16 Poliomyelitis

Key information

Mode of transmission	Faecal–oral route or by ingestion of pharyngeal secretions.
Incubation period	Paralytic disease usually 7–14 days, with a reported range of 3–35 days.
Period of communicability	Most infectious in the days immediately before and after the onset of any symptoms. Transmission is possible for as long as the virus is shed (can be years in immunocompromised individuals).
Incidence and burden of disease	Globally, endemic wild-type poliovirus 1 in Afghanistan and Pakistan. Circulating vaccine-derived poliovirus outbreaks continue. Wild-types 2 and 3 have been eradicated.
Funded vaccines	As inactivated polio vaccine (IPV), in combination with other antigens, or on its own: • DTaP-IPV-HepB/Hib (Infanrix-hexa) • DTaP-IPV (Infanrix-IPV) • IPV (IPOL).
Dose, presentation, route	All 0.5 mL per dose. DTaP-IPV-HepB/Hib: pre-filled syringe and glass vial, the vaccine must be reconstituted prior to intramuscular injection. DTaP-IPV: pre-filled syringe, intramuscular injection. IPV: pre-filled syringe, intramuscular or subcutaneous injection.
Funded vaccine indications and schedule	Usual childhood schedule: • at age 6 weeks, 3 months and 5 months: DTaP-IPV-HepB/Hib (primary series) • at age 4 years: DTaP-IPV (booster). For non-immune adults, 3 doses of IPV 8 weeks apart (may be shortened to 4-week intervals). For (re)vaccination of eligible patients: DTaP-IPV-HepB/Hib, DTaP-IPV or IPV.
Vaccine efficacy	Greater than 90 percent.
Precautions and special considerations	Non-immune pregnant women may be immunised if they are travelling to a region where polio is endemic.
Public health measures	All suspected cases of poliomyelitis be notified immediately on suspicion.

16.1 Virology

Poliomyelitis (polio) is a highly transmissible infectious disease caused by poliovirus, a small, non-enveloped enterovirus of the family Picornaviridae. There are three serotypes of poliovirus (types 1, 2 and 3). Wild types 2 and 3 have now been eradicated, but vaccine-derived poliovirus continue to circulate in some countries.

16.2 Clinical features

Poliovirus is transmitted by the faecal–oral route or by ingestion of pharyngeal secretions. The incubation period for poliomyelitis is commonly 7–14 days for paralytic disease, with a reported range of 3–35 days. The risk of transmission of infection is greatest shortly before to shortly after the onset of symptoms. The virus persists in the pharynx for approximately one week, and in the faeces for three to six weeks or longer, particularly in immunocompromised individuals, where cases have been reported shedding for many years.

The virus is highly neurotropic and its primary effect occurs in the neurones of the spinal anterior horn or the motor ganglia of the brain stem. in Up to 95 percent of infections are clinically inapparent; clinical cases range in severity from a non-paralytic fever to viral meningitis and acute flaccid paralysis.

Symptoms include fever; headache; gastrointestinal disturbances; malaise; stiffness of the neck and back; and pain in the limbs, back and neck, with or without paralysis. In children who develop paralysis, the illness may be biphasic with the initial phase of one to three days' duration being indistinguishable from that of other viral infections. The patient appears to recover, only to be struck down abruptly two to five days later with meningism, followed by paralysis. In adults and adolescents, the illness usually presents with a gradual onset of paralysis and pain without the early symptoms.

Infected asymptomatic people will shed the virus in their stool and may spread the infection to others. Infection rates may be as high as 100 percent in households where there are non-immune young children.

Paralysis may occur in 0.1–2 percent of infected individuals. It is more common in adults, occurring in up to 1 in 75 cases of infection. Case fatalities from paralytic polio vary from 2–5 percent among children and up to 15–30 percent for adults, increasing to 25–75 percent with bulbar involvement.

Post-polio syndrome may occur some 30–40 years after poliomyelitis. The cause is unknown but is probably related to the ageing or death of nerves and muscles that were compensating for the original damage. Patients experience muscle pain and exacerbation of existing muscle weakness. The risk of developing post-polio syndrome is greater in women than in men, and the risk increases with time from the episode of acute polio.

16.3 Epidemiology

16.3.1 Global burden of disease

In the pre-vaccination era, cases of poliomyelitis occurred sporadically with epidemics in high-income countries in temperate zones. In tropical countries, where the virus still circulates, there is no seasonal pattern.

Classically, poliomyelitis is a disease of young children and adolescents. In countries where polio was endemic, most children acquired antibodies to all three subtypes by age 5 years and most paralytic disease occurred in children aged under 3 years. However, with improvements in living standards a greater number of cases have occurred at an older age, particularly in early adult life, with an associated higher frequency of paralytic disease.

