17 Rotavirus

Key information

Mode of transmission	Faecal–oral route through close personal contact and fomites.
Incubation period	1–3 days.
Period of communicability	During symptoms and until approximately 8 days after onset of symptoms. Up to 30 days after onset of symptoms in immunocompromised patients.
Burden of disease	All children during infancy or early childhood. Severe disease occurs most often in children aged 3 months to 2 years.
Funded vaccine	Oral live attenuated monovalent rotavirus: RV1 (Rotarix).
Dose, presentation, route	1.5 mL per dose. Oral suspension in an oral applicator, Administered orally.
Funded vaccine indications and schedule	2 doses for infants, at ages 6 weeks and 3 months. For catch-up schedules, the first dose should be given before age 15 weeks (latest is 14 weeks and 6 days), and the 2nd dose should be given before age 25 weeks (latest is 24 weeks and 6 days).
Vaccine effectiveness	Highly effective against severe rotavirus diarrhoea; some evidence for efficacy against all-cause diarrhoea and herd protection.
Contraindications	Previous intussusception and with conditions that predispose the infant to intussusception. Severe combined immune deficiency.
Precautions and special considerations	Infants living in households with immunocompromised persons or pregnant women should still be vaccinated. Hand washing and the careful disposal of soiled nappies are likely to minimise any risk of vaccine transmission to household contacts. Immunosuppressed infants including those on immunosuppressive therapy (other than SCID, where it is contraindicated). Infants born to mothers on immunosuppressive biologic agents (see section 17.6.2).
Potential responses to vaccine	A possible, very small risk for intussusception; the benefits of immunisation considerably outweigh this potential risk.

17.1 Virology

The rotaviruses are segmented, double-stranded RNA viruses of the family Reoviridae.[1] They are classified according to two surface proteins on the outer capsid: VP4 protease cleaved 'P' protein and VP7, the 'G' glycoprotein, which allows a binary classification system. The G and P proteins are immunological targets for neutralising antibodies protecting against disease and re-infection.[2] While more than 60 G and P combinations have been found in humans, there are only five strains (P[8]G1, P[4]G2, P[8]G3, P[8]G4, and P[8]G9) that are associated with 80–90 percent of the global burden of disease in children.[3] For simplicity, these strains are commonly referred to by their G serotype as G1, G2, G3, G4 and G9.

17.2 Clinical features

Rotavirus infects almost all children during infancy or early childhood. Transmission occurs through the faecal–oral route through close personal contact and through fomites. Aerosol transmission has been hypothesised but remains unproven.[1]

The incubation period is one to three days, after which illness can begin abruptly, with fever and vomiting often preceding the onset of diarrhoea.[1, 4] Up to one-third of children will develop a fever of greater than 39°C.[5, 6] The illness lasts from three to eight days.

Children with rotavirus are infectious while they have symptoms and until approximately eight days after the onset of symptoms. Immunocompromised patients may be infectious for up to 30 days after the onset of symptoms.[7] Large quantities of rotavirus are shed in the stool, and only a few virions are required to cause infection in a susceptible host.[8]

Rotavirus infection in the first three months of life is frequently mild or asymptomatic. This is possibly due to passive protection from maternally acquired antibodies, being breastfed and the intestinal cell structure of newborn infants.[1, 9]

The burden of severe dehydrating gastroenteritis caused by rotavirus occurs predominantly in infants and children aged 3 months to 2 years.[3]

The clinical spectrum ranges from asymptomatic infection to an acute severe illness with frequent and large-volume diarrhoea and vomiting, leading to dehydration, electrolyte disturbance and their sequelae. The illness spectrum from rotavirus is more severe than from other common causes of diarrhoea in children.[1]

17.3 Epidemiology

17.3.1 Global burden of disease

Rotavirus gastroenteritis is a significant cause of infant diarrhoea worldwide, both in high- and low-income countries. Virtually all children are infected by age 5 years.[1] Each year rotavirus causes the death of approximately 200,000 to 450,000 children aged under 5 years worldwide[10, 11] and results in 2.4 million paediatric hospital admissions.[12] Virtually all of the deaths occur in low-income countries. Prior to the introduction of licensed rotavirus vaccines in high-income countries, more than 220,000 children were hospitalised with rotavirus gastroenteritis every year.[13, 14]

