02 General Immunisation Procedures

In some circumstances, advice in these guidelines may differ from that in the Summary of Product Characteristics (SmPC). When this occurs, the recommendations in these guidelines, which are based on current expert advice from NIAC, should be followed.

Key Changes

Blood products and Vaccination

- Recommended intervals between blood products and MMR or Varicella vaccines

Chapter 2 General Immunisation Procedures

2.1 Introduction

This chapter provides information on the following:

Immunisation schedules

- Routine childhood immunisation schedule
- Interrupted immunisation courses
- Optimal and minimum age for vaccinations
- Intervals between vaccine doses
- Vaccination before minimum recommended age or interval
- Vaccination after expiry date
- Delayed immunisation / late entrants to Irish health-care system
- Catch up schedules
- Intervals between live and non live vaccines

Contraindications and precautions for vaccination

- Conditions that are NOT contraindications to immunisation

Immunisation of specific groups

- Women of childbearing age
- Pregnant women
- Individuals at specific high risk
- Those travelling abroad
- Those aged 65 years and older
- Those with bleeding disorders or on anticoagulants
- Technique for IM injection in those with bleeding disorders or on anticoagulants
- Vaccination and anaesthesia or surgery
- Preterm infants

Blood products and vaccination

- Human immunoglobulin
- Specific immunoglobulins

Vaccine preparation and administration

- How to administer oral vaccines
- How to administer intramuscular injections
- Infants in a spica cast
- How to administer subcutaneous injections
- How to administer intradermal injections

How to hold an infant or child during immunisations

Pain reduction

- Distraction techniques
- Breastfeeding or ingestion of a sweet-tasting liquid
- Order of injections
- Tactile stimulation
- Administration technique
- Simultaneously administering vaccines at separate sites

Antipyretics and vaccination

2.2. Immunisation Schedule

2.2.1. Recommended Childhood Immunisation Schedule

Table 2.1 Recommended Childhood Immunisation Schedule 2020

Age	Immunisations	Comment
2 months	DTaP/Hib/IPV/Hep B + MenB + PCV + Rotavirus	3 injections + 1 oral
4 months	DTaP/Hib/IPV/Hep B + MenB + Rotavirus	2 injections + 1 oral
6 months	DTaP/Hib/IPV/Hep B + PCV + MenC	3 injections
12 months	MMR + MenB	2 injections
13 months	Hib / MenC + PCV	2 injections
4 - 5 years	DTaP/IPV* + MMR	2 injections
12-13years	HPV (2 doses 6 months apart) + Tdap +MenACWY	4 injections

*dTap/IPV	Can be given if DTaP/IPV is not available
DTaP	Diphtheria, Tetanus and acellular Pertussis vaccine
Hib	Haemophilius influenzae b vaccine
IPV	Inactivated Polio Virus vaccine
Hep B	Hepatitis B vaccine
HPV	Human Papilloma virus vaccine
IPV	Inactivated polio vaccine
MenACWY	Meningococcal ACWY vaccine
MenB	Meningococcal B vaccine
MenC	Meningococcal C vaccine
MMR	Measles, Mumps and Rubella vaccine
PCV	Pneumococcal conjugate vaccine
Rotavirus	Rotavirus vaccine
Tdap	Tetanus, low-dose diphtheria and low-dose acellular pertussis vaccine

2.2.2 Interrupted immunisation courses

If an immunisation course is interrupted, it should be resumed as soon as possible. It is not necessary to repeat the course, regardless of the interval from the previous incomplete course *except cholera vaccine* (Chapter 5). The course should be completed with the same brand of vaccine if possible.

2.2.3 Optimal and minimum age for vaccinations

The optimal recommended ages and intervals shown in Table 2.2 provide the best immune response. The minimum interval is shorter than the recommended interval between doses and is the shortest time between two doses of a vaccine in which an adequate response to the second dose can be expected. Every effort should be made to comply with these recommendations

2.2.4 Intervals between doses

In exceptional circumstances (e.g. imminent international travel, measles outbreak, catch-up) it may be necessary to provide one or more vaccines at less than the optimal age or interval. In these instances the minimum recommended age and intervals shown in Table 2.2, and Chapter 5 and 12 can be used.

This accelerated schedule should not be used routinely. Remaining doses should be given at recommended intervals to ensure the best protection.

2.2.5 Vaccination before minimum recommended age or interval

Giving a dose ≤4 days before the minimum age or interval (the four day rule) is unlikely to have a significant adverse effect on the immune response to that dose and does not need to be repeated.

If a vaccine is given >4 days before the recommended minimum age or interval, it is not a valid dose. The dose should be disregarded and another dose given, at least 1 month after the disregarded dose.

The four day rule should **not** be used for

i. rabies or Japanese encephalitis vaccines, because of their schedules (1, 7, 28 days)

ii. the 2nd or 3rd doses of the accelerated Hepatitis B schedule (0, 7, 21 days and 12 months).

iii. the 28-day interval between two different live parenteral vaccines not administered at the same visit (Table 2.4).

Table 2.2 Optimal and minimum recommended ages and intervals between doses of the Primary Childhood Schedule

	Dose 1		Dose 1 to Dose 2		Dose 2 to Dose 3	
	Optimal age	**Minimum age**	**Optimal interval**	**Minimum interval**	**Optimal interval**	**Minimum interval**
DTaP, Hib/IPV Hepatitis B (as 6 in 1 vaccine)	2 months	6 weeks	2 months	4 weeks	2 months (and 4 months after Dose 1)	8 weeks (and 16 weeks after Dose 1)
MenB	2 months	6 weeks	2 months	4 weeks	2 months (and >12 months of age)	8 weeks
MenC	6 months	6 weeks	2 months (and >12 months of age)	4 weeks (and >12 months of age)	> 2 years	8 weeks
MMR[1]	12 months	6 months[1]	1 month	4 weeks		
PCV	2 months	6 weeks	2 months	4 weeks	2 months	8 weeks (and >12 months of age)
Rotavirus	2 months	6 weeks	2 months	4 weeks	2 months	4 weeks (and <8 months 0 days of age)

[1]Children can be vaccinated with MMR between 6 and 12 months of e.g. during a measles outbreak. If so, they should have a repeat MMR at 12 months of age, at least one month after the first vaccine, with a 3rd dose at 4-5 years of age.