In the 30 years since the Global Polio Eradication Initiative began, an estimated 18 million cases of paralytic poliomyelitis have been prevented, and out of 125 countries, two have ongoing transmission of wild-type 1 disease (Afghanistan and Pakistan).[1] No wild-type disease has been detected in Nigeria since 2016, and the WHO hopes to declare Africa wild poliovirus free in 2020.[2] Although wild-type 2 and 3 polio have been eradicated, there was a dramatic increase in polio cases during 2019, primarily due to outbreaks in Pakistan which spread across its borders to Afghanistan and Iran.[1] Disruption of immunisation programmes and poor sanitary conditions has enabled polio to spread, and in some countries, there are pockets of children unable to be accessed for vaccination due to conflict.

The risk of international spread of poliovirus was declared as a Public Health Emergency of International Concern in May 2014. Further to wild-type 1 disease, the incidence of circulating vaccine-derived poliovirus types (cVDPV) within under-vaccinated populations is of significant international concern, particularly in Africa and South-East Asia (China, Malaysia, Philippines and Indonesia).[3] For up-to-date surveillance information and countries at risk of potential international spread of polioviruses, see the 'Polio Now' section of the Global Polio Eradication Initiative website (**polioeradication.org/polio-today/polio-now**).

There was a synchronised global switch to bivalent oral polio vaccine (bOPV) in 2016 in countries with circulating polio once the wild-type 2 disease was declared eradicated. In these countries, OPV is used together with inactivated poliovirus vaccine (IPV). Many countries without circulating virus have discontinued OPV and provide only IPV to eliminate the risk vaccine-associated paralytic poliomyelitis (VAPP). However, shortages of IPV supply led to delays in this switch and mixed schedules have continued. A revised Polio Eradication & Endgame Strategic Plan 2019–2023 has been developed by the Global Polio Eradication Initiative.[4] Its goal is 'the complete eradication and containment of all polioviruses'. Vaccination will continue worldwide until all polio has been eradicated.[1]

16.3.2 New Zealand epidemiology

Since 1962 only six polio cases have been reported. Four of these cases were laboratory confirmed as VAPP and two were classified as probable VAPP.[5] The last case of VAPP was reported in 1999.[6] No cases have been reported since IPV replaced OPV in 2002.

The New Zealand Paediatric Surveillance Unit carries out active surveillance of acute flaccid paralysis (AFP). In 2019 there were nine notifications: all were reviewed by the New Zealand National Certification Committee for the Eradication of Polio and all were classified as non-polio (ESR, 8 June 2020).

The risk of importing wild-type or neurovirulent oral vaccine-derived (cVDPV) strains means that maintaining high IPV coverage in New Zealand is essential.

For further details, refer to the ESR annual notifiable disease reports (available at **surv.esr.cri.nz/surveillance/IPD.php**).

16.4 Vaccines

New Zealand switched from OPV to IPV in 2002 (see Appendix 1).

16.4.1 Available vaccines

Funded polio vaccines

The polio-containing vaccines funded as part of the Schedule are:

- DTaP-IPV-HepB/Hib (Infanrix-hexa, GSK): diphtheria, tetanus, acellular pertussis, inactivated polio, hepatitis B and *Haemophilus influenzae* type b vaccine (see section 5.4.1 for more information)
- DTaP-IPV (Infanrix-IPV, GSK): diphtheria, tetanus, acellular pertussis and inactivated polio vaccine (see section 5.4.1 for more information)
- IPV (IPOL, Sanofi): contains three strains of poliovirus (40D antigen units of the Mahoney, 8D antigen units of the MEF-1 and 32D antigen units of the Saukett strains), inactivated by formaldehyde and containing phenoxyethanol as a preservative; trace amounts of neomycin, streptomycin, polymyxin B, polysorbate 80 and bovine serum albumin may be present.

Other vaccine

Adacel Polio (Sanofi) is a Tdap-IPV vaccines registered (approved for use) and available (marketed) in New Zealand.

16.4.2 Efficacy and effectiveness

See also section 14.4.2 for information about DTaP-IPV-HepB/Hib vaccine.

Immunogenicity and efficacy

IPV induces good systemic immune responses to protect against paralytic polio, but does not induce adequate intestinal neutralising antibody to interrupt faecal-oral transmission in regions with circulating polioviruses and with poor sanitation.[7]

Virtually all infants (99–100 percent) will seroconvert against all three strains after three doses of IPV vaccine, and more than 95 percent will seroconvert after two doses.[8] The efficacy of IPV is greater than 90 percent and immunity is expected to be long lasting.[9] Although antibody may decline over time in some individuals, there is no evidence that this leads to increased susceptibility to poliomyelitis.[10]

The combined IPV-containing vaccines induce immune responses against polioviruses superior to IPV stand-alone vaccines. This is due to the effect of the aluminium adjuvant present in these combination vaccines.[9]

Although immunocompetent adults previously immunised with OPV are expected to have lifelong protection against paralytic disease,[10] a study in Australia found that adolescents and young adults who were primed only with OPV had lower levels of serum neutralising antibody than the younger cohorts who had received OPV and at least one dose of IPV.[11] This data suggests that immunity provided by OPV primary schedule can be boosted by IPV to maintain individual immunity.