Rates of rotavirus illness in children before the introduction of vaccine were similar in high- and low-income countries, indicating that good hygiene and clean water supplies are unlikely to have a significant impact on disease prevention. As a result, immunisation is the primary public health measure for the reduction of rotavirus disease burden.[1]

In countries with a temperate climate, rotavirus epidemics occur every winter and spring. Factors associated with an increased risk of severe rotavirus gastroenteritis include age under 2 years, low birthweight, premature gestation, lack of breastfeeding, socioeconomic disadvantage, malnutrition and impaired immunity.[1, 15, 16, 17, 18] Rotavirus gastroenteritis is not, however, more severe in HIV-infected children, although viral shedding may be longer.[3]

Rotavirus is an important cause of hospital-acquired infection[19] and can also cause disease in adults, especially those caring for children[20] and those living in aged-care facilities. During outbreaks in early childhood settings, rotavirus has been isolated from telephone receivers, drinking fountains, water-play tables and toilet handles.[21] Outbreaks in elderly populations may be linked to waning immunity, institutional crowding or both.

Children and adults can be infected with rotavirus several times in their lives. After a single natural infection during infancy, approximately one-third are protected against subsequent rotavirus infection, more than three-quarters are protected against subsequent rotavirus gastroenteritis and 85–90 percent are protected against severe rotavirus gastroenteritis.[22] The proportion with protection against both infection and symptomatic rotavirus gastroenteritis increases with successive episodes.[22]

These observations serve as the biological basis for rotavirus vaccines, whereby live attenuated strains can induce cumulative protective immunity similar to that following natural infection by wild-type rotaviruses. Although the immune mechanism and correlates of protection against rotavirus infection are incompletely understood, it is likely that both mucosal and serum antibodies are associated with protection against rotavirus infection and disease.[23]

Since the introduction of the vaccine in other high-income countries, there have been reductions in all-cause and rotavirus gastroenteritis in age groups not eligible for the vaccine, suggesting herd immunity effects as a result of rotavirus vaccines[3, 24, 25] (see 'Herd immunity in the post-licensure period' in section 17.4.2).

17.3.2   New Zealand epidemiology

Rotavirus vaccine was introduced in July 2014, as a three-dose schedule to infants at ages 6 weeks, 3 months and 5 months, using the RV5 vaccine (RotaTeq) (see Appendix 1).

At present rotavirus is not a notifiable disease, so there is no national surveillance data available. National hospital discharge rates, community and hospital laboratory data plus a sentinel hospital-based surveillance system have been used to monitor rotavirus disease since vaccine introduction. The sentinel hospital-based rotavirus surveillance was introduced in December 2014 at Kidz First Children's Hospital in Counties Manukau DHB and extended to Wellington, Hutt and Christchurch Hospitals in April 2016.

For detailed information about rotavirus surveillance and rotavirus infections in New Zealand, see the ESR website (**https://surv.esr.cri.nz/surveillance/Rotavirus.php**).

Pre-vaccine epidemiology

Prior to the introduction of vaccine, by the age of 5 years, it is estimated 1 in 5 children had sought medical advice for rotavirus gastroenteritis and 1 in 43 children had been hospitalised.[13]

From 2010 to 2014, the average annual national hospitalisation rate for rotavirus in children aged under 5 years was 215.4 per 100,000.[26] The highest hospitalisation rates for children aged under 5 years were in those from the Middle Eastern/Latin American/African ethnic group, followed by Pacific and Māori ethnic groups. Hospitalisation rates in children aged under 5 years who reside in the most deprived NZDep2013 quintiles (quintiles 4 and 5) were significantly higher than those who reside in the least deprived quintile. There is a seasonal peak for rotavirus hospitalisations, usually occurring around September each year.

Post-vaccine epidemiology

The introduction of rotavirus vaccination in Australia resulted in a 70 percent decrease in rotavirus hospitalisations in the two and a half years post-vaccine introduction.[27]

A similar decline has been noted in New Zealand in the first year post-vaccine introduction, where rotavirus hospitalisation rates for children aged under 5 years declined by 85 percent in 2015 compared with the previous five-year average (2010–2014)[26] (Figure 17.1). The vaccine has been effective in decreasing the most severe rotavirus disease. Hospitalisation rates decreased for all ethnic groups and levels of socioeconomic deprivation. Community laboratory data also supports the large decrease in rotavirus infections in the community.