2.2.6 Vaccination after the expiry date

The expiry date of a vaccine is the last day of the stated month and year. The expiry date to be used for reconstituted vaccines is on the outside of the box.

If a vaccine is given after the expiry date, it is an invalid dose, and the dose can be repeated that day.

If the error is detected more than one day later and involves

- **live** vaccine: wait ≥28 days before repeating the dose.
- **non- live** vaccine: repeat the dose as soon as possible.

2.2.7 Delayed immunisation / late entrants to Irish health-care system

Lack of protection against vaccine-preventable diseases may be due to incomplete vaccination, improper storage or handling of vaccines, or to immune defects such as those that can occur during severe malnutrition.

Those who are not immunised or are incompletely immunised and are older than the recommended age range should be immunised as soon as possible according to the schedules in Table 2.3.

> Once a child is back on schedule, the optimal recommended ages and intervals should be followed for the remainder of the required doses.

Children and adults coming to Ireland who do not have a documented or reliable verbal history of immunisation or disease, should be assumed to be unimmunised. This includes:

- those coming from areas of conflict
- marginalised population groups (such as refugees), as they may not have had access to immunisations
- those raised during periods before immunisation services were well developed or when vaccine quality may have been sub-optimal.

It may be assumed that undocumented doses have not been received, and the Irish catch-up recommendations for that age should be followed.

> Children resident in Ireland should be given vaccines according to the recommended Irish schedule

Decisions regarding whether to give or withhold individual vaccines are based on a number of factors, including the slight risk of over-vaccinating children. The following guidelines may help decision making (for more details see Table 2.3 and 2.2.7).

As a general rule, infants or children more than 1 month or 1 dose behind the schedule should be on a catch-up schedule, with the intervals between doses reduced to the minimum allowable.

Diphtheria
Some countries give a 4th dose of diphtheria containing vaccine at approximately 18 months of age. If so, an additional dose should be given from the age of 4 years- usually in junior infants. If a 4th dose has been given at age ≥3 years and 4 months, a 5th dose is not required until age 12-13 years.

Hib
Hib vaccine should be given to unvaccinated children aged <10 years. If aged ≥12 months, a single dose of monovalent Hib vaccine can be given if this is the only vaccine that is required.

MenACWY
A child who has had MenACWY vaccine at 10 years or older does not need an adolescent booster.

MenB
Unvaccinated children less than 2 years of age should be given 2 or 3 doses, 2 months apart depending on their age (Table 2.3).

MenC
Unvaccinated persons aged 1 to < 10 years should be given 1 dose of Men C vaccine, with a booster dose at 13 years of age (as Men ACWY).

Those aged 10 years to <23 years require a single dose of MenC containing vaccine if they have not been previously vaccinated.

MMR
Two doses should be given, the first dose at 12 months and the second dose at 4-5 years of age. An interval of at least 1 month should be left between doses. If in doubt, it is preferable to give MMR vaccine. Significant adverse reactions to repeat MMR vaccines are rare.

Pertussis
If a child is aged 10 years or more, low-dose pertussis containing vaccine (as Tdap) should be given. Some countries give a 4th dose of pertussis-containing vaccine at approximately 18 months of age. An additional dose should be given from the age of 4 years, usually in junior infants. If a 4th dose has been given at age ≥3 years and 4 months, a 5th dose is not required until age 12-13 years.

Pneumococcal
One dose of PCV13 vaccine should be given to unvaccinated immuno-competent children between 1 and 2 years of age (Chapter 16, Table 2, for vaccination of those at increased risk).

Polio
Adverse reactions to IPV are extremely rare. Four doses of an IPV-containing vaccine should be given, preferably before 6 years of age. If a 4th dose has been given at age ≥3 years and 4 months, a 5th dose is not required.

Rotavirus
Two doses of rotavirus vaccine should be given if aged < 8 months (1 dose if aged 7-<8 months).

Tetanus
Some countries give a 4th dose of tetanus containing vaccine at approximately 18 months of age. An additional dose should be given from the age of 4 years, usually in junior infants. If a 4th dose has been given at age ≥3 years and 4 months, a 5th dose is not required until age 12-13 years.

If person is completely unimmunised, choose the column in Table 2.3 appropriate to their current age and vaccinate using intervals stated.

If person has documented evidence of having some vaccines, choose the column in Table 2.3 appropriate for their age, then provide vaccines not already received. There is no need to repeat doses or restart a course.

Continue with the routine Irish immunisation schedule as appropriate to the age of the patient once catch-up completed.

Table 2.3 Catch-up schedules for children and adults

Vaccine	4 months to <12 months	1 to < 2 years	2-<4 years	4 to <10 years	10 to <18 years	18 years and older
DTaP/IPV/HepB[1]/Hib[2] (6 in 1)	3 doses ≥8 weeks apart	3 doses ≥8 weeks apart[1,2]	3 doses ≥8 weeks apart [1,2]	3 doses ≥8 weeks apart[1,2]		
MenB	2 doses ≥8 weeks apart (if aged ≥ 10 months give 1 dose and a booster at ≥ 12 months ≥8 weeks after the first dose	2 doses ≥8 weeks apart				
PCV	2 doses ≥28 days apart	1 dose				
Rotavirus[3]	2 doses 8 weeks apart (No dose after 8 months 0 days)					
Men C	1 dose	1 dose	1 dose	1 dose	1 dose up to 23 years of age, if Men C containing vaccine not given at age ≥10years	1 dose up to 23, if Men C containing vaccine not given at age ≥10years
MMR		1 dose	1 dose	2 doses ≥28 days apart[4]	2 doses ≥28 days apart	2 doses ≥28 days apart[5]
Tdap/IPV					3 doses 1 month apart	1 dose[6]
Td/IPV						2 doses 1 month apart leave >1 month gap after Tdap/IPV vaccine
NOTE	Continue with routine childhood immunisation schedule from 12 months	Routine school immunisations with Tdap/IPV >6 months and preferably 3 years after primary course and MMR2 >1 month after MMR1		Tdap/IPV as school immunisation at least 6 months and preferably 3 years after primary course and MMR2 > 1 month after MMR1	Booster of Tdap/IPV 5 years after primary course; Tdap 10 years later	

