

02

General Immunisation Procedures

This chapter provides information on the following:

- Immunisation schedules
 - Routine childhood immunisation schedule
 - Interrupted immunisation courses
 - Late primary immunisation
 - Catch-up schedule for children aged 4 months to 10 years
 - Catch-up schedule for children aged 10 to 18 years
 - Vaccination before minimum recommended interval
 - Vaccination after the expiry date
 - Immunisation of late entrants to Irish health-care system
- Conditions that are NOT contraindications to immunisation
- Contraindications and precautions to vaccines
- Immunisation of specific groups
 - Adults
 - Intramuscular vaccination in those with bleeding disorder or on anticoagulants
 - Live vaccines and pregnancy
 - Immunocompromised children
 - Congenital (primary) immune deficiencies
 - Severe immunodeficiency
 - Moderate or non-specific immunodeficiency
 - Asplenia and hyposplenism
 - Intensive chemotherapy and bone marrow transplant recipients
 - Solid organ transplantation
 - Standard cancer chemotherapy
 - Corticosteroid therapy
 - HIV Infection
 - Vaccination of preterm infants
- Immunoglobulin
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- Specific immunoglobulins
- Live viral vaccines following immunoglobulin administration
- General guidelines for spacing the administration of killed and live antigens
- How to administer intramuscular (IM) injections
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- How to administer intradermal injections
- How to hold a child during immunisation
- Bibliography

Adrenaline should be available at all times before giving vaccines.

Immunisation Schedules

Routine childhood immunisation schedule

Table 2.1 Routine childhood immunisation schedule

Age	Immunisations	Comment
Birth	BCG	1 injection
2 months	DTaP/Hib/IPV/Hep B + PCV	2 injections
4 months	DTaP/Hib/IPV/Hep B + MenC	2 injections
6 months	DTaP/Hib/IPV/Hep B + PCV + MenC	3 injections
12 months	MMR + PCV	2 injections
13 months	MenC + Hib	2 injections ¹
4 to 5 years	DTaP/IPV + MMR	2 injections
11 to 14 years	Tdap + BCG ²	1 injection

¹ If a combined MenC/Hib vaccine is available only one injection is required.

² Only for those who are known to be tuberculin negative and have no previous BCG (see Chapter 16).

BCG	Bacille Calmette Guerin vaccine
DTaP	Diphtheria, Tetanus and acellular Pertussis vaccine
Hib	<i>Haemophilus influenzae</i> b vaccine
IPV	Inactivated Polio Virus vaccine
Hep B	Hepatitis B vaccine
PCV	Pneumococcal Conjugate Vaccine
MenC	Meningococcal C vaccine
MMR	Measles, Mumps and Rubella vaccine
Tdap	Tetanus, low-dose diphtheria and low-dose acellular pertussis vaccine

Available evidence suggests that simultaneous administration of multiple

vaccines as in the Irish schedule is not only safe and effective, but can potentially increase uptake rates by up to 17%.

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 time interval from the previous incomplete course*. With Hib and MenC vaccine, the course should be completed with the same brand of vaccine if possible. Some children for a variety of reasons may not have been immunised, or their immunisation history may be unknown or unreliable. Advice regarding vaccination of these children is provided in this chapter.

Late primary immunisation

Children who are not immunised or who are incompletely immunised and are older than the recommended age range should be immunised as soon as possible. Injections of vaccines that are not already combined by the manufacturer must be given in separate sites. It is currently recommended that PCV is not given at the same time as Hib/MenC booster. This is a precautionary measure until more data accumulates as to whether these two particular conjugate vaccines can be given at the same time without any interference between them. The number of Hib, PCV and MenC doses required depends on the child's age. Hib and DTaP are not recommended over 10 years of age and MenC is not recommended over 22 years of age.