Although only children aged under 1 year were eligible for rotavirus vaccination, hospital discharge rates decreased in all children aged under 5 years in 2015[26] (Figure 17.2). Older children are more likely to have been exposed to rotavirus already, and are less likely to benefit from vaccination.

Hospital discharges for rotavirus ranged from 510 to 822 cases per year in the four years prior to vaccine introduction (2010–2013).[26] There were 99 hospital discharges for rotavirus in children aged under 5 years in New Zealand in 2015, compared with 770 in 2014. This reduction in rotavirus hospitalisations of children aged under 5 years was maintained to 2019, with 80 cases hospitalised in the year to June 2019.

There was a 93.6 percent decrease in rotavirus outbreaks (three outbreaks reported in 2015 compared with 47 in 2014) after the introduction of vaccine in New Zealand.[26] This demonstrates that universal rotavirus vaccination is an effective public health intervention.
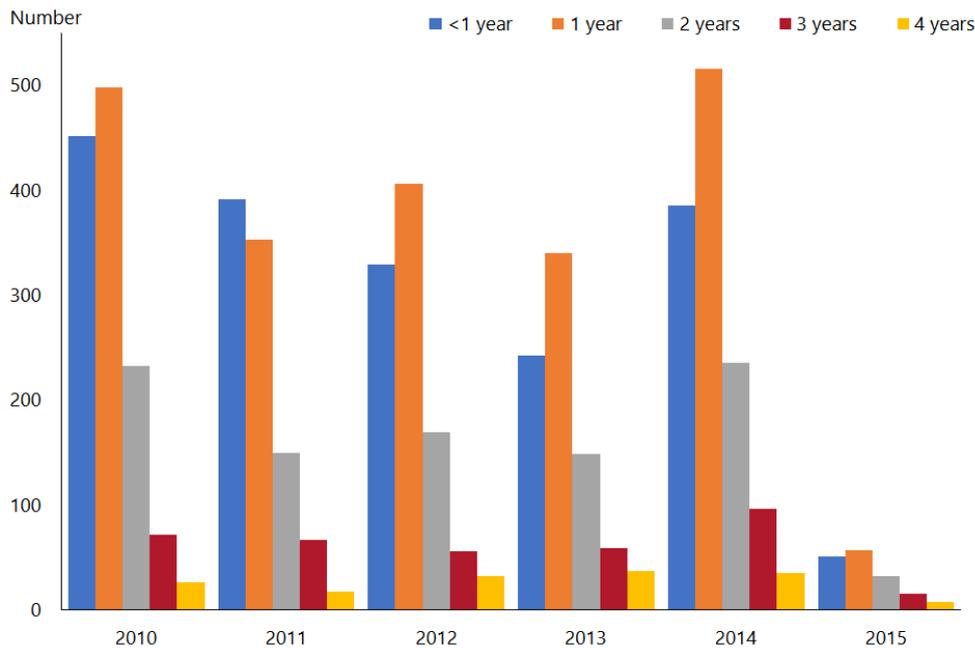
Figure 17.1: Rotavirus hospital discharges and as a percentage of all gastroenteritis discharges for children aged under 5 years, all New Zealand, June 2009–June 2019
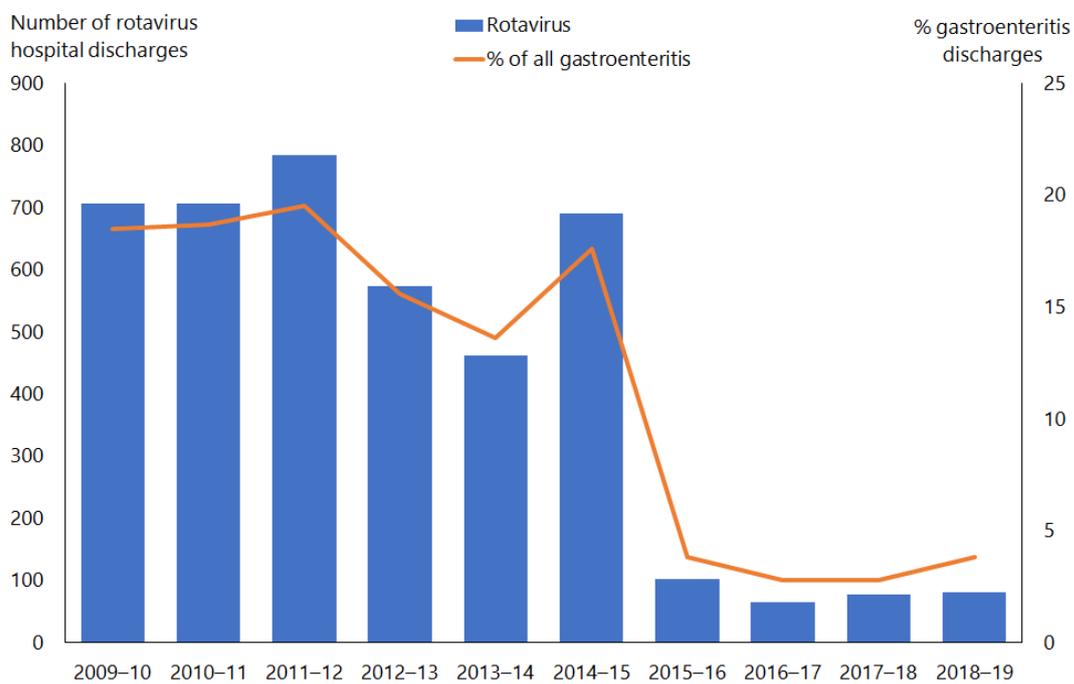
Note: Rotavirus vaccine introduced in July 2014.