16.4.3 Transport, storage and handling

Transport according to the *National Standards for Vaccine Storage and Transportation for Immunisation Providers 2017 (2nd edition)* (available at **www.health.govt.nz/publication/national-standards-vaccine-storage-and-transportation-immunisation-providers-2017**).

Store at +2°C to +8°C. Do not freeze. DTaP-IPV-HepB/Hib vaccine should be stored in the dark.

DTaP-IPV-HepB/Hib (Infanrix-hexa) must be reconstituted by adding the entire contents of the supplied container of the DTaP-IPV-HepB vaccine to the vial containing the Hib pellet. After adding the vaccine to the pellet, the mixture should be shaken until the pellet is completely dissolved. Use the reconstituted vaccine as soon as possible. If storage is necessary, the reconstituted vaccine may be kept for up to eight hours at 21°C.

16.4.4 Dosage and administration

The dose of DTaP-IPV-HepB/Hib (Infanrix-hexa) and DTaP-IPV (Infanrix-IPV) is 0.5 mL, administered by intramuscular injection (see section 2.2.3).

The dose of IPV (IPOL) is 0.5 mL, administered by intramuscular injection or subcutaneous injection, if indicated (see section 2.2.3).

Co-administration with other vaccines

DTaP-IPV-HepB/Hib, DTaP-IPV and IPV may be given at the same time as inactivated or live attenuated vaccines, at separate sites and in separate syringes.

16.5 Recommended immunisation schedule

Table 16.1: Immunisation schedule for IPV-containing vaccines (excluding catch-up)

Age	Vaccine	Comment
6 weeks	DTaP-IPV-HepB/Hib	Primary series
3 months	DTaP-IPV-HepB/Hib	Primary series
5 months	DTaP-IPV-HepB/Hib	Primary series
4 years	DTaP-IPV	Booster

16.5.1 Usual childhood schedule

A primary course of poliomyelitis vaccine is given as DTaP-IPV-HepB/Hib at ages 6 weeks, 3 months and 5 months, followed by a booster dose given as DTaP-IPV at age 4 years (see Table 16.1).

16.5.2 Unimmunised adults and children

For partially immunised or previously unimmunised individuals, a primary immunisation course consists of three doses of IPV-containing vaccine (funded). The recommended interval is eight weeks between doses, but the minimum interval can be as short as four weeks for catch-up of children or adults (see Appendix 2).[12]

If a course of vaccine is interrupted, it may be resumed without repeating prior doses. A booster may be given if 10 years have elapsed since the last dose and exposure is possible (eg, in the case of a traveller to an area where the virus circulates; this is not funded).

If a child who began a course of OPV in another country moves to New Zealand, they can switch to IPV to complete the final doses. A further dose of IPV should be administered even if they have completed a full OPV (OPV or bOPV) course.

Note: All immunocompromised individuals and their household contacts may receive IPV. OPV was contraindicated in the immunocompromised because of the risk of VAPP. There is no risk of VAPP with IPV.

16.5.3 Pregnancy and breastfeeding

No adverse effects on the fetus have been reported following administration of IPV during pregnancy, but immunisation should not be carried out during the first or second trimester unless there are compelling reasons to do so, such as planned travel to an endemic area. However, bear in mind that pregnant women are particularly susceptible to paralytic polio.

If a previously unvaccinated pregnant woman is travelling to a country where polio is occurring, two doses should be administered four weeks apart prior to departure. If departure cannot be delayed allowing a four-week gap, give two doses at the maximum possible interval, though protection cannot be guaranteed. If the available interval is less than two weeks, a single dose is recommended, with further doses given on arrival where possible.

IPV may be given to breastfeeding women.

16.5.4 (Re)vaccination

Polio-containing vaccines are funded for (re)vaccination of eligible patients, as follows. See also sections 4.2 and 4.3.

DTaP-IPV-HepB/Hib (Infanrix-hexa) and DTaP-IPV (Infanrix-IPV)

An additional four doses (as appropriate) of DTaP-IPV-HepB/Hib (for children aged under 10 years) or DTaP-IPV are funded for (re)vaccination of patients:

- post-HSCT or chemotherapy
- pre- or post-splenectomy
- pre- or post-solid organ transplant
- undergoing renal dialysis
- prior to planned or following other severely immunosuppressive regimens.