Table 2.2 changed August 2010

Catch-up schedule for children aged 4 months to <10 years
Table 2.2 Catch-up schedule for children aged 4 months to <10 years

Vaccine	Minimum interval between doses		
	Dose 1 to Dose 2	Dose 2 to Dose 3	Dose 3 to Dose 4
BCG	1 dose only		
Diphtheria (D) Tetanus (T) Pertussis (aP) IPV Hib ¹ Hepatitis B (as a 6 in 1 vaccine)	2 months	2 months (and 4 months after first dose)	DTaP/IPV as a 4 in 1 vaccine at least 6 months and preferably 3 years after primary course
Men C	1 month, or at the age recommended in the routine childhood immunisation schedule (Table 2.1) if this is later. No further dose if any dose given aged ≥ 12 months.	2 months, or at the age recommended in the routine childhood immunisation schedule (Table 2.1) if this is later. No further dose if any dose given aged ≥ 12 months	
MMR ² (not recommended if <12 months unless at risk; see Ch.8)	1 month, or at the age recommended in the routine childhood immunisation schedule (Table 2.1) if this is later.		
PCV (not recommended if > 2 years unless at risk; see Ch. 12) ³	1 month, or at the age recommended in the routine childhood immunisation schedule (Table 2.1) if this is later. No further dose if any dose given aged ≥ 12 months	2 months, or at the age recommended in the routine childhood immunisation schedule (Table 2.1) if this is later. No further dose if any dose given aged ≥ 12 months	

1. One dose of single Hib vaccine may be given to children up to 10 years of age if this is the only vaccine they require
2. The second dose of MMR is recommended routinely at 4-5 years but may be administered earlier.

Children vaccinated before their first birthday in the case of an outbreak should have a repeat MMR vaccination at 12 months of age, at least one month after the first vaccine with a further dose at 4-5 years of age. If a child aged <18 months receives a second MMR vaccine within 3 months of the first MMR, a third MMR should be given at 4-5 years of age.

- PCV vaccine should be given to at risk children aged 24-59 months. For schedule for children at risk see detailed recommendation in Chapter 12.

Note A: This schedule may be altered in certain circumstances, e.g. during a measles outbreak.

Note B: For catch-up schedule the intervals between doses may be less than those routinely recommended in order to complete the immunisation schedule rapidly.

Catch up schedule for children aged 10 years and older and adults

Table 2.3 changed August 2010

Table 2.3 Catch up schedule for children aged 10 years and older and adults

Vaccine	Minimum interval between doses			
	Dose 1 to Dose 2	Dose 2 to Dose 3	Dose 3 to Dose 4	Dose 4 to Dose 5
BCG	1 dose only (up to 15 years of age if in low risk group or 35 years of age if in specified high risk group ¹)			
Tdap/IPV	1 month	1 month	5 years after primary course	Tdap 10 years later
Men C	1 dose only (up to 23 years of age)			
MMR	1 month			

- See Chapter 16 for specified high risk groups

Vaccination before minimum recommended interval

If a vaccine is given before the minimum interval recommended in Table 2.3, it should not be considered as part of the primary series as there may be a sub-optimal immune response. If this happens, disregard the dose and give another dose at the recommended time, at least 1 month after the disregarded dose. However, inadvertently giving a dose less than 4 days before the minimum recommended interval is unlikely to have a significantly adverse effect on the immune response to that dose.

Vaccination after the expiry date

If a vaccine is given after the last day of expiry month there may be a reduced immune response and that dose should be disregarded. A further dose should be given 1 month later. There is an increased likelihood of a local reaction following the repeat dose with diphtheria- and tetanus-containing vaccines, and parents/guardians should be informed of this.

Immunisation of late entrants to Irish health-care system

Immunisation records of children adopted from some low-income countries may not be accurate, and should be accepted with caution. Lack of protection against vaccine-preventable diseases may be due not only to erroneous records, but also to improper storage or handling of vaccines, or to immune defects such as those that can occur during severe malnutrition.

Decisions regarding whether to give or withhold vaccines are based on a number of factors, including the slight risk of over-vaccinating children. The following guidelines are based on the best available evidence:

1. BCG

BCG should be given to low risk children up to 15 years of age and specified high risk children and adults up to 35 years of age, who do not have documented evidence of BCG vaccination and who do not have a characteristic BCG scar and who are tuberculin (or interferon-gamma) negative (see Chapter 16 for indications re tuberculin test and specified risk groups).

2. Diphtheria, Tetanus, Pertussis

More than 4-5 doses of vaccines containing diphtheria, tetanus or pertussis antigens may very occasionally result in severe local (Arthus) reactions if given more frequently than recommended. If a major local or systemic reaction occurs, tetanus and diphtheria antibody levels may need to be checked. A high level indicates that subsequent doses are not necessary for at least 5 years. If a child at presentation is over 10 years of age acellular pertussis is given as appropriate.

