not high enough for the funded vaccination program to be cost-effective, given the cost of vaccine purchase and delivery, are not eligible to receive the recommended pneumococcal vaccine doses funded under the NIP.

List 1 contains the risk conditions for which pneumococcal vaccination is recommended, with those conditions where people are eligible to receive the NIP-funded vaccines clearly marked. Of note this single list replaces the previous category A and B risk conditions lists.

It is important for clinicians to carefully screen all patients to determine if they either have any of the risk conditions in List 1 or identify as Aboriginal and Torres Strait Islander to ensure they receive the full complement of recommended pneumococcal vaccine doses.

List 1: Risk factors associated with an increased risk of pneumococcal disease and their eligibility for funding under the NIP

Risk condition	Eligibility for NIP funding	
	<5 years of age	≥5 years of age
Previous episode of invasive pneumococcal disease	✓	✓
Functional or anatomical asplenia, including		
– sickle cell disease or other haemoglobinopathies	✓	✓
– congenital or acquired asplenia (for example, splenectomy) or hyposplenia	✓	✓
Immunocompromising conditions, including		
– congenital or acquired immune deficiency, including symptomatic IgG subclass or isolated IgA deficiency	✓	✓
– haematological malignancies	✓	✓
– solid organ transplant	✓	✓
– haematopoietic stem cell transplant	✓	✓
– HIV infection	✓	✓
– immunosuppressive therapy, where sufficient immune reconstitution for vaccine response is expected; this includes those with underlying conditions requiring but not yet receiving immunosuppressive therapy		
– non-haematological malignancies receiving chemotherapy or radiotherapy (currently or anticipated)		
Proven or presumptive cerebrospinal fluid (CSF) leak, including		
– cochlear implants	✓	✓
– intracranial shunts	✓	✓
Chronic respiratory disease, including†		
– suppurative lung disease, bronchiectasis and cystic fibrosis	✓	✓
– chronic lung disease in preterm infants	✓	✓
– chronic obstructive pulmonary disease (COPD) and chronic emphysema		
– severe asthma (defined as requiring frequent hospital visits or the use of multiple medications)		
– interstitial and fibrotic lung disease		
Chronic renal disease		
– relapsing or persistent nephrotic syndrome	✓	✓
– chronic renal impairment – eGFR <30 mL/min (stage 4 or 5 disease)	✓*	✓*
Cardiac disease, including†		
– congenital heart disease	✓	
– coronary artery disease	✓	
– heart failure	✓	
Children born less than 28 weeks gestation	✓	
Trisomy 21	✓	
Chronic liver disease, including†		
– chronic hepatitis		
– cirrhosis		
– biliary atresia		
Diabetes		
Smoking (current or in the immediate past)		
Harmful use of alcohol (Defined as consuming on average ≥60 g of alcohol (6 Australian standard drinks) per day for males and ≥40 g of alcohol (4 Australian standard drinks) per day for females)		

* Funded under the NIP for eGFR <15 mL/min only (including patients on dialysis)

† Individual conditions listed beneath or those that are similar based on clinical judgment

Note: All children and adults with above conditions are recommended to receive additional pneumococcal vaccine doses but eligibility for NIP funding is as shown in shaded boxes.

Recommendations

Pneumococcal vaccination recommendations from 1 July 2020 (refer to the Australian Immunisation Handbook for detailed information)

All healthy (i.e. without any risk conditions in List 1) children living in the ACT, NSW, TAS or VIC and non-Indigenous children in the NT, QLD, SA or WA

These children are recommended to receive 2 primary doses of 13vPCV at 2 and 4 months of age followed by a booster dose at 12 months of age. The first primary dose can be administered as early as 6 weeks of age. Refer to Table 1.

Aboriginal and Torres Strait Islander children living in the NT, QLD, SA or WA and all children with risk conditions (i.e. with any of the conditions in List 1)

These children are recommended to receive 3 primary doses of 13vPCV at 2, 4 and 6 months of age, followed by a booster dose at 12 months of age. The first primary dose can be administered as early as 6 weeks of age. These children are also recommended to receive 2 doses of 23vPPV: first dose at 4 years of age and the second dose at least 5 years later. Refer to Table 1.

