

Pneumococcal vaccinations in Australia

Current recommendations and beyond

DANIEL A. NORMAN BSc, MInfectDis, MPH, PhD

SANJAY JAYASINGHE MBBS, MSc, PhD

Pneumococcal vaccines are effective in protecting against disease. They are recommended in Australia for young children, older people, Indigenous Australians and those at increased risk of disease, and funded under the National Immunisation Program for many of these groups. Clinicians should be aware of the available vaccine types and the current recommendations to effectively advise about and administer vaccines to those who will benefit most while also being abreast of the latest developments in this field.



Invasive pneumococcal disease (IPD) is the severe form of pneumococcal disease and is a nationally notifiable disease in Australia. Although rates of infection have been low during the COVID-19 pandemic, they are predicted to increase with relaxation of COVID-19 restrictions, including the resumption of international travel. In Australia, pneumococcal vaccination is recommended for young children, older people, Aboriginal and Torres Strait Islander Australians and at-risk cohorts, and is funded for most of these groups under the National Immunisation Program (NIP). This article gives an overview of the pneumococcal vaccines available and highlights the recent changes to the pneumococcal vaccination schedule.

Pneumococcal disease

Pneumococcal disease is caused by the encapsulated Gram-positive coccus *Streptococcus pneumoniae*, with pneumococcal disease responsible for 14% of deaths in children under five years of age in 2019 globally.¹ IPD is characterised by the presence of *S. pneumoniae* in sterile body sites, including blood and cerebrospinal, pleural, peritoneal and joint fluid, causing severe disease.² Noninvasive pneumococcal disease typically presents as localised mucosal infections that are usually less clinically serious and more common than IPD, such as otitis media, often seen in children.³ The most common adult presentation of IPD is bacteraemic pneumonia; however, most community-acquired pneumococcal pneumonia cases are noninvasive.⁴ In most cases, *S. pneumoniae* resides in the nasopharynx, leading to asymptomatic carriage, which can be a precursor to disease and an important transmission factor.⁵ One hundred unique pneumococcal serotypes have been identified so far based on the polysaccharide capsule of *S. pneumoniae*, which is an important virulence factor,

MedicineToday 2022; 23(8): 55-59

Dr Norman is a Senior Research Officer at the National Centre for Immunisation Research and Surveillance, Sydney.

Dr Jayasinghe is a Medical Epidemiologist and Research Fellow at the National Centre for Immunisation Research and Surveillance; and Senior Lecturer at Sydney Children's Hospital Westmead Clinical School, The University of Sydney, NSW.