[1] Hep B vaccine is not needed if this is the only vaccine required unless in a risk group (Chapter 9)
[2] One dose of single Hib vaccine may be given to children from 12 months to < 10 years of age if this is the only vaccine required
[3] One dose if aged 7-<8 months
[4] One dose if not yet in primary school and second dose will be given in junior infants
[5] For HCWs or contacts in outbreaks born in Ireland since 1978 or born outside Ireland, and for adults from low resource countries, without evidence of two doses of MMR vaccine
[6] Only one dose of Tdap/IPV is required due to likely previous exposure to pertussis infection

2.2.8 Catch up schedules

4 months to <12 months of age

DTaP/IPV/Hib/Hep B (6 in 1)	3 doses ≥8 weeks apart
Men B	2 doses ≥8 weeks apart (1 dose if ≥ 10 months), and booster at ≥12 months, ≥8 weeks after previous dose)
MenC	1 dose at ≥6 months
PCV	2 doses 2 months apart
Rotavirus	2 doses if <8 months 0 days (1 dose if 7-<8 months)

Continue with routine childhood immunisations from 12 months of age

1 to <4 years of age

DTaP/IPV/Hib*/Hep B (6 in 1)	3 doses ≥8 weeks apart (*1 dose of Hib may be given if this is the only vaccine required)
MenB	2 doses ≥8 weeks apart if aged <2 years
MenC	1 dose
MMR	1 dose
PCV	1 dose: (omit if ≥2 years of age unless at increased risk)

Continue with routine school immunisations from 4 years of age

- Booster DTaP/IPV at least 6 months and preferably 3 years after the primary course
- Second MMR at least one month after the first dose

4 – <10 years of age

DTaP/IPV/Hib*/HepB (6 in 1)	3 doses ≥8 weeks apart (*1 dose of Hib may be given if this is the only vaccine required) Booster of DTaP/IPV at least 6 months and preferably 3 years after the primary course
MenC	1 dose
MMR	2 doses ≥28 days apart

Continue with routine school immunisations

10 - <18 years of age

MenC	1 dose <23 years of age if MenC containing vaccine not given at ≥10 years)
MMR	2 doses ≥28 days apart
Tdap/ IPV	3 doses at ≥28 days apart Booster doses of Tdap/IPV 5 years after the primary course and Tdap 10 years later

18 years and older

MenC	1 dose up to <23 years of age if MenC containing vaccine not given at ≥10years)
MMR	2 doses ≥28 days apart (for health care workers born in Ireland since 1978 or born outside Ireland and for adults from low resource countries.
Tdap/ IPV	1 dose, then Td/IPV, 2 doses ≥28 days apart

2.2.9 Intervals between live and non live vaccines

The following table shows the recommended intervals between vaccines.

Table 2.4 Recommended intervals between vaccine doses

Antigen combination	Recommended interval between doses
MMR and yellow fever*	MMR and yellow fever should **not** be administered on the same day. They should be given ≥4 weeks apart
MMR, varicella and zoster vaccine	Can be given on the same day or ≥4 weeks apart
BCG, rotavirus, live attenuated influenza vaccine (LAIV), MMR, oral typhoid vaccine, varicella, yellow fever, and zoster	**Apart from the combinations listed above**, can be given on the same day or at any interval between doses
Non live vaccines	May be administered simultaneously or at any interval between doses
Non live and live vaccines	May be administered simultaneously or at any interval between doses

***MMR and yellow fever**. If these vaccines are given at the same time there may be reduced immune responses to the mumps, rubella and yellow fever antigens, so at least a 4 week interval should be left between them. If protection is required rapidly the vaccines may be given on the same day and an additional dose of MMR given at least 4 weeks later.

2.3. Contraindications and precautions to vaccines

Routine physical examination and temperature measurement of persons who appear to be healthy are not necessary prior to vaccination. Ask if the proposed recipient is well; postpone vaccination if an acute severe febrile illness is present.

The risks of not giving specific vaccines should be carefully considered when precautions exist (see individual chapters). When there are doubts whether or not to give a vaccine, contact a relevant specialist.

Contraindications

- Anaphylaxis to a vaccine or to one of its constituents or a constituent of the syringe, syringe cap or vial (e.g. Latex anaphylaxis).

  If a person has had anaphylaxis caused by latex, vaccines supplied in vials or syringes that contain natural rubber should not be administered unless the benefit of vaccination outweighs the risk for a potential allergic reaction. For those with contact allergy to latex gloves, vaccines supplied in vials or syringes that contain dry natural rubber or rubber latex may be given.

- Live vaccines
  - Rotavirus vaccine ≥8 months 0 days of age (Chapter 19)
  - Pregnancy (some vaccines, see individual Chapters)
  - Some immunocompromising conditions due to disease or treatment (Chapter 3).

Precautions

- Acute moderate or severe febrile illness; defer until recovery. The concern in vaccinating someone with moderate or severe illness is that a fever following the vaccine could complicate management of the concurrent illness; it could be difficult to determine if the fever was from the vaccine or due to the concurrent illness.
- Immunoglobulin administration may impair the efficacy of MMR and varicella vaccines (Chapters 12, 15, 20 and 23).
- Previous Type III (Arthus) hypersensitivity reaction. This is characterised by pain, swelling, erythema and oedema of most of the diameter of the limb between the joint above and below the injection site. It is not associated with fever. It usually begins 2-8 hours after vaccination, is more common in adults and usually resolves without sequelae within 1 week.

Persons experiencing such a reaction to DTaP-containing vaccines usually have very high IgG tetanus antitoxin levels; they should not be given further routine or emergency booster doses of tetanus or diphtheria containing vaccines more frequently than every 10 years.

If the reaction occurs with the first dose in the primary series in a child aged <6 months, it is likely due to high levels of maternal antibodies. Subsequent doses should be deferred until the child is aged ≥6 months, when circulating maternal antibodies will be greatly reduced.

2.3.1 Conditions that are NOT contraindications to immunisation

- Family history of adverse reaction to immunisation.
- Minor illness with fever <38°C.
- Family or personal history of convulsions.
- History of vaccine-preventable infection.
- Prematurity or low birth weight. However, Hepatitis B vaccine should be deferred in those <2kg until 1 month of age unless there is a maternal history of HBV infection (Chapter 9).
- Stable neurological conditions, e.g. cerebral palsy.
- Recent contact with an infectious disease.
- Corticosteroid treatment which is:
  - short term (<14 days)
  - long-term with <20mg/day of prednisolone, or equivalent (0.5mg/kg/day in children <40kgs)
  - long-term, alternate-day treatment with short-acting steroids
  - maintenance physiologic doses (replacement therapy)
  - topical (skin or eyes), or by inhalation
  - intra-articular, bursal, or tendon injection.
- Low dose methotrexate (< 0.4 mg/kg/week), azathioprine (<3.0 mg/kg/ day) or 6-mercaptopurine (<1.5 mg/kg/day).
- Asthma, eczema, hay fever, or food allergy.
- Treatment with antibiotics.