Catch-up schedules for all children who are incompletely vaccinated or presenting late are available in the Australian Immunisation Handbook. The recommended minimum intervals between 13vPCV doses are 1 month if the child is aged <12 months and 2 months if the child is aged ≥2 months. Healthy children aged ≥5 years do not need catch-up doses of 13vPCV.

Children aged ≤5 years in whom a risk condition in List 1 is newly diagnosed

Refer to catch-up schedule table for children with risk conditions in the Australian Immunisation Handbook to determine the number of 13vPCV doses now required, based on the number of doses they have already received and the age at presentation. The 13vPCV doses should be followed with 2 doses of 23vPPV. The first dose of 23vPPV should be given 12 months after the last 13vPCV dose or at 4 years of age, whichever is later. The second dose of 23vPPV should be given 5 years after the previous 23vPPV dose.

Children aged ≥5 years and adults with risk conditions in List 1

A person in whom a risk condition is newly diagnosed or a person who has never received a dose of 13vPCV despite the presence of a risk condition is recommended to receive a single dose of 13vPCV followed by 2 doses of 23vPPV. The interval between the 13vPCV dose and the subsequent 23vPPV dose should be 12 months (an interval of 2–12 months is acceptable). The recommended minimum interval between the two 23vPPV doses is 5 years. Refer to List 1 to determine eligibility for NIP funding for these recommendations.

If the person has received 1 dose of 23vPPV previously, the 13vPCV dose should be given at least 12 months after the previous 23vPPV dose. The second 23vPPV dose should be given 12 months after the 13vPCV dose and at least 5 years after the previous 23vPPV dose, whichever is later.

The maximum number of 23vPPV doses recommended for the lifetime now is two. Therefore, if the person has already received at least 2 doses of 23vPPV, no further 23vPPV doses are required.

For Aboriginal and Torres Strait Islander adults aged ≥50 years, these vaccine doses are covered in the routine recommendation and do not need to be repeated. For non-Indigenous adults aged ≥70 years, a dose of 13vPCV is part of the routine recommendation and does not need to be repeated.

Table 1: Recommendations for pneumococcal vaccinations in Australian children and adolescents (modified from The Australian Immunisation Handbook)

Risk status	Vaccine for use	Jurisdiction and Indigenous status	Age of child				
			2 and 4 months*	6 months	12 months	4 years	>4 years (<10 years of age)
Children **without** any risk conditions in List 1	**13vPCV**	**ACT, NSW, TAS or VIC**	13vPCV	–	13vPCV	–	–
		NT, QLD, SA or WA					–
	13vPCV and 23vPPV	**NT, QLD, SA or WA:** Aboriginal and Torres Strait Islander healthy children†	13vPCV	13vPCV	13vPCV	23vPPV	23vPPV‡
All children **with a risk** condition in List 1	**13vPCV and 23vPPV**	All	13vPCV	13vPCV	13vPCV	23vPPV	23vPPV‡

* The 1st dose can be given as early as 6 weeks of age; the next scheduled doses should still be given at 4 and 6 months of age.
† Healthy children refers to children without any of the risk conditions included in List 1.
‡ This second dose of 23vPPV should be given at least 5 years after the first dose.

Older adults with and without risk conditions in List 1

For healthy non-Indigenous adults the age at which pneumococcal vaccination is recommended now is ≥70 years. They should receive a single dose of 13vPCV, which is NIP-funded, and no further pneumococcal vaccine doses. Only adults with risk conditions are now recommended to receive 23vPPV doses. Refer to Table 2.

For Aboriginal and Torres Strait Islander adults the age at which pneumococcal vaccination is recommended remains ≥50 years. They are recommended a dose of 13vPCV followed by 2 doses of 23vPPV given at least 5 years apart. The recommended interval between the dose of 13vPCV and the subsequent dose of 23vPPV is 12 months.

If an adult has previously received a dose of 23vPPV, the dose of 13vPCV should be given at a minimum interval of 12 months after the previous 23vPPV dose.