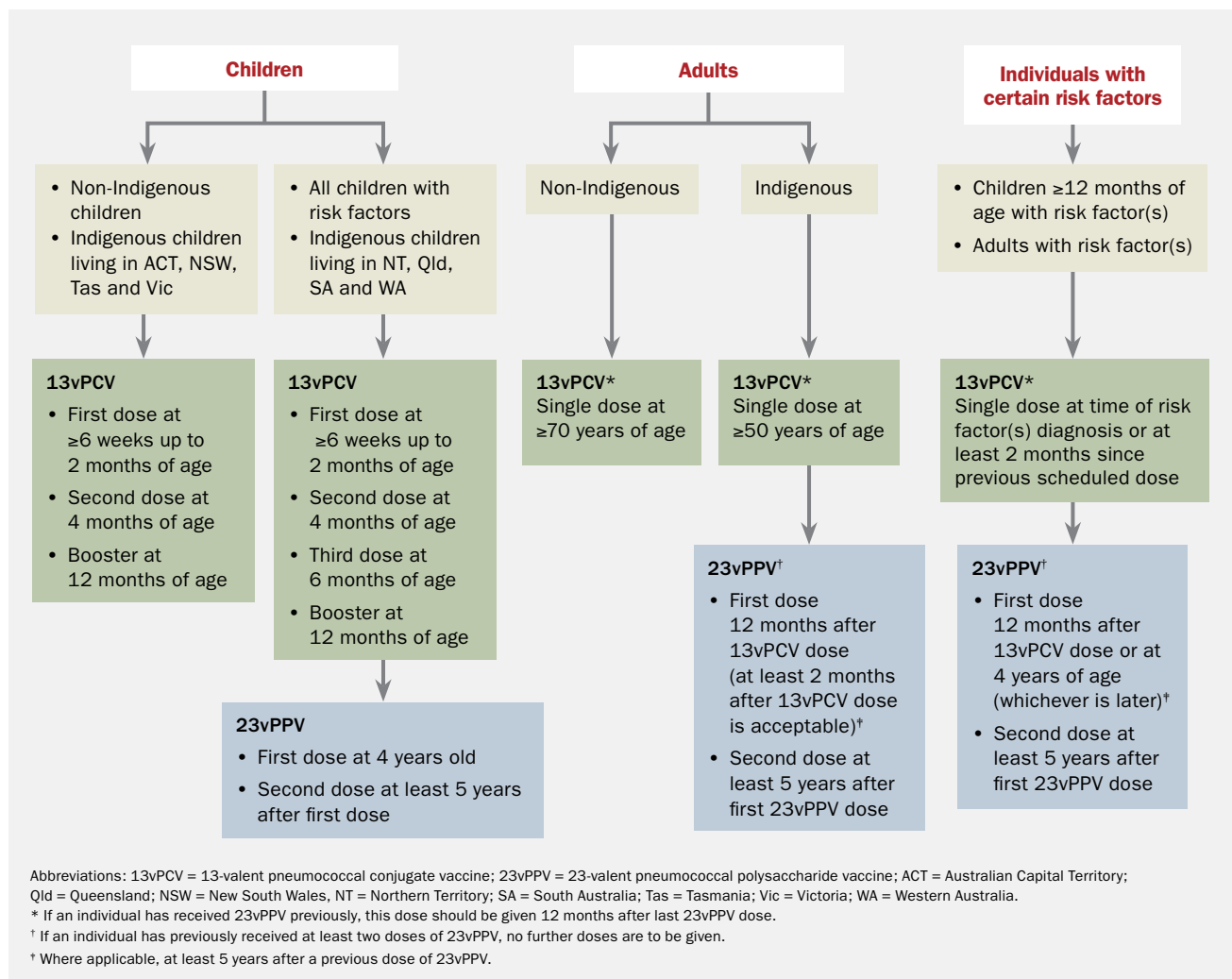


Figure. Current Australian pneumococcal vaccines funded under the National Immunisation Program.

Adapted from: *The Australian Immunisation Handbook* (<https://immunisationhandbook.health.gov.au/sites/default/files/2021-07/Publication-Pneumococcal-vaccination-for-all-Australians.pdf>).

with vaccines targeting serotypes that commonly cause disease.⁶

Pneumococcal disease in Australia

IPD became nationally notifiable in 2001, with 2028 notifications in 2018, 14% of which were in children aged younger than five years and 37% in adults 65 years or older.⁷ Notification rates are consistently higher among Indigenous Australians than non-Indigenous Australians.⁸ Internationally, rates of IPD have decreased, both in adults and children, during the

COVID-19 pandemic mainly due to public health restrictions resulting in reduced circulation of viruses associated with IPD. The reduced testing capacity and healthcare presentations may also have contributed to this observed decline.^{9,10} However, trends showing surges in respiratory virus infections linked to the recent relaxation of COVID-19 restrictions raise concerns of the potential for increased pneumococcal coinfections, including increases in IPD cases as well as the re-emergence of certain pneumococcal serotypes.^{11,12}

Pneumococcal vaccine types

Pneumococcal conjugate vaccines (PCVs) involve the conjugation of multiple selected pneumococcal polysaccharides to a protein. This protein carrier conjugation converts the pneumococcus polysaccharide to a T cell-dependent antigen that induces immune memory and results in a robust, high-quality immune response, sufficient to prevent pneumococcal disease, including in infants, together with the ability to reduce carriage of the vaccine serotypes.^{13,14} In comparison, pneumococcal polysaccharide vaccines (PPVs) generate antibodies

against pneumococcal disease alone, producing relatively short-lived immunity and are considered to have no effect on pneumococcal carriage.¹⁵ Pneumococcal vaccines currently available in Australia are 13-valent pneumococcal conjugate vaccine (13vPCV) and 23-valent pneumococcal polysaccharide vaccine (23vPPV).