Up to five doses of DTaP-IPV-HepB/Hib (for children aged under 10 years) or DTaP-IPV are funded for children requiring solid organ transplantation.

IPV (IPOL)

IPV is funded for patients following immunosuppression.

16.5.5 Recommendations for other groups

Booster doses of IPV are recommended (but not funded) for:

- travellers to areas or countries where poliomyelitis remains endemic or with cVDPV (see section 16.3.1); a booster of IPV, given four weeks to 12 months prior to departure, is recommended for these individuals if more than 10 years have elapsed since their last dose (where there is uncertainty about previous immunisation, a full course of IPV is recommended). For certain countries, an International Certificate of Vaccination or Prophylaxis is an entry requirement[1]
- health care workers in direct contact with a case of poliomyelitis
- individuals at particular risk of exposure (eg, laboratory workers routinely handling faecal specimens from persons recently arriving from high-risk countries, which may contain wild or vaccine-derived polioviruses); a booster dose of IPV is recommended every 10 years.

There is no evidence for the need for routine boosters, but they are recommended to reduce any possible risk from waning immunity in situations of increased risk of exposure.

16.6 Contraindications and precautions

See also section 2.1.3 for pre-vaccination screening guidelines and section 2.1.4 for general contraindications for all vaccines.

16.6.1 Contraindications

IPV-containing vaccines are contraindicated if there is a history of an anaphylactic reaction to a previous dose or to any of the vaccine components.

See also section 14.6 for information about DTaP-IPV-HepB/Hib vaccine.

16.6.2 Precautions

Pregnancy is a precaution for IPV-containing vaccination, but may be given to women who clearly need it. See section 16.5.3.

16.7 Potential responses and AEFIs

See also section 14.7 for information about DTaP-IPV-HepB/Hib and DTaP-IPV vaccines.

16.7.1 Potential responses

A small proportion of individuals experience mild local symptoms following IPV. Injection-site erythema is seen in 1–2 percent of infants, induration in 3–11 percent and pain in 14–29 percent. Similar local reactions are seen with combination vaccines.[9] There is no poliovirus excretion following IPV.

16.7.2 AEFIs

Serious adverse events are very rare following administration of the IPV currently manufactured.[8] See section 14.6 for information about DTaP-IPV-HepB/Hib vaccine.

16.8 Public health measures

It is a legal requirement that all suspected cases of poliomyelitis be notified immediately on suspicion to the local medical officer of health.

Collect two faecal specimens 24 hours apart, 0–14 days after the onset of paralysis and send to the national poliovirus reference laboratory at ESR.

Contact the polio reference laboratory for specific advice on the specimens required, and on packing and transporting the specimens (see also the 'Single human source specimen form', available on the ESR website: **www.esr.cri.nz/our-services/testing/test-request-forms/**).

All cases of acute flaccid paralysis must be investigated as suspected poliomyelitis. All clinicians caring for any person aged under 15 years with AFP must notify the case to the local medical officer of health and report the case to the New Zealand Paediatric Surveillance Unit. If in a hospital, all cases of AFP should also be discussed with a local microbiologist and infection control service.

Case investigation and surveillance for AFP will continue in New Zealand to monitor the successful eradication of polio.[13] The New Zealand Paediatric Surveillance Unit is based at the University of Otago and is responsible for sending case investigation and follow-up forms to clinicians to continue to monitor that New Zealand has eradicated polio and to provide information to the WHO.

Any case of poliomyelitis in New Zealand constitutes a Public Health Emergency of International Concern, and the Director of Public Health at the Ministry of Health should be contacted urgently. The *National Poliomyelitis Response Plan for New Zealand (Updated 2019)* outlines the actual response and is published on the Ministry of Health website (**www.health.govt.nz**).[13]

Although wild-type polio has been eradicated in the WHO Western Pacific Region, circulating vaccine-derived poliovirus has been notified within the region (Indonesia, Philippines, China). New Zealand continues to need high levels of IPV coverage because of the small risk that polio may be imported from regions where poliovirus remains in circulation (see section 16.3.1).

For more details on control measures, refer to the 'Poliomyelitis' chapter of the *Communicable Disease Control Manual*[14] (available at **www.health.govt.nz/publication/communicable-disease-control-manual-2012**).

16.9 Variations from the vaccine data sheets

See section 14.9 for variations from the DTaP-IPV-HepB/Hib (Infanrix-hexa) and DTaP-IPV (Infanrix-IPV) data sheets.

The IPV (IPOL) data sheet recommends three doses of vaccine administered at eight-week intervals.[15] The Ministry of Health recommends that this schedule may be shortened to four-week intervals for catch-up (see Appendix 2).

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