NCIRS National Centre for Immunisation Research and Surveillance

FactSheet

Poliomyelitis vaccines for Australians

This fact sheet provides information on poliomyelitis disease and the available vaccines to assist immunisation providers in the delivery of poliomyelitis vaccinations.

Disease and epidemiology

- Poliomyelitis (polio) is caused by a virus that has three serotypes: type 1, type 2 and type 3.
- Person-to-person spread of poliovirus occurs via the faecal–oral route. Typical manifestations of polio are caused when the virus spreads to infect and replicate in the cells of the central nervous system.
- The characteristic and most severe clinical manifestation of polio infection is paralytic polio that usually presents as asymmetrical permanent paralysis of the legs.
- Australia was declared polio-free by the World Health Organization in 2000.

Who should be vaccinated

- Inactivated polio vaccine (IPV) is recommended and funded under the National Immunisation Program as a primary schedule of 3 doses at 2, 4 and 6 months of age. A booster dose is recommended at 4 years of age.
- Unvaccinated adults are recommended a schedule of 3 doses at 1–2 month intervals.
- A booster dose every 10 years is desirable for certain groups who are at continued risk of polio infection.

Vaccines

- Since 2005, IPV is used for all doses of polio vaccine in Australia.
- IPV-containing vaccines recommended for use in children aged 2 months to <10 years are Infanrix hexa, Vaxelis, Infanrix IPV and Quadracel.
- IPV-containing vaccines recommended for use in people aged ≥10 years are Adacel Polio and Boostrix-IPV.
- An IPV that only contains inactivated poliovirus, IPOL, is recommended for use in children from 2 months of age and adults, in circumstances where only IPV vaccination is required.

The disease

Poliomyelitis (polio), historically called infantile paralysis, is an infectious disease caused by the poliovirus. Poliovirus is a member of the enterovirus subgroup of the Picornaviridae family and has three serotypes: type 1, type 2 and type 3. Immunity to one serotype does not provide significant protection against the other serotypes.[1,2]

Poliovirus transmission is primarily by the faecal–oral, or occasionally oral–oral, route. Once in the gastrointestinal tract, the virus invades the local lymphoid tissues and, in a minority of cases, enters the bloodstream and spreads to the central nervous system. The virus may also spread to the central nervous system along the peripheral nerves. The incubation period for polio infection is usually between 7 and 14 days but may range from 2 to 35 days. By 3–5 days after exposure,

the virus can be isolated in the blood, throat and faeces. The virus continues to be excreted in the stools for several weeks after infection.[1,2]

The majority (up to 95%) of polio infections are asymptomatic. Those infected who do not show any symptoms shed the virus in their stools and, therefore, are able to transmit the virus to others. In polio-endemic areas, people with asymptomatic infections, particularly children, act as the main reservoir of polio infection.[1,2]

Clinical manifestations of polio can vary and are categorised according to severity. Acute flaccid paralysis (AFP) is a common acute manifestation of polio (refer also to Surveillance for acute flaccid paralysis). Rarely (in less than 1% of polio infections), the virus invades and damages or destroys the motor neurons of anterior horn cells of the spinal cord and brain stem. This form, known as paralytic polio**,** is the most severe and typical manifestation of poliomyelitis. Depending on the extent of central nervous system damage, paralytic polio is classified into spinal, bulbar and bulbospinal forms, which have different clinical presentations.[1,3]

Most patients, even with paralytic polio, recover completely and, in most others, muscle function returns to some degree. However, paralysis or weakness that persists 12 months after the onset is usually permanent.[1,2] Among those paralysed, 5–10% die when their breathing muscles become paralysed.[4] In the past, these patients were immobilised inside negative pressure mechanical ventilators, called 'iron lungs', to regulate their breathing and keep them alive.[5]

Postpolio syndrome (PPS) is a complex condition of neuromuscular symptoms that usually occurs 15 years or more after the acute illness in 15–80% of survivors of paralytic polio. Diagnosis of PPS is based on clinical signs and symptoms that include muscle weakness or decreased muscle endurance, with or without muscle atrophy or muscle and joint pain. There are no diagnostic tests available for PPS and diagnosis is based on exclusion of other causes for the new symptoms. PPS is not infectious and people who develop PPS do not shed poliovirus.[6,7]

Polio vaccines in Australia

The trivalent inactivated polio vaccine (IPV), which includes all three poliovirus serotypes, was first registered in Australia in 1955, with routine vaccination on the National Immunisation Program (NIP) starting in 1956. In 1966, it was replaced by live attenuated oral polio vaccine (OPV).