Current pneumococcal vaccine recommendations

In Australia, all adults aged 70 years and older are offered a dose of the 13vPCV for free through the NIP.¹⁶ For children, the NIP schedule is three doses of 13vPCV at ages 2, 4 and 12 months (2+1 schedule).¹⁷ Aboriginal and Torres Strait Islander people and those with certain underlying risk conditions are recommended adult vaccine doses at a younger age and additional doses of pneumococcal vaccines, including 23vPPV, because of their increased risk for pneumococcal disease, with a considerable proportion caused by extra serotypes in 23vPPV. The Figure summarises current pneumococcal vaccine recommendations for each target population.

Vaccination for people with... high-risk conditions is funded under the National Immunisation Program

For children who are at increased risk of pneumococcal disease, four doses of 13vPCV at two, four, six and 12 months of age (3+1 schedule) are recommended. Children and infants can receive 13vPCV coadministered with other routine childhood vaccines, including inactivated influenza vaccines. However, parents and caregivers should be made aware of a small increased risk of fever when 13vPCV and influenza vaccinations are given together. The 13vPCV should not be coadministered with Menactra, the quadrivalent meningococcal ACWY vaccine, in children and adults because of possible immune response interference. It is preferred that 13vPCV be administered first,

NIP FUNDING OF PNEUMOCOCCAL VACCINATION (13vPCV AND 23vPPV) FOR CONDITIONS AT INCREASED RISK OF PNEUMOCOCCAL DISEASE

Conditions funded under the NIP

Immunocompromising conditions:

- congenital or acquired immune deficiency, including symptomatic IgG subclass or isolated IgA deficiency
- haematological malignancies
- solid organ transplant
- haematopoietic stem cell transplant
- HIV infection

Chronic respiratory disease:*

- suppurative lung disease, bronchiectasis and cystic fibrosis
- chronic lung disease in preterm infants

Functional or anatomical asplenia:

- sickle cell disease or other haemoglobinopathies
- congenital or acquired asplenia (e.g. splenectomy) or hyposplenism

Proven or presumptive cerebrospinal fluid leak:

- cochlear implants
- intracranial shunts

Chronic renal disease:

- relapsing or persistent nephrotic syndrome[†]
- chronic renal impairment – eGFR <30 mL/min (stage 4 disease)

Cardiac disease, including:*,†

- congenital heart disease
- coronary artery disease
- heart failure

Previous episode of invasive pneumococcal disease

Children born less than 28 weeks' gestation

Trisomy 21

Conditions not funded under the NIP

Immunocompromising conditions:

- immunosuppressive therapy, where sufficient immune reconstitution for vaccine response is expected; this includes those with underlying conditions requiring but not yet receiving immunosuppressive therapy
- nonhaematological malignancies receiving chemotherapy or radiotherapy (currently or anticipated)

Chronic respiratory disease:*

- 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 liver disease:*

- chronic hepatitis
- cirrhosis
- biliary atresia

Harmful use of alcohol, consuming on average:

- >60 g of alcohol (six standard drinks) per day for men
- ≥40 g of alcohol (four standard drinks) per day for women

Diabetes

Smoking (current or in the immediate past)

Abbreviations: 13vPCV = 13-valent pneumococcal conjugate vaccine; 23vPPV = 23-valent pneumococcal polysaccharide vaccine; eGFR = estimated glomerular filtration rate; NIP = National Immunisation Program.

* Based on clinical judgement.

† Yes, for eGFR <15 mL/min only (including patients on dialysis).

‡ Yes, for children under 5 years of age only.

Adapted from: *The Australian Immunisation Handbook* (<https://immunisationhandbook.health.gov.au/resources/tables/list-risk-conditions-for-pneumococcal-disease>).

followed by Menactra at least four weeks later. Either 13vPCV or 23vPPV can be coadministered with live attenuated herpes zoster vaccine (Zostavax) and inactivated influenza vaccines in adults.¹⁶

People with conditions that put them at increased risk of pneumococcal infection are also recommended to receive the pneumococcal vaccine. Vaccination for people

with most (but not all) of these high-risk conditions is funded under the NIP and are summarised in the Box. All current recommendations by the Australian Technical Advisory Group on Immunisation (ATAGI) for pneumococcal vaccines are published in the Australian Immunisation Handbook (<https://immunisationhandbook.health.gov.au>).¹⁶