Table 2: Recommendations for pneumococcal vaccination in Australian adults (based on The Australian Immunisation Handbook)

Risk category	Indigenous status	Age	Recommended dose(s) of 13vPCV	Recommended dose(s) of 23vPPV*
Without any risk conditions	Non-Indigenous	≥70 years	Single dose	–
	Indigenous	≥50 years	Single dose	Initial dose, then one repeat (2nd) dose at least 5 years later.
Individuals with risk conditions†	Any	>12 months	Single dose‡	Initial dose, then one repeat (2nd) dose at least 5 years later§,¶

* The minimum interval between any 2 doses of 23vPPV should be 5 years, and no more than 2 lifetime adult doses of 23vPPV are recommended. For adults, prior childhood doses of 23vPPV that may have been given at either 18–24 months and/or 4–5 years of age should be counted.

† Haematopoietic stem cell transplant (HSCT) recipients require 3 doses of 13vPCV post transplantation, followed by 1 dose of 23vPPV, irrespective of previous vaccine doses received (refer also to *Vaccination of people who are immunocompromised* in *The Australian Immunisation Handbook* for more recommendations for immunocompromised people, including more specific revaccination recommendations for HSCT recipients.

‡ A single dose of 13vPCV is recommended if they have never received any 13vPCV dose previously. This dose should precede the 1st dose of the recommended 23vPPV vaccine by 2 months. For those who have had prior 23vPPV dose, this 13vPCV dose should be given at least 12 months after the most recent dose of 23vPPV.

§ This initial dose of 23vPPV should be given at age ≥4 years or 2–12 months after the preceding dose of 13vPCV, whichever is later.

¶ A non-Indigenous adult whose condition is diagnosed after receiving their recommended dose of 13vPCV at age ≥70 years should receive 1 dose of 23vPPV at least 2 months after the adult 13vPCV dose, then 1 repeat (2nd) dose at least 5 years later.

Vaccines

There are two major types of pneumococcal vaccines: pneumococcal polysaccharide vaccine (PPV), which contains purified pneumococcal polysaccharide capsule, and pneumococcal conjugate vaccine (PCV), in which pneumococcal polysaccharide capsule is linked to a protein carrier. These vaccines vary in the number of pneumococcal capsular serotypes they contain (called the valency). PCVs also vary in the conjugating proteins used.

PPVs generate protective antibodies against pneumococcal disease without involving T-cells that are required for long-term immune memory. Immunity triggered by PPVs is relatively short-lived and the vaccine is less immunogenic in children aged <2 years. PCVs generate a higher quality immune response resulting in adequate protection in young children and longer-term immune memory.

The two pneumococcal vaccines available in Australia and currently used on the NIP are:

- Pneumovax 23® (Seqirus/Merck) – 23-valent pneumococcal polysaccharide vaccine (23vPPV)
- Prevenar 13® (Pfizer) – 13-valent pneumococcal conjugate vaccine (13vPCV). The carrier protein in this vaccine is non-toxic *Corynebacterium diphtheriae* CRM197.

Table 3 shows the serotypes contained in pneumococcal vaccines currently available in Australia, their registered age for use and the population and age group covered by the NIP.

Table 3: Serotypes contained in pneumococcal vaccines currently available in Australia, their registered age for use and the population and age group covered by the NIP

Vaccine	Serotypes common to these vaccines*	Additional serotypes	Age group registered for use	Population and age group covered by the NIP
Prevenar 13® 13vPCV (Pfizer)	4, 6B, 9V, 14, 18C, 19F, 23F	1, 5, 7F, 3, 19A, 6A	≥6 weeks	All infants
Pneumovax 23® 23vPPV (Seqirus/Merck)		1, 5, 7F, 3, 19A, 2, 8, 9N, 10A, 11A, 12F, 15B, 17F, 20, 22F, 33F	≥2 years	All non-Indigenous adults aged ≥65 years All Indigenous adults aged ≥50 years Indigenous adults aged 18–49 years with conditions associated with increased risk of IPD

Contraindications

The only absolute contraindications to pneumococcal vaccines are:

- anaphylaxis to a previous dose of any pneumococcal vaccine
- anaphylaxis to any vaccine component.