Source: Ministry of Health.

Figure 17.2: Rotavirus hospital discharge rates for children aged under 5 years by age and year, all New Zealand, 2010–2015

Source: ESR

17.4 Vaccines

17.4.1 Available vaccines

The types of virus assessed for use as rotavirus vaccines have included live attenuated virus, both human and animal strains of the virus, and human–animal reassortant viruses. Two rotavirus vaccines have been used in New Zealand. Both are orally administered live attenuated vaccines and have been extensively evaluated.[28, 29] The live attenuated vaccine viruses replicate in the intestinal mucosa and are shed in the stools of vaccine recipients.[28, 30, 31]

Funded vaccine

RV1 (Rotarix, GSK) is a live attenuated monovalent human G1P1A[8] strain rotavirus vaccine. It protects against non-G1 serotypes (these include G2P[4], G3P[8], G8P[4], G9P[8] and G12P[6]) on the basis of other shared epitopes. Each 1.5 mL dose contains:

- at least 106 CCID50 (cell culture infective dose 50 percent) of the RIX 4414 strain of human rotavirus
- other components and residuals, including sucrose, disodium adipate and culture medium.

17.4.2 Efficacy and effectiveness

Prevention of disease

A 2012 Cochrane review[32] of the efficacy of rotavirus vaccines for the prevention of rotavirus diarrhoea assessed 41 trials which met the inclusion criteria, involving 186,263 enrolled participants. Of these, 29 trials assessed the monovalent vaccine (RV1; Rotarix) and 12 trials assessed the pentavalent vaccine (RV5; RotaTeq).

For the first two years of life in countries with low mortality rates, both vaccines prevented over 80 percent of cases of severe rotavirus diarrhoea (Table 17.1). Both vaccines impact severe all-cause diarrhoea (moderate to low quality of evidence). See also Figure 17.1 and Figure 17.2 above, which show a reduction in rotavirus hospitalisations in New Zealand children aged under 5 years after rotavirus vaccine was introduced in 2014.

Table 17.1: Cochrane review: percentage of severe rotavirus and all-cause diarrhoea cases prevented in children by RV1 and RV5, compared to placebo (low mortality rate countries)