TABLE. COMPOSITION OF PNEUMOCOCCAL VACCINES USED IN THE PAST, CURRENTLY IN USE AND IN THE PIPELINE

Vaccine	Brand name	Availability
7-vPCV	Prevenar	Used for children on the NIP until 2011
10-vPCV	Synflorix	Only used in the Northern Territory from 2009 to 2011
13-vPCV	Prevenar-13	Currently used on the NIP for children and adults
15-vPCV	Vaxneuvance	Approved by the TGA and PBAC for adults in late 2021 but not currently available in Australia
20-vPCV	Prevnar-20	Not currently licensed for use in Australia
23-vPPV	Pneumovax	Currently offered on the NIP for Indigenous Australians and individuals with risk conditions
24-vPCV	Vax-24	Currently undergoing clinical trials by manufacturer Vaxcyte

Abbreviations: NIP = National Immunisation Program; PBAC = Pharmaceutical Benefits Advisory Committee; PCV = pneumococcal conjugate vaccine; PPV = pneumococcal polysaccharide vaccine; TGA = Therapeutic Goods Administration.

Changes to the pneumococcal vaccination program

The current recommendations and funding of 13vPCV for adults were introduced in July 2020.¹⁸ This updated schedule no longer recommends the 23vPPV for healthy adults aged 70 years or older, and instead recommends a single dose of 13vPCV for this cohort. Under the updated recommendations, the 23vPPV is reserved for Aboriginal and Torres Strait Islander adults aged 50 years or older and adults with underlying risk conditions only, following a dose of 13vPCV in both. The key evidence leading to the decision to use 13vPCV in adults came from the results of a randomised controlled trial that showed 13vPCV was effective against all pneumococcal pneumonia, including less severe but more common nonbacteremic pneumonia.¹⁹ Serotype epidemiology of pneumococcal disease in adults in Australia showed that most disease from the additional serotypes contained in 23vPPV occurred in Indigenous adults and individuals with pre-existing risk conditions; therefore, 23vPPV doses are

now offered to those groups only.

Alongside this change, two doses of 23vPPV were added to the existing recommended 3+1 schedule of 13vPCV for Aboriginal children living in the Northern territory, Queensland, South Australia and Western Australia to provide broader serotype protection. In 2018, the PCV schedule was changed, from the long-standing 3+0 to the current 2+1, for most children in Australia to address the waning immunity from the second year of life.^{20,21} Early assessment of this change shows that the expected reduction in breakthrough cases of IPD in older children is occurring.²²

What's next for pneumococcal vaccination?

As current pneumococcal vaccines target specific serotypes, infections with certain non-vaccine serotypes of *S. pneumoniae* may occur when those serotypes have a competitive advantage in nasopharyngeal carriage, leading to some 'serotype replacement' disease.²³ The development of vaccines with expanded serotypes (known as higher

	Serotypes																							
	7v							10v-non-7v			13v-non-7v			15v-non13v		20v-non-15v					24v-non-20v			
	4	6B	9V	14	18C	19F	23F	1	3	5	6A	7F	19A	22F	33F	8	10A	11A	12F	15B	2	9N	17F	20
	✓	✓	✓	✓	✓	✓	✓																	
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓														
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓									
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

valency vaccines) aims to maintain and optimise pneumococcal disease prevention by covering these emerging and common residual serotypes.

Previous pneumococcal conjugate vaccines used in Australia have been superseded by vaccines with an expanded serotype spectrum (e.g. 13vPCV replacing 7vPCV in 2011).²⁴ Two PCVs with expanded serotypes, Vaxneuvance (a 15-valent PCV by Merck) and PREVNAR20 (a 20-valent PCV by Pfizer) have become commercially available overseas and are being considered for use in several countries, first in adults and then in children, aligning with clinical development of these vaccines.²⁵ In late 2021, the TGA licensed the use of 15vPCV for adults in Australia and the Pharmaceutical Benefits Advisory Committee recommended listing of 15vPCV on the NIP for the adult populations currently offered NIP-funded 13vPCV.²⁶

The Table summarises important details of pneumococcal vaccines previously used in Australia, those currently part of the NIP and the higher valency vaccines currently available or under

development. In the US, 15vPCV has been recently approved by the Food and Drug Administration and recommended by the Advisory Committee on Immunization Practices for use in children and adults interchangeably with 13vPCV, and 20vPCV for use in adults as an alternative for 13vPCV and 23vPPV, which is the existing recommendation.^{27,28}

Conclusion

In Australia, the recommendations of pneumococcal vaccination are based on vaccine characteristics and individuals' IPD risk factors, including age, Indigenous status, state or territory of residence, the presence of risk factors and previous pneumococcal vaccination history. It is important for immunisation providers to be aware of the differences between pneumococcal vaccine types, their dose schedules and approved population groups, as well as changes to recommendations, with potential inclusion of new vaccines. Understanding the difference between pneumococcal vaccines and potential changes with future

vaccine approvals will provide easier implementation of updated pneumococcal vaccination and patient recommendation practices.