Precautions

Pregnancy and breastfeeding

Pneumococcal vaccine is not routinely recommended for pregnant or breastfeeding women. Women of child-bearing age who have conditions associated with increased risks of IPD should be vaccinated before a planned pregnancy or as soon as practicable after delivery.

Concurrent administration with other vaccines

One study in the United States had suggested there was a slightly higher risk of febrile seizures when 13vPCV and inactivated trivalent influenza vaccine were given concurrently than when these vaccines were given on separate days.[27] However, this increase in risk was relatively low, and a more recent study did not show a similar association.[28] The current recommendation is that 13vPCV and inactivated influenza vaccines may be given at the same visit if both vaccines are due.

In adults, Zostavax®, the vaccine to prevent herpes zoster, can be given at the same time as either pneumococcal vaccine (either 13vPCV or 23vPPV) (refer also to the NCIRS fact sheet on Zoster vaccine for Australian adults).

Vaccine efficacy and effectiveness

Observational studies have confirmed high effectiveness of 13vPCV in Australian children.[29,30] A retrospective cohort study showed effectiveness of 85% for 3 doses of 13vPCV in Australian children aged < 2 years against IPD due to vaccine serotypes. A separate case–control study showed effectiveness of 95% for 13vPCV in a 3+0 schedule, but it waned considerably beyond 2 years after the last dose.[31] The current schedule with the booster dose is expected to improve the persistence of protection from 13vPCV.

A large randomised controlled trial (RCT) in the Netherlands showed 13vPCV had an efficacy of 46% against community-acquired pneumonia due to vaccine serotypes in people aged ≥65 years who had not previously received any pneumococcal vaccine.[32] In the same study, the efficacy against IPD due to vaccine serotypes was found to be 75%.

The efficacy of 23vPPV against IPD in adults has been found to be approximately 80% in multiple RCTs.[33-35] Another study found effectiveness of 63% for 23vPPV against IPD among non-Indigenous Australian adults.[36] The protective effect of 23vPPV against non-bacteraemic pneumonia in adults is less certain; efficacy estimates based on RCTs have been mostly statistically non-significant. Some observational studies have reported effectiveness of 20% for 23vPPV against pneumonia hospitalisations in adults.[37,38]

Vaccine safety

The common adverse events reported after 13vPCV in children in clinical trials were mild and transient injection site reactions, including tenderness (around 75%), swelling (around 30%) and redness (around 45%).[39] The proportion of infants who had fever of >39°C to ≤40°C was approximately 3% after the 1st dose and 8% after the 3rd dose. No incident of high fever (>40°C) was reported. Irritability was the most commonly reported systemic event (approximately 90%). In the CAPiTA study (Community Acquired Pneumonia Immunisation Trial in Adults), local injection site reactions were commonly reported in adults following 13vPCV. The proportion of 13vPCV recipients that reported injection site pain of any severity was 36% compared with 6% in those who received the placebo. No significant difference was detected in severe local adverse events between the two arms. Other mild to moderate local reactions (redness, swelling, arm movement limitations) also occurred more frequently in 13vPCV recipients.

The proportion of 23vPPV recipients reporting local and systemic reactions after a primary or repeat dose varies among different study populations. Among US adults aged 60–64 years, local injection site reactions were reported by 60–70% of participants after a 1st dose of 23vPPV.[40,41] Generally, injection site reactions were common after a repeat dose of 23vPPV in adults.[42] Overall, injection site reactions are mostly non-serious and self-limiting.

Additional resources for primary medical care/vaccination providers

- Australian Immunisation Handbook
- National Immunisation Program Schedule
- ATAGI clinical advice on vaccination recommendations for people with risk conditions from 1 July 2020
- ATAGI clinical advice on vaccination recommendations for Aboriginal and Torres Strait Islander people from 1 July 2020
- ATAGI clinical advice on changes to recommendations for pneumococcal vaccines from 1 July 2020
- ATAGI clinical advice on vaccine recommendations for older non-Indigenous adults from 1 July 2020
- AusVaxSafety website

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