OPV has several advantages over IPV in providing mass protection against the transmission of wild poliovirus. OPV induces a local immune response in the intestines, the primary site for poliovirus multiplication, which provides local resistance to subsequent infection with wild poliovirus, and also reduces the risk of excretion of the virus. In addition, the virus in OPV can be transmitted from recent vaccinees to their non-immunised contacts, in turn providing protection to the community.[8] However, there is a risk of the attenuated vaccine virus strains in OPV reverting to forms that are capable of causing vaccine-associated paralytic poliomyelitis (VAPP), which is clinically indistinguishable from paralytic polio caused by wild poliovirus. (Refer also to Epidemiology.) OPV virus may also gain the ability to circulate in communities for long periods of time (referred to as vaccine-derived polioviruses [VDPVs]). Following circulation of VDPV type 2 cases, there was a global 'switch' to replace trivalent OPV with bivalent OPV containing only types 1 and 3 in 2016.[9]

In comparison to OPV, IPV does not contain live virus and, therefore, cannot cause VAPP. An enhanced-potency IPV first became available internationally in 1988 and gradually replaced OPV in many countries. The change from OPV to IPV was implemented in Australia in November 2005 as part of combination vaccines also containing antigens against a number of other diseases.

Vaccination coverage for polio in Australia, including the Torres Strait Islands, is high. In 2020, IPV vaccination coverage was 95.3% in all children and 93.3% in Aboriginal and Torres Strait Islander children aged 12 months.[10]

Epidemiology

Humans are the only reservoir of polioviruses,[9] so eradication of polio is possible. Eradication would mean the incidence of polio was permanently zero and intervention measures such as vaccination would no longer be needed.[11] In 1988, when the World Health Organization (WHO) committed to the eradication of polio, there were more than 350,000 cases of paralytic polio caused by wild poliovirus annually. By 2021, these numbers of decreased by more than 99.9% due to vaccination.[9] Global eradication of wild poliovirus type 2 and type 3 was certified in 2015 and 2019, respectively.[9] The Polio Endgame Strategy, most recently renewed for 2019–2023, lays out a roadmap to achieving and sustaining polio eradication.[12]

Since 2014, only two countries have reported polio cases caused by wild poliovirus type 1 (Afghanistan and Pakistan).[13-15] Until global eradication of polio is achieved, all countries are at risk of polio infection, particularly with the ease of global travel. For example, in 2007, wild poliovirus type 1 was isolated from a young man in Australia who had recently arrived from Pakistan. Because of high polio vaccine coverage in Australia, the imported virus did not spread any further in the community.[16,17] WHO estimates that from 2003 to 2014, there were 191 new importation events of wild poliovirus into previously polio-free countries, resulting in 3,763 reported cases of paralytic polio in 43 countries.[18,19] Temporary polio vaccination requirements were introduced to reduce the risk of international spread of polioviruses from infected areas into previously polio-free countries.[18,20]

Polio has been a notifiable disease in Australia since 1922. The highest recorded incidence of polio in the country (39.1 per 100,000 population) was in 1938. A dramatic decline in polio notifications was seen after the introduction of routine vaccination with IPV in 1956, with the last polio epidemic in 1961–1962.[21] As expected, sustained high coverage with OPV following its introduction in 1966 led to cessation of indigenous transmission of wild poliovirus infections in Australia, with the last reported case of locally acquired wild poliovirus in 1972.[22] In 1986, there was a case of polio reported in a 22-year-old that was initially thought to be due to wild poliovirus but was later confirmed as VAPP.[22-24] The last reported case of VAPP in Australia occurred in an unvaccinated mother of a recently vaccinated infant in 1995.[24] In October 2000, Australia, together with the other 36 countries in the Western Pacific Region, was declared ‘polio-free’ by WHO.[25]

Surveillance for acute flaccid paralysis

In addition to maintaining high polio vaccine coverage, adequate surveillance for cases of AFP is also an important defence against the continuing threat of polio infection.[22,26-28] Although AFP has a number of possible causes,[6] the rate of AFP is a highly sensitive indicator of polio. Adequate active surveillance and classification of all cases of AFP in children aged 0–15 years to detect suspected cases of polio is required for certification of polio-free status by WHO.[29]

In Australia, the Paediatric Active Enhanced Disease Surveillance (PAEDS), a hospital-based surveillance system, conducts ongoing surveillance of AFP. PAEDS relies on active identification of AFP cases by specialist surveillance nurses in seven children’s hospitals across the country. Read about PAEDS surveillance here.

Who should be vaccinated

Infants and children

Polio vaccination with IPV (IPOL) or IPV-containing vaccine is recommended and funded under the NIP as a 3-dose primary course at 2, 4 and 6 months of age, unless contraindicated (refer to Contraindications/precautions). The first dose of an IPV-containing vaccine can be given as early as 6 weeks of age. If the first dose is given at 6 weeks of age, the next scheduled doses should still be given at 4 months and 6 months of age.