- Child's mother is pregnant.
- Breast-feeding child, unless mother is on immune modulators (Chapter 3)
- History of jaundice.
- Recent or imminent surgery or general anaesthesia (Section 2.4.3).
- Non-anaphylactic egg allergy.
- For MMR vaccine: anaphylaxis following egg (Chapter 12).

2.4. Immunisation of specific groups

The following should receive the vaccines listed below:

2.4.1 Women of childbearing age

- seronegative for rubella: MMR vaccine (unless documented evidence of having received at least 1 MMR vaccine)
- seronegative for varicella: varicella vaccine (unless documented evidence of having received 2 varicella vaccines).

2.4.2 Pregnant women

- pertussis vaccine (as Tdap) as early as possible after 16 weeks and before 36 weeks gestation *in each pregnancy*.
- seasonal inactivated influenza vaccine at any stage of pregnancy.

There is no evidence of harm to the foetus from vaccinating pregnant women with non-live vaccines (Chapter 15).

Live vaccines pose a theoretical risk to a foetus and are contraindicated during pregnancy unless the benefits outweigh this theoretical risk.

2.4.3 Individuals at specific high risk (Chapter 3)

- BCG, hepatitis A, hepatitis B, Hib, influenza, MenACWY, MenB, MMR, pneumococcal, HPV and varicella vaccines (see individual chapters)

2.4.4 Those travelling abroad (Chapter 5)

- travel vaccines

2.4.5 Those aged 65 years and older

- pneumococcal polysaccharide vaccine (PPV23).
- influenza vaccine

2.4.6 Persons with bleeding disorders or on anticoagulants

Individuals with a bleeding disorder or receiving anticoagulant therapy may develop haematomas in IM injection sites. Prior to vaccination, inform the recipient about this risk. For those with thrombocytopoenia (platelet count $<50x10^3$), consult the supervising consultant.

Some vaccines recommended for IM injection may be administered SC to persons with a significant bleeding disorder if the immune response and clinical reaction to these vaccines are expected to be comparable by either route of injection. This applies to MMR, influenza and yellow fever vaccines.

Hepatitis B and rabies vaccines administered SC result in a lower antibody response. Additionally, when aluminum-adsorbed vaccines are given SC, an increased incidence of local reactions including subcutaneous nodules has been observed.

Those with inherited coagulopathies receiving factor replacement therapy should be given IM vaccination within a few days after treatment.

Those receiving long-term anticoagulation with either warfarin or heparin are not considered to be at higher risk of bleeding complications following immunisation. There is no reason to expect that there is a greater risk of bleeding complications with the newer types of anticoagulants, such as antiplatelet agents, than with other anticoagulants.

2.4.7 Technique for IM injections in persons with bleeding disorders or on anticoagulants

- Only one injection per muscle mass should be given at each visit. Use a 23 or 25 gauge needle to reduce the pressure gradient and cause less trauma to the tissue. The vaccine should be injected slowly (≥5 seconds) to reduce the risk of tissue damage.
- Firm pressure should be applied to the site for 5 to 10 minutes after injection.
- Stabilisation of the limb will reduce the risk of a haematoma.
- The site should not be rubbed or massaged.
- Instruct the patient/parent to monitor the injected limb and to report any concerns to their supervising consultant.

2.4.8 Vaccination and anaesthesia or surgery

> There is no evidence that any effects of immunisation have an impact on outcomes of either anaesthesia or surgery. Urgent or emergency surgery should never be delayed as a result of recent vaccination.

Delaying vaccination increases the risk of vaccine preventable infections and has been shown to result in non-completion of the vaccination schedule in some children. The importance of completing the vaccination schedule both for the child and the community outweighs any concerns about the impact of vaccination upon surgery.

The risk of developing a fever following **live vaccines** is the same as the risk of common febrile illnesses of childhood and should not be considered an indication to delay either vaccination or surgery.

However, it may be wise to postpone elective major surgery for 48 hours after **non live vaccine** administration in order to avoid diagnostic confusion should the child develop post vaccination pyrexia.

If consent has been given, it is acceptable to vaccinate while the recipient is under anaesthesia if it is likely that vaccination will otherwise be omitted.

If indicated, vaccination may be given before discharge.

2.4.9 Preterm infants

Preterm infants are more vulnerable than full term infants when exposed to infections, particularly pertussis and rotavirus, and to their complications. Therefore, routine vaccines should be started at 2 months chronological age in infants of any gestational age.

Infants vaccinated with rotavirus vaccine while in hospital do not need to be isolated from other infants. Standard infection control precautions should be followed at all times to reduce the risk of transmission of the vaccine virus. The benefits of vaccination for this at-risk population at the appropriate time far outweighs any potential risk of transmission of this highly attenuated vaccine virus.

If an infant born ≤28 weeks of gestation is still in hospital, the first and second vaccines should be given under cardiorespiratory monitoring for 48 hours, as there may be an increase in bradycardia and/or apnoeic episodes in these infants. Such episodes do not recur after subsequent vaccinations, nor have they been reported in preterm infants given their vaccines after discharge.

Compared with infants born at term, there is a smaller rise and a more rapid decline in antibody levels following vaccination of extremely preterm infants. However, there may be less interference from maternal antibodies, as most antibody transfer occurs in the third trimester.

Hepatitis B vaccine may not give an adequate immune response in infants weighing less than 2kgs, until they are aged one month or more. However, if a mother is HBsAg positive, her infant should be given HepB vaccine at birth and further doses (as 6-in-1 vaccine) at 2, 4 and 6 months of age.

The presence of an intraventricular haemorrhage is not a contraindication to vaccination.

Infants born to mothers given antenatal steroids for foetal lung maturation should be vaccinated according to the recommended schedule.

2.5. Blood products and vaccination

Blood products include red cells and immunoglobulins.

Non-live vaccines and BCG, rotavirus, yellow fever and varicella zoster vaccines can be administered at the same time or at any interval before or after any blood product transfusion.