Vaccine	Percentage of cases prevented	Risk ratio (95% confidence interval)	Number of participants (number of trials)	Quality of evidence
Severe rotavirus diarrhoea: infants aged under 1 year				
RV1	86	0.14 (0.07–0.26)	40,631 (6)	High
RV5	87	0.13 (0.04–0.45)	2,344 (3)	Moderate
Severe rotavirus diarrhoea: children aged under 2 years				
RV1	85	0.15 (0.12–0.2)	32,854 (8)	High
RV5	82	0.18 (0.07–0.5)	3,190 (3)	Moderate
Severe all-cause diarrhoea: infants aged under 1 year				
RV1	40	0.60 (0.5–0.72)	17,867 (1)	Moderate
RV5	72	0.28 (0.16–0.48)	1,029 (1)	Low
Severe all-cause diarrhoea: children aged under 2 years				
RV1	37	0.63 (0.56–0.71)	39,091 (2)	Moderate
RV5	96	0.04 (0.00–0.70)	5,916 (1)	Low

Adapted from: Soares-Weiser K, MacLehose H, Bergman H, et al. 2012. Vaccines for preventing rotavirus diarrhoea: vaccines in use. *Cochrane Database of Systematic Reviews* Issue 11, Art. No. CD008521. DOI: 10.1002/14651858.CD008521.pub3 (accessed 24 June 2020).

Effectiveness

In pre-marketing clinical trials, rotavirus vaccination prevented 42–58 percent of all-cause hospital admissions for acute gastroenteritis, suggesting it is responsible for more gastroenteritis than is detected by routine testing.[28, 33, 34]

Post-licensure surveillance studies have demonstrated large reductions in rotavirus-positive stool isolates from children with gastroenteritis (US)[35] and in diarrhoea-related deaths (Mexico).[36, 37] Summarised, post-licensure vaccine effectiveness studies in high-income countries have shown an 89–100 percent reduction in emergency department visits or hospitalisation; a 74–90 percent decline in hospitalisations for rotavirus gastroenteritis in children aged under 2 years; and a 29–50 percent decline in 'all-cause' acute gastroenteritis hospitalisations for children aged under 5 years.[38]

A protective association between rotavirus vaccine and childhood seizures has been reported in the US[39] and Australia.[40] In US children, a full course of rotavirus vaccination was associated with an 18–21 percent reduction in the risk of seizure requiring hospitalisation or emergency department care in the year following vaccination, compared with unvaccinated children.[39] In the Australian state of Queensland, rotavirus vaccine was 35.8 percent effective at preventing emergency department presentation for febrile seizures and 38.0 percent effective at preventing subsequent hospitalisation in children up to two years following vaccination.[40]

Herd immunity in the post-licensure period

Since the beginning of the post-licensure period, over 80 countries have introduced the rotavirus vaccine into their national immunisation programmes.[41] There has been substantial though somewhat variable efficacy data to show a decline in rotavirus infections in the different country environments. In the US, there was a 73 percent reduction in rotavirus infections among infants from 2003 to 2014.[42] The effectiveness tends to wane with age, and rotavirus 'seasons' appear to be longer in the post-licensure period.[42]

While a decline has occurred in rotavirus infection alone, there has also been a reduction in all-cause diarrhoeal illnesses.[41] Furthermore, the protective effect of the vaccine has surpassed the expected level of vaccine efficacy and coverage, resulting in a herd protection. Therefore, the immunised proportion of the population is causing a reduction of infection in the unimmunised portion of the community.[43]

Duration of protection

Prior to the introduction of rotavirus vaccines in Europe, extension studies of the pivotal phase III RV5 trial showed protection lasting up to three years from the last vaccine dose.[44] The duration of protection provided by rotavirus vaccines is difficult to measure because of the herd immunity effect that occurs after the vaccine is implemented. Some studies indicate waning immunity after the first year of life, particularly in low-income countries.[45, 46] In a large multicentre study in the US, both RV1 and RV5 vaccines were found to provide lasting and broadly heterologous protection against infection. Vaccine effectiveness persisted to the seventh year of life for RV5 and through the third year of life for RV1.[47] Note that the differences in duration are because RV1 was licensed in the US approximately two years later than RV5, affecting vaccination coverage and corresponding study power for older age groups for RV1 analyses.[47]

Partial vaccination

Studies in partially vaccinated infants (ie, those who had not completed the three-dose course of RV5 or the two-dose course of RV1) found that protection against rotavirus gastroenteritis ranged from 51–55 percent in low- and middle-income countries, and from 69–93 percent in high-income countries.[48]

Cross-protection

Rotavirus vaccine strains vary considerably, and multiple wild-type strains can occur at the same time. In high-income countries, both vaccines appear to provide some cross-protection against non-vaccine serotypes.[49, 50] Vaccine protection against newly emerging genotypes is not well known, and national surveillance of circulating rotavirus types post-vaccination is necessary.[51]

17.4.3 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 in the dark at +2°C to +8°C. Do not freeze.