A booster dose of IPV (IPOL) or IPV-containing vaccine is recommended at 4 years of age but can be given as early as 3.5 years of age. This is commonly provided in combination with diphtheria, tetanus and acellular pertussis as DTPa-IPV.

If any of the doses recommended as part of the infant primary schedule have been missed, advice on planning catch-up can be found in the Australian Immunisation Handbook.[30]

Adults

No adult should remain unvaccinated against polio. If an adult was not vaccinated against polio during childhood, a 3-dose primary course of IPV (IPOL) or IPV-containing vaccine is recommended. Advice on planning catch-up can be found in the *Australian Immunisation Handbook*.[30]

Special risk groups

A booster dose every 10 years is desirable for adults at continued risk of polio infection, such as:

- travellers to areas or countries where polio is epidemic or endemic; refer also to WHO recommendations on vaccinations for travellers[31]
- healthcare workers, including laboratory workers, in possible contact with polio cases or poliovirus.

Reduced antigen diphtheria-tetanus-acellular pertussis-IPV (dTpa-IPV) combination vaccines can be used where otherwise indicated.

Vaccines

Formulations currently registered in Australia

For any age group

IPOL (IPV; inactivated poliovirus)

For children aged <10 years

Infanrix hexa (DTPa-hepB-IPV-Hib), Vaxelis (DTPa-hepB-IPV-Hib), Infanrix IPV (DTPa-IPV) and Quadracel (DTPa-IPV)

Adults, adolescents and children aged ≥10 years

Adacel Polio (dTpa-IPV) and Boostrix-IPV (dTpa-IPV)

Interchangeability of oral and inactivated polio vaccines

Oral polio vaccine (OPV) is no longer in use in Australia. OPV and IPV are interchangeable. Children commenced on OPV should complete their polio vaccination schedule using IPV (IPOL) or IPV-containing vaccines.

Vaccine efficacy/effectiveness

IPV is highly effective in producing immunity to poliovirus and protection from paralytic polio. After two doses of the vaccine, over 90% of recipients develop protective antibodies to all three types of poliovirus. After three doses, at least 99% of recipients will have protection against the disease. Protection against paralytic disease correlates with the presence of antibodies against poliovirus.[1]

The exact duration of protection from IPV is not known with certainty. However, evidence shows that IPV provides protection for many years after a complete course.[1]

Vaccine safety

Inactivated polio vaccines can be safely administered to people with impaired immunity and to those living with someone with impaired immunity.

IPV (IPOL) and IPV-containing vaccines may cause erythema, pain and induration at the injection site. Other symptoms reported following administration of IPV (IPOL) or IPV-containing vaccines in young babies include fever, crying and decreased appetite.

Contraindications/precautions

The only absolute contraindications to IPV (IPOL) or IPV-containing vaccines are anaphylaxis following a previous dose of the vaccine or anaphylaxis to any component of the vaccine.

Pregnancy and breastfeeding

IPV (IPOL) or IPV-containing vaccines are not routinely recommended for pregnant or breastfeeding women, but can be given where vaccination is considered necessary (e.g. for travel to endemic countries). Further advice on the vaccination of women who are planning pregnancy, pregnant or breastfeeding, and preterm infants can be found in the Australian Immunisation Handbook.[30]

Additional resources for primary medical care/vaccination providers

- The Australian Immunisation Handbook
- Immunise Australia
- National Immunisation Program schedule
- Paediatric Active Enhanced Disease Surveillance (PAEDS)
- Polio Endgame Strategy

References

1. US Department of Health and Human Services, Centers for Disease Control and Prevention (CDC). Poliomyelitis. In: Hamborsky J, Kroger A, Wolfe C (editors). *Epidemiology and prevention of vaccine-preventable diseases*. 13th ed. Washington DC: Public Health Foundation; 2015. p. 297-310.
2. Poliomyelitis, acute. In: Heymann DL (editor). *Control of communicable diseases manual*. 19th. Washington, D.C.: American Public Health Association; 2008. p. 484-91.
3. Melnick JL. Current status of poliovirus infections. *Clinical Microbiology Reviews* 1996;9:293-300.
4. Global Polio Eradication Initiative. Polio and prevention. Available from: www.polioeradication.org/Polioandprevention.aspx (Accessed 1 February 2016).
5. Drutz JE, Ligon BL. Polio: its history and its eradication. *Seminars in Pediatric Infectious Diseases* 2000;11:280-6.
6. Howard RS. Poliomyelitis and the postpolio syndrome. *BMJ* 2005;330:1314-8.
7. Koopman FS, Beelen A, Gilhus NE, de Visser M, Nollet F. Treatment for postpolio syndrome. *Cochrane Database of Systematic Reviews* 2015;(5):CD007818. doi:10.1002/14651858.CD007818.pub3.