MMR and varicella vaccines can be given at the same time or at any interval before or after washed red blood cells. These vaccines should be given at least two weeks before and 6 months after the administration of packed red blood cells which may interfere with the immune response (Table 2.5).

Receipt of Anti-D immunoglobulin is not a reason to delay vaccination.

2.5.1 Human immunoglobulin

Human Normal Immunoglobulin (HNIG) can provide passive temporary immunity to specific infections. HNIG is prepared from the pooled blood of donors who are negative to hepatitis B surface antigen (HBsAg), hepatitis C antibody (anti-HCV) and antibody to human immunodeficiency virus (HIV).

HNIG contains antibodies to varicella, hepatitis A and other viruses prevalent in the population from which it was obtained.

Contraindications

Intramuscular HNIG should not be administered to any patient with severe thrombocytopenia or with a significant coagulation disorder. If indicated, IVIG can be used.

Precautions

Caution should be exercised with any patient who has a history of a significant adverse experience following HNIG administration.

Non-live vaccines can be administered at the same time or at any interval before or after HNIG. If given at the same time, the non-live vaccine and HNIG should be given in different sites.

HNIG may interfere with the immune response to MMR and varicella vaccines. It should not interfere with BCG, LAIV, oral typhoid, yellow fever or herpes zoster vaccines.

MMR or varicella vaccine should not be given from 2 weeks before to 5 -11 months after injection of HNIG as it may interfere with their immune response (Table 2.5). This does not apply to herpes zoster vaccine. The amount of antigen in zoster vaccine is high enough to offset any effect of circulating antibody.

2.5.2 Specific immunoglobulins

These are prepared from the pooled plasma of blood donors who have high antibody titres to specific organisms. Specific immunoglobulins are available for administration following exposure to tetanus[1], hepatitis B[2], rabies[3] and varicella-zoster[2] virus. Recommendations for their use are found in the relevant chapters.

There is minimal or no interaction between blood products or immunoglobulins and:

- non-live vaccines
- live oral vaccines (rotavirus, oral typhoid)
- live intranasal vaccine (live attenuated influenza vaccine)
- BCG vaccine
- yellow fever vaccine

These vaccines may be given concomitantly with, or at any time before or after a blood product has been administered.

MMR or varicella vaccine should not be given from 2 weeks before to 3- 11 months after specific immunoglobulins as they may interfere with the immune response (Table 2.5).

[1] available from the National Cold Chain Service
[2] available directly from manufacturer
[3] available from Cherry Orchard Hospital

Table 2.5 Recommended intervals between blood products and MMR or Varicella vaccines

This table is not intended for determining correct indications and doses for using antibody-containing products

Preparation	Route	Dose	Estimated IgG mgs/kg	Interval (months)
Blood products				
Washed RBCs	IV	10mls/kg	Negligible	0
Packed RBCs and wholeblood	IV	10mls/kg	60	6
Plasma & platelets	IV	10mls/kg	160	7
HNIG				
Immune deficiencies	SC, IM, IV		300-400	8
ITP treatment	IV	400mgs/kg/day	400	8
		1,000 mgs/kg/day	1,000	10
Kawasaki disease	IV		1,600-2,000	11
Measles *Immunocompetent contacts*	IM	0.6ml/kg	80	6
Immunocompromised contacts	IV	3 ml/kg	400	8
Specific immunoglobulins				
Cytomegalovirus	IV	3mls/kg	150	6
Hepatitis B	IM	100- 500 IU	10	3
Rabies	IM, wound	20 IU/kg	22	4
Tetanus	IM	250 - 500 IU	10	3
Varicella	IM	15-25 IU/kg		5

2.6. Vaccine preparation and administration

Vaccines should be prepared according to the SmPC.

Unless the SmPC requires mixing of vaccines in one syringe (e.g. DTaP/IPV/HepB with Hib), multiple vaccines given at the same visit must be given at least 2.5cm apart, and if necessary in different limbs.

Some vaccines (e.g. 6 in 1, MMR, Hib/MenC, MenACWY) require reconstitution.

It is unnecessary to change needles after a vaccine dose has been drawn into a syringe.

It is unnecessary to change the needle if it has passed through two stoppers, e.g. when a lyophilised (dried) vaccine is reconstituted.

Filter needles are not indicated for drawing up vaccines in ampoules <1ml, as they could potentially filter out particulate matter such as adjuvants or other active ingredients, making a vaccine less effective. Also, shards are very unlikely to be drawn into needles used for immunisations. Using an alcohol swab when opening the ampoule will reduce the risk of glass shards entering the ampoule. Tap the ampoule lightly to ensure that the contents are in the lower part of the ampoule. Wrap an alcohol swab around the neck of the ampoule. Snap the top off by breaking it away from your body.

Prefilled syringes (e.g. MenB, PCV)
If a needle is provided separately,

- break the rubber seal on the prefilled syringe and remove it.
- attach needle and break the seal of the needle cap without removing the cap.

If a needle is attached to prefilled syringe (e.g. inactivated influenza vaccine)

- break the seal of the needle cap.
- hold syringe upright by the barrel to check for air bubbles. Small air bubbles (less than the internal diameter of the syringe) do not need to be expelled except for intradermal injections. Rarely there may be a large air bubble in the pre-filled syringe. If so draw back slightly on the plunger to ensure no vaccine is expelled along with the air and then expel the air through the needle, until the hub is filled with vaccine.
- do not prime the needle with any of the vaccine, as this may cause an increased local reaction.

2.6.1 How to administer oral vaccines

Oral typhoid vaccine (Chapter 5 and SmPC)
The capsule should be taken approximately one hour before a meal with a cold or lukewarm drink. The vaccine capsule should not be chewed and should be swallowed as soon as possible after placing in the mouth.

Rotavirus vaccines (Chapter 19 and SmPC)
To reduce the likelihood of significant regurgitation

- the vaccine should be given at the beginning of the visit, while the infant is still happy, and before administering injections. As the vaccines contain sucrose, they help reduce the pain of subsequent injections.
- the dropper containing the vaccine should be aimed down one side and toward the back of the infant's mouth. The dropper should not be inserted so far back that the infant gags.

In the unlikely event that an infant spits out or regurgitates most of the vaccine dose, a single replacement dose should be given at the same vaccination visit.