17.4.4 Dosage and administration

The dose of RV1 (Rotarix) is 1.5 mL, administered orally (for administration instructions see section A7.2.4 of this *Handbook* or the vaccine data sheet, available at **www.medsafe.govt.nz**). Do not inject RV1.

Two doses are given, at ages 6 weeks and 3 months. See section 17.5 below for more information.

Co-administration with other vaccines

Rotavirus vaccines can be administered at the same time as other scheduled vaccines. Note that no time interval is required between administration of rotavirus and BCG vaccines; the two live vaccines likely to be administered to infants aged under 6 months.

If the dose is regurgitated or vomited

If the dose of rotavirus vaccine is regurgitated or vomited during or after administration, a repeat dose *should not be given*.[52] The second dose should be administered as per the schedule. Receptor binding of vaccine is instantaneous, making repeat dosing unnecessary.

If the first dose is immediately spat out then a single repeat dose could be given.

17.5 Recommended immunisation schedule

RV1 is recommended and funded for all infants. See section 17.5.2 for RV1 age limit information.

Immunisation is especially encouraged for those who will be attending early childhood education services or where there is an immunocompromised individual living in the household.

Infants who have already had rotavirus gastroenteritis should still receive the full course of immunisation. Initial rotavirus infection only provides partial protection against subsequent infection.[1, 22]

17.5.1 Routine schedule

Two RV1 doses are given orally, at ages 6 weeks and 3 months.

Table 17.2: The infant RV1 (Rotarix) schedule

Dose	Usual scheduled age	Recommended age limits for dosing
Dose 1	6 weeks	6–14 weeks[a]
Dose 2[b]	3 months	10–24 weeks[c]

a. The upper age limit for receipt of the first dose of RV1 is immediately prior to turning 15 weeks old (14 weeks and 6 days).

b. The minimum interval between doses 1 and 2 is 4 weeks.

c. The upper age limit for receipt of the second dose of RV1 is immediately prior to turning 25 weeks old (24 weeks and 6 days).

17.5.2 Catch-up schedules

The first dose of RV1 should be given before age 15 weeks (ie, 14 weeks and 6 days), and the second dose administered at least four weeks later (see Table 17.2). An infant who has not had the first dose before age 15 weeks will not be able to commence the rotavirus course. Where the first dose is inadvertently given at age 15 weeks or older, the second dose should be given, but both doses should be given before age 25 weeks (ie, the latest is 24 weeks and 6 days).[1] Rotavirus vaccine is not intended for use in older children, adolescents or adults.

The age limits for initiating and completing the vaccine series are recommended because there is insufficient safety data on the use of these vaccines outside this age range. If a partially vaccinated infant reaches age 25 weeks before the second dose is given, the first dose already given will offer them partial protection against disease.

The severity of rotavirus infection decreases with age, so a cost–benefit analysis for vaccinating older children is a low priority and has not been done.

17.5.3 Preterm infants

Vaccination as per the Schedule (ie, at the usual chronological age, with the usual vaccine dosage and interval) is recommended for preterm infants and infants with low birthweight, including those still in hospital (see below). Rotavirus vaccine can be given to preterm infants born who are receiving corticosteroids. (See also 4.2.1 for more immunisation recommendations for preterm infants.)

17.5.4 Hospitalised infants

Rotavirus vaccine should be given on time to any infant admitted to a general hospital ward (where other patients are not high risk). If standard infection control precautions are maintained, there is no risk of transmission of vaccine strain rotavirus when rotavirus vaccine is administered to hospitalised infants, including hospitalised preterm infants and those in neonatal units.[53, 54] (See also section 4.2 for more information about infants with special immunisation recommendations.)

17.5.5 Pregnancy and breastfeeding

There is no concern caused by vaccine exposure during pregnancy. There is no restriction for breastfeeding before or after vaccination of the infant (see 'Shedding' in section 17.6.2).