8. Valtanen S, Roivainen M, Piirainen L, Stenvik M, Hovi T. Poliovirus-specific intestinal antibody responses coincide with decline of poliovirus excretion. *Journal of Infectious Diseases* 2000;182:1-5.

9. World Health Organization. Polio vaccines: WHO position paper – June 2022. 2022. Available from: https://www.who.int/publications/i/item/WHO-WER9725-277-300 (Accessed 13 July 2022).

10. Hull B, Hendry A, Dey A, et al. Annual Immunisation Coverage Report 2020. Sydney, Australia:2021. Available from: https://www.ncirs.org.au/sites/default/files/2022-07/NCIRS%20Annual%20Immunisation%20Coverage%20Report%202020.pdf.

11. Dowdle WR. The principles of disease elimination and eradication. *Bulletin of the World Health Organization* 1998;76 Suppl 2:22-5.

12. Polio Global Eradication Initiative. Global Polio Eradication Initiative. 2022. Available from: https://polioeradication.org/ (Accessed 13 July 2022).

13. Global Polio Eradication Initiative. Global eradication of wild poliovirus type 2 declared: declaration further milestone for globally-coordinated vaccine switch in 2016. 20 September 2015. Available from: www.polioeradication.org/mediaroom/newsstories/Global-eradication-of-wild-poliovirus-type-2-declared/tabid/526/news/1289/Default.aspx (Accessed 16 December 2015).

14. Global Polio Eradication Initiative. WHO South-East Asia region declared polio-free. 27 March 2014. Available from: www.polioeradication.org/tabid/488/iid/362/default.aspx (Accessed 13 January 2016).

15. Global Polio Eradication Initiative. Data and monitoring. Polio this week. Available from: www.polioeradication.org/Dataandmonitoring/Poliothisweek.aspx (Accessed 13 January 2016).

16. Roberts JA, Grant KA, Ibrahim A, Thorley BR. Annual report of the Australian National Poliovirus Reference Laboratory, 2007. *Communicable Diseases Intelligence* 2008;32:308-15.

17. Thorley B, Kelly H, Roberts J. Importation of wild poliovirus into Australia, July 2007. *Communicable Diseases Intelligence* 2007;31:299.

18. Cochi SL, Jafari HS, Armstrong GL, et al. A world without polio. *Journal of Infectious Diseases* 2014;210 Suppl 1:S1-4.

19. Wilder-Smith A, Leong WY, Lopez LF, et al. Potential for international spread of wild poliovirus via travelers. *BMC Medicine* 2015;13:133.

20. Simons H, Patel D. Polio in Pakistan – A public health event of international concern with implications for travellers' vaccination [editorial]. *Travel Medicine and Infectious Disease* 2015;13:357-9.

21. Hall R. Notifiable diseases surveillance, 1917 to 1991. *Communicable Diseases Intelligence* 1993;17:226-36.

22. Roche P, Spencer J. Polio eradication in Australia and the world [editorial]. *Communicable Diseases Intelligence* 2002;26:113-7.

23. Kennett ML, Brussen KA, Wood DJ, et al. Australia's last reported case of wild poliovirus infection. *Communicable Diseases Intelligence* 1999;23:77-9.

24. Burgess MA, McIntyre PB. Vaccine-associated paralytic poliomyelitis. *Communicable Diseases Intelligence* 1999;23:80-1.

25. D'Souza RM, Kennett M, Watson C. Australia declared polio free. *Communicable Diseases Intelligence* 2002;26:253-60.

26. Thorley BR, Brussen KA, Elliott EJ, Kelly HA. Vigilance is required for Australia to remain polio free [letter]. *Medical Journal of Australia* 2006;184:474-5.

27. Conclusions and recommendations of the Advisory Committee on Poliomyelitis Eradication, November 2009. *Weekly Epidemiological Record* 2010;85:1-11.

28. D'Souza R, Kennett M, Antony J, Longbottom H, Elliott E. Acute flaccid paralysis surveillance in Australia progress report 1995–1998. *Communicable Diseases Intelligence* 1999;23:128-31.

29. Roberts JA, Hobday LK, Ibrahim A, Aitken T, Thorley BR. Australian National Enterovirus Reference Laboratory annual report, 2013. *Communicable Diseases Intelligence* 2015;39:E208-16.

30. Australian Technical Advisory Group on Immunisation (ATAGI). The Australian Immunisation Handbook, Australian Government Department of Health. Canberra: Australian Goverment Department of Health; 2019. Available from: https://immunisationhandbook.health.gov.au/ (Accessed 20 March 2019).

31. World Health Organization. International travel and health. 2014. Available from: www.who.int/ith/en/ (Accessed 16 December 2015).