2.6.2 How to administer intramuscular (IM) injections

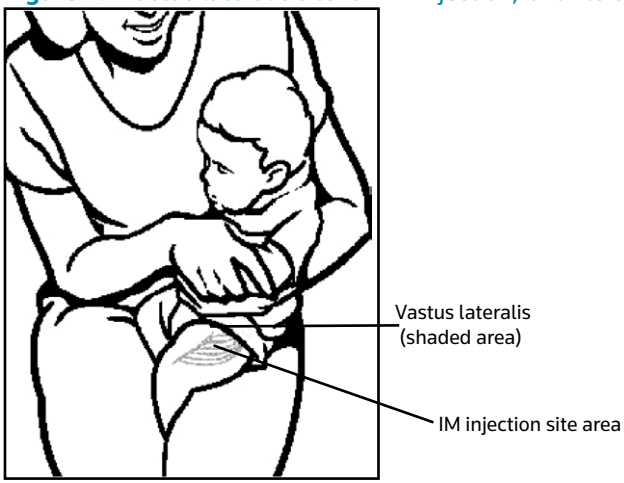
Site

There are only two routinely recommended IM sites for administration of vaccines, the vastus lateralis muscle (anterolateral thigh) and the deltoid muscle (upper arm), (Figures 2.1- 2.4). Using these sites reduces the chance of involving significantly sized nerves or blood vessels. The site depends on the age and muscle mass of the recipient.

Vastus lateralis

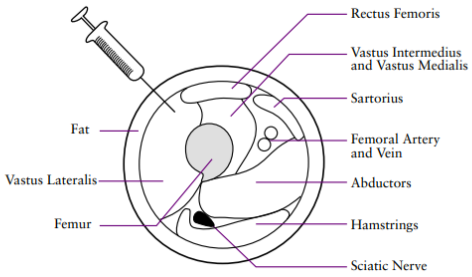
The vastus lateralis muscle is located on the antero-lateral aspect of the thigh, from one of the patient's hand breadths below the greater trochanter to one hand's breath above the knee. The middle third of the muscle is the site for injections. The width of the Injection site extends from the mid-line of the thigh anteriorly to the mid-line of the outer thigh (Figures 2.1 and 2.2).

Figure 2.1 Vastus lateralis site for IM injection, birth to 36 months



The injection site is the middle third of the vastus lateralis, in the anterolateral thigh (shaded area above).

Figure 2.2 Site for IM injection, birth to 36 months (cross section of left mid-thigh*)



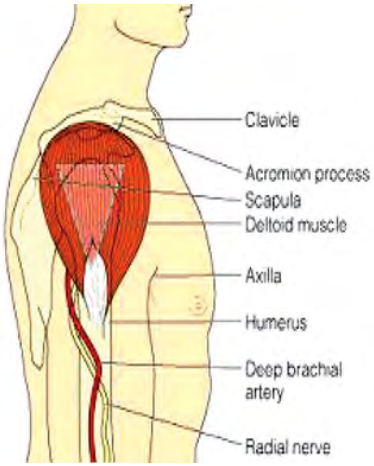
*Either leg can be used.

Deltoid

The light triangle in Figure 2.3 indicates site for IM injection into the deltoid muscle for older toddlers, children and adults. The upper border of the triangle is approximately two finger-breadths below the acromion process and the apex is at the midpoint of the humerus.

The recommended site is in the middle of the triangle. To avoid causing an injury, do not inject too high or too low. Insert needle at 90^{o} angle.

Figure 2.3 Deltoid site for IM injection, older toddlers, children and adults



Multiple injections given in the same limb should be separated by at least 2.5cm.

Do not inject into a limb affected by a lymphatic system problem, such as lymphoedema or mastectomy with lymph node curettage. The opposite arm or the vastus lateralis are alternate sites.

No vaccines should be injected into the arm used for BCG administration for at least 3 months, because of the risk of regional BCG lymphadenitis.

Needle size

The correct needle size is shown in Table 2.6.

A 16mm needle usually is adequate for neonates up to 28 days of age, preterm infants (<37 weeks gestation) up to 2 months of age, and very small infants, if the skin is stretched flat between the thumb and forefinger. (See also section 2.6.3).

A 25mm needle should be used for other infants and children, and most adults. Using a 16mm needle to give vaccines IM to this population may lead to inadvertent SC injection. This can increase the risk of significant local adverse reactions, particularly with aluminium-adjuvanted vaccines (such as HepB, DTaP combination and Men B vaccines).

A 40 mm needle should be used in females >90kg and males >120kg.

There is little difference in local adverse reactions or immune responses between needles of the same length but different gauges.

Table 2.6 Recommended site and needle size for intramuscular injections

Patient's age	Site (see illustrations below)	Needle length and size
Birth to <12 months	Vastus lateralis muscle (Figure 2.1	25 mm* 23-25 gauge
12 to <36 months	Vastus lateralis or deltoid muscle (depending on muscle mass)	25 mm 23-25 gauge
3 years and older	Deltoid muscle (Figure.2.3)**	25 mm*** 23-25 gauge

* Use a 16 mm needle in infants under 2.5-3 kg.

** The anterolateral thigh may also be used.

*** Use 40 mm needle in females >90 kg, males >120kgs.

Technique

It is not necessary to use gloves for vaccine injections, unless contact with potentially infectious body fluids is possible, or unless the health care worker has an infected lesion on the hand. If gloves are worn they should be changed for each patient.

If the skin at the injection site is visibly dirty it should be cleaned with soap and water. There is no need to use a disinfectant e.g. alcohol swabs.

If an alcohol swab is used, injection should be delayed for ≥30 seconds, to ensure the alcohol will have evaporated.

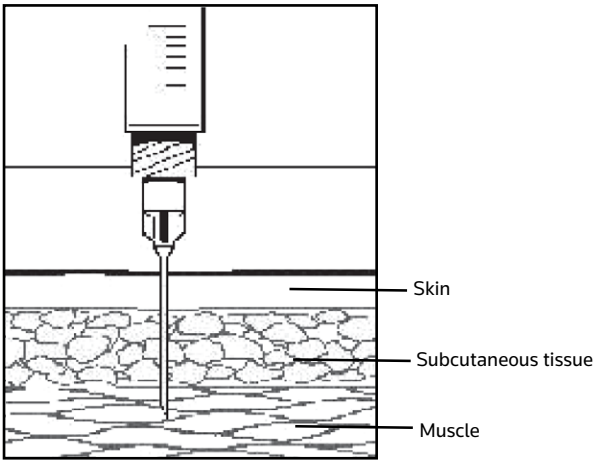
Spread the skin of the administration site taut between the thumb and forefinger (to avoid injecting into subcutaneous tissue and to isolate the muscle).