17.6 Contraindications and precautions

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

17.6.1 Contraindications

Rotavirus vaccine should not be given to infants with:

- a history of a severe (anaphylactic) allergic reaction after a previous dose or to a vaccine component

- a history of intussusception or an uncorrected congenital malformation of the gastrointestinal tract that would predispose the infant to intussusceptions (see section 17.7.1).

- severe combined immunodeficiency (SCID).[55]

17.6.2 Precautions

Rotavirus vaccine can be administered to infants with a mild illness, including gastroenteritis and upper respiratory tract infections. Infants with moderate to severe gastroenteritis should not be vaccinated until symptoms resolve.

There is very little safety data on infants with predisposing conditions such as metabolic disorders and chronic gastrointestinal diseases (Hirschsprung's, malabsorption syndromes or short gut syndromes). Since there is a greater risk of serious wild-type rotavirus disease, the benefits outweigh the risk, and vaccination is encouraged.[52]

Infants who have received antibody-containing blood products and are the appropriate age should be vaccinated. Rotavirus vaccine and antibody-containing blood products can be administered simultaneously.[52] There is a theoretical risk of interference in the immune response to the vaccine; therefore the interval between vaccination and receipt of blood products should ideally be as long as possible within the age limits of the vaccine schedule.

Administration of RV1 in immunosuppressed infants, including infants on immunosuppressive therapy, should be based on careful consideration of potential benefits and risks.

Infants born to mothers on immunosuppressive therapies

There is limited data on rotavirus vaccination safety when given to infants born to mothers receiving immunosuppressive therapy during pregnancy.[19, 36, 56] Although in most cases it is likely to be safe, caution is required. The level of circulating wild-type rotavirus is currently very low in New Zealand; therefore, the risk of gastroenteritis following rotavirus vaccination in this cohort of infants may be greater than the risk of acquiring the disease. The decision to administer rotavirus vaccine to infants born to mothers who received immunosuppressive agents (biologic agents) during pregnancy should be determined case by case.

If an infant turns 15 weeks of age before the first rotavirus vaccine dose can be administered, they will not be able to receive any rotavirus vaccine doses.

See section 4.3.7 and Table 4.2 for a list of the highly immunosuppressive medications with long half-lives that require a prolonged delay before vaccination (for up to one year in those being treated). These include monoclonal antibody (mab) agents that readily cross the placenta.

Each case should be assessed on a risk–benefit basis and with specialist advice.

Shedding

Since rotavirus vaccine virus replicates in the gastrointestinal tract, it can be shed in stools – especially after the first dose.[57] Shedding is also more likely in immunocompromised patients (eg, children with HIV). The vaccine virus could then be transmitted to unvaccinated populations; a feature that is generally beneficial as it promotes herd immunity.

Infants living in households with immunocompromised individuals should be vaccinated. So far there are no safety concerns, but there is also no data to confirm the safety of these vaccines for immunocompromised patients. Infants living in households with pregnant women should also be vaccinated. Hand washing and the careful disposal of soiled nappies are likely to minimise any risk of vaccine transmission to household contacts.[52, 53]

17.7 Potential responses and AEFIs

The 2012 Cochrane review[32] described in section 17.4.2 also reviewed the safety of RV1 and RV5 vaccines. No significant difference was found between children receiving RV1 or RV5 and placebo in the number of serious adverse events, particularly intussusception (see below). No statistical differences were observed for fever, diarrhoea and vomiting between cases and placebo groups. There was no significant difference between cases and placebos in the number of adverse events leading to discontinuation of the schedule.

In 2010 porcine circovirus or porcine circovirus DNA was detected in both rotavirus vaccines. However, there is no evidence that this virus is a safety risk or causes illness in humans.[52]

17.7.1 Intussusception

Intussusception is a cause of an acute abdomen when one part of the intestine telescopes into another part of the intestine; the mechanism by which these events occur remains uncertain. In 1999 an oral human–rhesus rotavirus quadrivalent vaccine (RotaShield) was licensed in the US and on the infant schedule but was withdrawn later that year after reports of an association with intussusception (a risk of approximately one case in 5,000–10,000 vaccine recipients).