MT

References

A list of references is included in the online version of this article (www.medicinetoday.com.au).

COMPETING INTERESTS: Dr Jayasinghe holds an emerging leadership investigator grant from the NHMRC. Dr Norman: None.



Share your anecdotes

Tell us your own personal anecdote in 1000 words or less and share the lessons you learned. You can use a nom de plume if you wish and there is a small reward if we publish your article in 'Innocence revisited'. Write to:

Medicine Today
PO Box 1473
Neutral Bay NSW 2089
or editorial@medicinetoday.com.au

Pneumococcal vaccinations in Australia

Current recommendations and beyond

DANIEL A. NORMAN BSc, MInfectDis, MPH, PhD; **SANJAY JAYASINGHE** MBBS, MSc, PhD

References

1. World Health Organization. Pneumonia. Geneva: WHO; 2021. Available online at: <https://www.who.int/news-room/fact-sheets/detail/pneumonia> (accessed July 2022).
2. Tuomanen EI, Austrian R, Masure HR. Pathogenesis of pneumococcal infection. *N Engl J Med* 1995; 332: 1280-1284.
3. Eskola J, Kilpi T, Palmu A, et al. Efficacy of a pneumococcal conjugate vaccine against acute otitis media. *N Engl J Med* 2001; 344: 403-409.
4. Drijkoningen JJ, Rohde GG. Pneumococcal infection in adults: burden of disease. *Clin Microbiol Infect* 2014; 20(Suppl 5): 45-51.
5. Jochems SP, Weiser JN, Malley R, Ferreira DM. The immunological mechanisms that control pneumococcal carriage. *PLoS Pathog* 2017; 13: e1006665.
6. Ganaie F, Saad JS, McGee L, et al. A new pneumococcal capsule type, 10D, is the 100th serotype and has a large cps fragment from an oral streptococcus. *mBio* 2020; 11: e00937-20.
7. Patel C, Dey A, Wang H, McIntyre P, Macartney K, Beard F. Summary of national surveillance data on vaccine preventable diseases in Australia, 2016-2018 final report. *Commun Dis Intell* (2018) 2022; 46. doi: 10.33321/cdi.2022.46.28.
8. Australian Institute of Health and Welfare. Pneumococcal disease in Australia. Canberra: AIHW; 2018. Available online at: https://www.aihw.gov.au/getmedia/0e959d27-97c9-419c-8636-ec50dbda3c1/aihw-phe-236_Pneumococcal.pdf.aspx (accessed July 2022).
9. Brueggemann AB, Jansen van Rensburg MJ, Shaw D, et al. Changes in the incidence of invasive disease due to *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Neisseria meningitidis* during the COVID-19 pandemic in 26 countries and territories in the Invasive Respiratory Infection Surveillance Initiative: a prospective analysis of surveillance data. *Lancet Digit Health* 2021; 3: e360-e370.
10. Dirkx KKT, Mulder B, Post AS, et al. The drop in reported invasive pneumococcal disease among adults during the first COVID-19 wave in the Netherlands explained. *Int J Infect Dis* 2021; 111: 196-203.
11. Foley DA, Phuong LK, Peplinski J, et al. Examining the interseasonal resurgence of respiratory syncytial virus in Western Australia. *Arch Dis Child* 2022; 107: e1-e7.
12. Casanova C, Küffer M, Leib SL, Hilty M. Re-emergence of invasive pneumococcal disease (IPD) and increase of serotype 23B after easing of COVID-19 measures, Switzerland, 2021. *Emerg Microbes Infect* 2021; 10: 2202-2204.
13. Pichichero ME. Protein carriers of conjugate vaccines: characteristics, development, and clinical trials. *Hum Vaccin Immunother* 2013; 9: 2505-2523.
14. Rose MA, Schubert R, Strnad N, Zielen S. Priming of immunological memory by pneumococcal conjugate vaccine in children unresponsive to 23-valent polysaccharide pneumococcal vaccine. *Clin Diagn Lab Immunol* 2005; 12: 1216-1222.