In small infants and others with little subcutaneous tissue or muscle mass the tissue around the injection site may be gently bunched up.

Insert the needle rapidly and fully at a 90° angle to the skin (Figure 2.4). It is not necessary to aspirate the syringe before depressing the plunger. Inject the vaccine over 1-2 seconds.

Rapidly withdraw the needle and apply light pressure to the injection site for several seconds with a dry cotton ball or gauze.

Figure 2.4 Intramuscular injection-correct angle and depth of insertion



Do not massage the area after injection, as this can damage the underlying tissue or force vaccine up the needle track.

Application of a plaster is not routinely recommended. Reactions to plasters may also be confused as a reaction to the vaccine. If parents request plasters, they may be used.
If some of the vaccine leaks out of the syringe during administration this is not be a valid dose. A further dose of the vaccine should be administered at a separate site at the same visit.

If a vaccine licenced for IM administration is inadvertently given SC, it may need to be repeated.

Vaccines that should be repeated if given subcutaneously

***Hepatitis B* vaccines** should usually be repeated IM if inadvertently given SC, because of reduced immunogenicity. However, some hepatitis B vaccines may be given SC in special circumstances. An example is in people with significant bleeding disorders (Section 2.4.6 and the relevant SmPCs).

***HPV* vaccines** should be repeated IM if inadvertently given SC, as that route of administration has been not studied.

***Rabies* vaccine** should be repeated IM if inadvertently given SC, as immunogenicity is sub-optimal or unknown if given SC.

If in doubt, refer to the relevant SmPC.

Vaccine providers should consider observing patients (seated or supine) for 15 minutes following administration of any vaccine to decrease the risk for injury should syncope occur.

2.6.3 Infants in a hip spica cast

Infants in a hip spica cast should ideally be vaccinated when the cast is being changed. Alternatively, vaccines may be administered using a 16mm needle

in the deltoid muscle. It is important to note that the radial nerve is more superficial in infants so the deltoid muscle should be bunched up prior to vaccine administration and only one vaccine should be given in either deltoid at any one time.

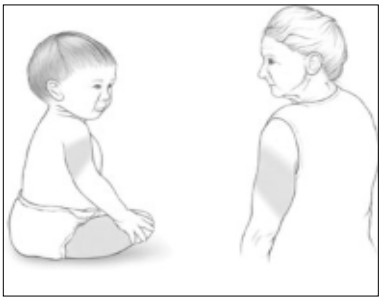
2.6.4 How to administer subcutaneous (SC) injections

Use this route for yellow fever vaccine. It may also be used for varicella and MMR vaccines and in those with severe bleeding disorders.

Site

Recommended sites for SC administration of vaccines are the anterolateral thigh, the deltoid region and the upper outer triceps region (Figure 2.5). A 16mm, 23- to 25-gauge needle should be used for all ages.

Figure 2.5 Sites for SC injection, birth to adults



If a vaccine can be administered either IM or SC (e.g. influenza, MMR, yellow fever), the IM route is preferred because it causes fewer local adverse reactions.

Table 2.7 Preferred site and needle size for subcutaneous injections

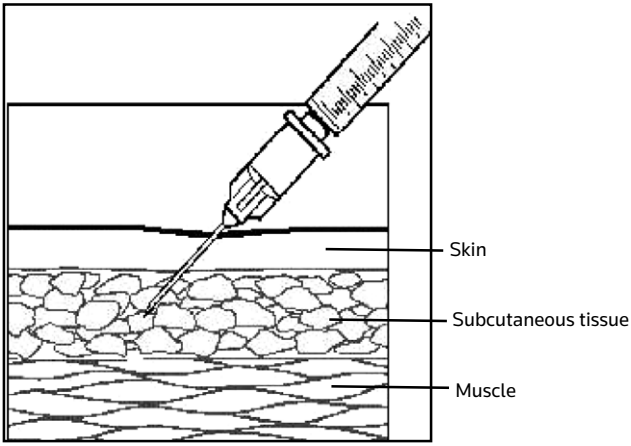
Patient's age	Site (see illustrations below)	Needle size
Birth to <12 months	Anterolateral thigh	16 mm 23-25 gauge
12 to <36 months	Anterolateral thigh or deltoid region	16 mm 23-25 gauge
3 years and older	Deltoid region	16 mm 23-25 gauge

Technique
Insert needle at 45^{0} angle to the skin (Figure 2.6)

Gently pinch up SC tissue to prevent injecting into muscle.

There is no need to aspirate prior to injection as there are no large blood vessels at the recommended injection sites.

Figure 2.6. Subcutaneous injection-correct angle and depth of insertion



2.6.5 How to administer intradermal injections

Use for BCG and Purified Protein Derivative (PPD).

Site
BCG is given as a single injection into the skin over the lower part of the left deltoid muscle (approximately one third down the lateral side of the upper arm).

PPD is generally injected into the ventral surface of the mid-forearm as a tuberculin skin test (TST) which is also known as the Mantoux test.

Local anaesthetic cream should not be applied.

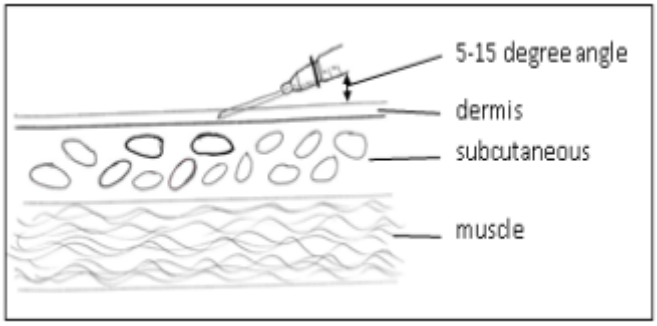
Technique
Use a 1 ml syringe with a 10-16 mm, 25-26G short-bevelled needle.

Expel all air bubbles.

Slightly stretch the skin over the injection site with thumb and index finger of the non dominant hand.

Insert the needle almost parallel (5-15^{o}) to the surface, bevel upwards, to a length of approximately 5 mm and slowly inject the dose (Figure 2.7).