No increased risk of intussusception was detected in the large phase III pre-licensure clinical trials of RV1 (Rotarix) and RV5 (RotaTeq), despite this being a specifically monitored adverse event. However, post-marketing surveillance of both rotavirus vaccines indicates the possibility of an increased risk of intussusception shortly after the first dose of rotavirus vaccination. Evidence from Australia[58] indicates that after the first dose, RV1 had a relative incidence (relative risk) of 6.8 (95% CI: 2.4–19.0, p<0.001) and 3.5 (95% CI: 1.3–8.9, p=0.01) for the periods of 1–7 days and 8–21 days after vaccination, respectively. For RV5, the relative incidence was 9.9 (95% CI: 3.7–26.4, p<0.001) and 6.3 (95% CI: 2.8–14.4, p<0.001) for the same time periods.

There was also some elevated risk of intussusception 1 to 7 days after the second dose of both vaccines. The relative incidence for RV1 was 2.8 (95% CI: 1.1–7.3, p=0.03) and for RV5 was 2.8 (95% CI: 1.2–6.8, p=0.02). There was no evidence of increased risk of intussusception following a third dose of RV5.[58] The increased risk of intussusception following rotavirus vaccination is estimated at approximately 6 additional cases of intussusception among every 100,000 infants vaccinated (approximately 1 in 15,500 vaccine recipientss), or 14 additional cases per year in Australia.[58]

Studies in the post-licensure period continue to show small increases in risk for both RV1 and RV5 and primarily within seven days of the first dose of vaccine.[59, 60] Recent safety data has continued to emphasise the clear and dramatic benefit of vaccination over the very low risk of vaccine-associated intussusception.[41] For example, a self-controlled case-series study estimated that the RV1 programme in England caused 21 intussusception admissions annually and prevented 25,000 gastrointestinal infection admissions with a clear risk–benefit ratio.[61]

While there appears to be an increased relative risk of intussusception, the condition remains rare, and this risk is outweighed by the benefits of rotavirus vaccination in preventing rotavirus infections; there was an estimated 70 percent reduction in hospitalisations in young children after the vaccine's introduction to the Australian schedule.[62] It is uncertain whether rotavirus vaccine administration affects the overall incidence of intussusception: US data suggests no increased overall rate in infants despite a small cluster effect.[63] Both the WHO[64] and the Australian Technical Advisory Group on Immunisation[62] continue to recommend the use of rotavirus vaccine for infants.

Although the risk of intussusception after rotavirus immunisation is very small, it is recommended that parents seek medical advice and health care professionals are attentive if the baby develops intermittent crying or screaming episodes, pulling their knees towards their chest and vomiting, or pink- or red-coloured jelly-like stools.

A recent study has described the epidemiology of intussusception in New Zealand children aged 0–36 months (794 cases) for a 16-year period before the introduction of routine rotavirus vaccination.[65] This study will provide a valuable baseline to determine if the introduction of the vaccine has significant effects on intussusception rates in the New Zealand population.

17.8 Public health measures

Prevention of spread is by contact precautions, including careful handwashing. In an early childhood service setting where there has been a child known to have had a rotavirus infection, the surfaces should be washed with sodium hypochlorite (bleach) and water. Disinfectants inactivate rotavirus and may help to prevent disease transmission resulting from contact with environmental surfaces.[52]

For more details on control measures, refer to the 'Acute gastroenteritis' chapter of the *Communicable Disease Control Manual*[7] (available at **www.health.govt.nz/publication/communicable-disease-control-manual-2012**).

17.9 Variations from the vaccine data sheet

The RV1 (Rotarix) vaccine data sheet states that if an infant vomits or regurgitates most of the vaccine dose, a single replacement dose may be given at the same vaccination visit. The Ministry of Health does not recommend repeating the dose (see section 17.4.4).[52]

The RV1 data sheet recommends postponing the administration of the vaccine in infants suffering from diarrhoea or vomiting. The Ministry of Health recommends vaccinating infants with mild gastroenteritis, and to wait until symptoms have resolved for infants with moderate to severe gastroenteritis (see section 17.6.2).

The RV1 data sheet states that the vaccine should not be administered to subjects with any chronic gastrointestinal disease. The Ministry of Health recommends instead that pre-existing chronic gastrointestinal disease is not a contraindication to rotavirus vaccination, with the exception of those conditions that may predispose the infant to intussusceptions (see sections 17.6.1 and 17.7.1).[53]

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