15. Daniels CC, Rogers PD, Shelton CM. A review of pneumococcal vaccines: current polysaccharide vaccine recommendations and future protein antigens. *J Pediatr Pharmacol Ther* 2016; 2: 27-35.
16. Australian Technical Advisory Group on Immunisation. Pneumococcal disease. In: Australian immunisation handbook. Canberra: Australian Government Department of Health; 2018. Available online at: <https://immunisationhandbook.health.gov.au/contents/vaccine-preventable-diseases/pneumococcal-disease> (accessed July 2022).
17. Australian Government Department of Health. National Immunisation Program Schedule. Canberra, Commonwealth of Australia; 2022. Available online at: <https://www.health.gov.au/health-topics/immunisation/when-to-get-vaccinated/national-immunisation-program-schedule> (accessed July 2022).
18. Australian Technical Advisory Group on Immunisation. ATAGI clinical advice on changes to recommendations for the use and funding of pneumococcal vaccine for 1 July 2020. Canberra, ATAGI; 2020. Available online at: <https://www.health.gov.au/resources/publications/atagi-clinical-advice-on-changes-to-recommendations-for-pneumococcal-vaccines-from-1-july-2020> (accessed July 2022).
19. Bonten MJ, Huijts SM, Bolkenbaas M, et al. Polysaccharide conjugate vaccine against pneumococcal pneumonia in adults. *N Engl J Med* 2015; 372: 1114-1125.
20. Blyth C, Jayasinghe S, Andrews R. A rationale for change: an increase in invasive pneumococcal disease in fully vaccinated children. *Clin Infect Dis* 2020; 7: 680-683.
21. Jayasinghe S, Chiu C, Quinn H, Menzies R, Gilmour R, McIntyre P. Effectiveness of seven and thirteen valent pneumococcal conjugate vaccines in a schedule without a booster dose: a ten year observational study. *Clin Infect Dis* 2018; 67: 367-374.
22. Public Health Association of Australia. Blyth CC. Looking back, looking forward: vaccine preventable disease control in Australia. Presented at: Communicable Disease and Immunisation Conference 2022.
23. Weinberger DM, Malley R, Lipsitch M. Serotype replacement in disease after pneumococcal vaccination. *Lancet* 2011; 378: 1962-1973.
24. Chiu C, McIntyre P. Pneumococcal vaccines – past, present and future. *Aust Prescr* 2013; 36: 88-93.
25. Kobayashi M, Farrar JL, Gierke R, et al. Use of 15-valent pneumococcal conjugate vaccine and 20-valent pneumococcal conjugate vaccine among U.S. adults: updated recommendations of the Advisory Committee on Immunization Practices - United States, 2022. *Morb Mortal Wkly Rep* 2022; 71: 109-117.
26. The Pharmaceutical Benefits Advisory Committee. Pharmaceutical Benefits Advisory Committee (PBAC) meeting outcomes November 2021 PBAC meeting. Canberra, PBAC; 2021. Available online at: <https://www.pbs.gov.au/industry/listing/elements/pbac-meetings/pbac-outcomes/2021-11/pbac-web-outcomes-11-2021.pdf> (accessed July 2022).
27. Merck. Merck announces U.S. FDA approval of VAXNEUVANCE™ (pneumococcal 15-valent conjugate vaccine) for the prevention of invasive pneumococcal disease in adults 18 years and older caused by 15 serotypes. Press release; 2021. Available online at: <https://www.merck.com/news/merck-announces-u-s-fda-approval-of-vaxneuvance-pneumococcal-15-valent-conjugate-vaccine-for-the-prevention-of-invasive-pneumococcal-disease-in-adults-18-years-and-older-caused-by-15-serot/> (accessed July 2022).
28. Business wire. Advisory Committee on Immunization Practices votes to recommend routine use of Pfizer's PREVNAR 20™ (pneumococcal 20-valent conjugate vaccine) in adults. 2021. <https://www.businesswire.com/news/home/20211020006069/en/> (accessed July 2022).