Figure 2.7. Intradermal injection-correct angle and depth of insertion

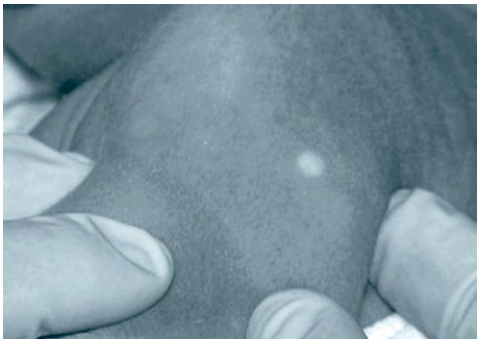


Release the stretched skin and hold the syringe in place with thumb and forefinger of your non-dominant hand. Maintain stability of limb and needle at all times.

Grip the body of the syringe between the first and middle fingers of your dominant hand. Do not aspirate. Slowly depress the plunger with your thumb. You should feel fairly firm resistance during depression.

A bleb 7-10 mm in diameter should result (~3 mm if the dose is 0.05 ml as for BCG for infants aged <12 months (Figure 2.8).

Figure 2.8. BCG intradermal injection-resulting bleb



Remove the needle. Use a cotton ball to lightly blot any blood. Do not press down or massage the area. Bandages should not be used.

If little resistance is felt when injecting and a diffuse swelling occurs rather than a tense bleb, the needle is too deep. If this occurs the needle should be withdrawn and the procedure repeated correctly at the same visit at a site at least 5 cm below the first site.
No further immunisation should be given in the arm used for BCG for at least 3 months, because of an increased risk of regional lymphadenitis.

2.7 How to hold an infant or child during immunisations

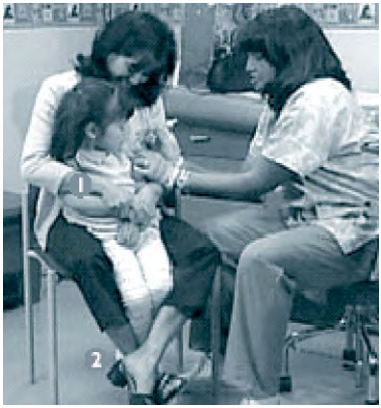
This method involves the carer embracing the child and controlling all four limbs. It avoids 'holding down' or overpowering the child, but it helps steady and control the limb of the injection site.

For infants and toddlers
Have the carer hold the child on his/her lap.

1 Inside arm against carer's chest
2 Carer's hand restrains outside arm
3 Both legs held between carer's legs

- One of the child's arms embraces the carer's back and is held by the carer's arm.
- The child's other arm is controlled by the carer's arm and hand. For infants, the carer can control both arms with one hand.
- Both legs are anchored by holding the child's lower legs firmly between the carer's thighs, and controlled by the carer's other arm

For older children



- The child is held on the carer's lap or stands in front of the seated parent.
- The carer's arms embrace the child during the process.
- Both legs are firmly between the carer's legs.

2.8 Pain reduction

The following have been shown to reduce pain from injections:

2.8.1 Distraction techniques

Age-appropriate, non-pharmacologic techniques may provide distraction from pain associated with injections. Holding by the caregiver and sitting upright may reduce pain in infants and young children. Psychological interventions such as distraction in children have been shown to be effective at reducing stress and the perception of pain from the injection. Distraction can be accomplished through a variety of techniques (e.g. playing music, books, pretending to blow away the pain, deep breathing techniques).

2.8.2 Breastfeeding or ingestion of a sweet-tasting liquid

Breast feeding and formula feeding are effective, non-costly, feasible and safe pain-reducing interventions which should be used prior to vaccinations. There is some evidence that breastfeeding can decrease the incidence of fever after immunisations.

Several studies have demonstrated a reduction in crying after injections when children 1 year or younger ingest a small amount (a few drops to half a teaspoon) of a 24-30% sugar solution just prior to an injection.

Both licensed rotavirus vaccines contain approximately 20% sucrose; if indicated, they should be administered just before recommended injections instead of a sucrose solution.

2.8.3 Order of injections

Injecting the most painful vaccine (e.g. MMR, PCV, or HPV) last when multiple injections are being administered may also decrease the pain of injections.

2.8.4 Tactile stimulation

Rubbing, stroking or applying pressure close to the injection site before and during injection may decrease pain in older children (4 years and older) and adults.

2.8.5 Administration technique

Rapid needle insertion, depressing the plunger over 1-2 seconds, and withdrawal without aspiration has been shown to reduce pain.

2.8.6 Simultaneously administering vaccines at separate sites

The evidence for or against this technique is insufficient to make a recommendation.

2.9 Antipyretics and Vaccination

Fever is a normal part of the inflammatory response, and commonly occurs after vaccination. It is associated with improved antigen recognition, increased T-cell activity and immune responses. Fever which occurs after vaccination is generally mild, benign, and self-limiting; it rarely rises above 39^{o}C.

Antipyretic drugs do not prevent febrile convulsions in at-risk children.

Either paracetamol or ibuprofen may be considered *for treatment* of a fever above 39^{o}C, for a significant reaction at the site of vaccination, or if a child remains significantly distressed.

Prophylactic use of paracetamol at the time of or closely after MenB vaccination is recommended as fever >39^{o}C may occur when MenB vaccine is given with other childhood vaccines in infancy. This has been shown to reduce the incidence and height of fever in children aged <1 year by up to 50%. *This is only recommended when MenB vaccine is given with other vaccines <1 year of age.*

Children receiving the vaccines recommended at 2 and 4 months should be given three doses of paracetamol as follows:

- Dose 1 of liquid infant paracetamol (2.5 ml /60 mg) as or just after MenB vaccine is given.
- Dose 2 (2.5 ml /60 mg) 4-6 hours after Dose 1.
- Dose 3 (2.5 ml / 60 mg) 4-6 hours after Dose 2.
- If a fever ≥39^{O}C persists a fourth dose (2.5 ml / 60 mg) may be given 4-6 hours after Dose 3.

A child weighing less than 3.5kg at their 6-week check should be reweighed at the time of vaccination. Any child weighing less than 4kg should be given paracetamol at a dosage of 15 mg /kg.

A post vaccination fever may still develop after paracetamol administration but this is usually mild and not long lasting.

Prophylactic paracetamol is not recommended after MenB vaccine at age ≥ 12 months, as the rate of fever is similar to that following other routine childhood vaccines.

There is no evidence of a decrease in the immune response when paracetamol is given with the MenB vaccine and other primary childhood immunisations

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