3. Polio

Adverse reactions to IPV are extremely rare. It is recommended that 4 doses of IPV containing vaccine be given, preferably before the age of 4-6 years in keeping with the current Irish schedule.

4. Hib, Men C, Pneumococcal

Because adverse reactions are rare and because it is very unlikely that these vaccines would have been given to such children, age appropriate immunization should be given (see Table 2.2 and 2.3).

5. Hep B

A 3 dose series (as part of a 6 in 1 vaccine) may be given to unvaccinated children up to the age of 10 years. A 3-dose series of Hepatitis B vaccine may be given to children >10 years and adults who are unvaccinated, if required, as per the Irish recommendations (Chapter 6).

6. MMR

Because adverse reactions to the MMR vaccine are rare, two doses should be given at 12 months and 4-5 years of age (or at least 1 month apart if aged over 4 years) unless there is a documented history of 2 previous vaccinations. If in doubt, it is preferable to give an extra MMR vaccine. If a child aged <18 months receives a second MMR vaccine within 3 months of the first MMR, a third MMR should be given at 4-5yrs of age.

Indications on BCG added. Changes to DTP, Polio, Hep B, MMR. Update August 2010.

If there is uncertainty regarding previous vaccine history, it is preferable to give the vaccines, as the risk of lasting adverse events from administering extra doses is very small.

Conditions that are NOT contraindications to immunisation

1. Family history of any adverse reactions following immunisation.
2. Minor infections without fever or systemic upset.
3. Family or personal history of convulsions. Antipyretic measures are advisable following immunisation of children under 5 years with a family history of febrile convulsions.
4. History of pertussis, measles, rubella or mumps infection in the absence of proof of immunity.
5. Prematurity or low birth weight (defer Hep B in those under 2kg unless there is a maternal history of HBV infection).
6. Stable neurological conditions e.g. cerebral palsy.
7. Recent contact with an infectious disease.

8. Asthma, eczema, hay fever, migraine or food allergy.
9. Therapy with antibiotics or low-dose oral or locally-acting steroids.
10. Child's mother is pregnant.
11. Child being breastfed.
12. History of jaundice.
13. Child over the age recommended in immunisation schedule.
14. Recent or imminent surgery or general anaesthesia.
15. Corticosteroid replacement therapy.

Contraindications and precautions to vaccines

- Minor illness with a temperature of less than 38°C is not a reason to defer immunisation.
- Sometimes these recommendations differ from those in licensed information on the Summary of Product Characteristics (SPC).
- The benefits and risks of giving specific vaccines should be carefully considered when the events listed as precautions exist.
- When there are doubts as to whether or not to give a vaccine contact a Paediatrician or Public Health Specialist.

Table 2.4 Contraindications and precautions for specific vaccines

Vaccine	Contraindications	Precautions
General for all vaccines	Confirmed anaphylactic reaction to the vaccine or to a constituent See introduction	Moderate or severe illness; defer until recovery, unless the benefits outweigh the risks Latex allergy (see note 2 below)
DTP/DTaP/Tdap (see note 1 below)	As above (see note 1 below)	Evolving neurological conditions; defer until stable
IPV	As above	Pregnancy; give if benefits outweigh risks
MMR	As above Pregnancy	– Recent administration of blood or blood product (defer for at least 3 months) – Immune deficiency or suppression (see note 3 below) – Thrombocytopenia within 6 weeks of a previous dose (see Chapter 8)

Notes

1. Encephalopathy, temp >40.5°C, seizures, prolonged crying or hypotonic-hyporesponsive episodes following a previous dose of a whole-cell pertussis-containing vaccine have **not** been shown to result in permanent damage, are far less likely to occur following acellular pertussis vaccines, and **are no longer regarded as either precautions or contraindications.**
2. Vaccines supplied in vials or syringes containing rubber should not be used in those who had an anaphylactic reaction to latex.
3. **May need to seek medical guidance from treating physician, regarding severity of immunosuppression (see page 20).**

Immunisation of specific groups**Adults**

Adults should receive the following vaccines:

- (a) Women sero-negative for rubella: **MMR**
- (b) Women sero-negative for varicella: **varicella vaccine** (see Chapter 17)
- (c) Previously non-immunised individuals: **polio, tetanus, diphtheria and MenC (if under 23 years)** (see relevant chapters)
- (d) Individuals in specific high-risk groups: **hepatitis B, hepatitis A, MMR, Hib, MenC, influenza, pneumococcal, varicella and BCG vaccines** (see relevant chapters)
- (e) Those travelling abroad (see Chapter 19).
- (f) Those aged over 50 years: **influenza** (see Chapter 7).
- (g) Those aged over 65 years: **pneumococcal polysaccharide vaccine (PPV23)** (see Chapter 12).

Intramuscular vaccination in those with bleeding disorders or on anticoagulants

There is little published information regarding the administration of intramuscular vaccines to persons with bleeding disorders or receiving anticoagulant treatment.

If vaccines are given intramuscularly to such persons, it is prudent to use a 23-gauge needle, and to apply pressure to the vaccine site for 1-2 minutes after the injections.

Administration of vaccines by the subcutaneous route may be considered

in those with severe bleeding disorders. However, immunogenicity of vaccines recommended for IM administration may not be as long-lasting if they are given subcutaneously. The patient or parent should be advised of this.

Live vaccines and pregnancy

Live vaccines should generally not be administered to pregnant women because of the theoretical possibility of harm to the foetus. However, where there is a significant risk of exposure, the need for immunisation should be balanced against the remote possibility of risk to the foetus.

Immunocompromised children

Over the last number of years there has been an increase in the number of immunocompromised children for a number of reasons such as better survival after cancer chemotherapy and in those with chronic disease such as cystic fibrosis. There is also an increase in the number of those with dysfunctional spleens (sickle cell disease, thalassaemia major) and with HIV.

For detailed guidance regarding vaccination of immunocompromised persons, consult the Royal College of Paediatrics and Child Health document 'Immunisation of the Immunocompromised Child (2002)', at www.rcpch.ac.uk/Health-Services/Immunisation

The decision whether or not to give a vaccine to such children must be made on an individual basis, and the risks and benefits carefully weighed. It is important to realise that the extent of immunocompromise can vary over time, as in those recovering from chemotherapy and those with HIV infection. The following, therefore, are to be regarded as guidelines.

Congenital (primary) immune deficiencies

Persons with B lymphocyte (humoral) defects or complement deficiencies are susceptible to infection with encapsulated bacteriae, especially *Strep. pneumoniae*, *Haemophilus influenzae* type b, *N. meningitidis*, and also to enteroviruses. Those with T-lymphocyte (cell-mediated immunity) defects are susceptible to most viruses and to a number of intracellular bacteria, fungi and parasites.

Severe immunodeficiency

This group includes severe combined immunodeficiency (SCID), X-linked agammaglobulinaemia, and some children with Di-George syndrome (the degree of immune compromise in Di-George syndrome is very variable, with many only having relatively minor impairment). They can be given

non-live vaccines. Some can receive MMR, but they should not be given BCG.

Moderate or non-specific immunodeficiency This group includes IgA and IgG subclass deficiencies, chronic neutropaenia, chronic granulomatous disease, and complement deficiency diseases. These children should be given all routine vaccines, including MMR. They should also be given pneumococcal and influenza vaccines. Those with complement deficiencies should get meningococcal ACW₁₃₅Y vaccine.

In addition to vaccination as recommended in this section, persons with these conditions who intend travelling abroad should be vaccinated as recommended in Chapter 19.

Asplenia and hyposplenism

This may be congenital, post-surgical or functional (sickle cell disease, thalassaemia major, storage disorders, coeliac disease etc.) Such persons are at risk of infection caused by encapsulated bacteria (*Strep. pneumoniae*, *Hib*, *Meningococci*, etc.)

Children with these conditions can receive all routine childhood vaccines. In addition they should be given conjugated pneumococcal vaccine (PCV) up to the age of 5 years and polyvalent pneumococcal vaccine (PPV) over the age of 2 years (see Chapter 12). They should be re-immunised with this after a period of 5 years and should also be given long-term penicillin prophylaxis. They should also get annual influenza vaccine.

Adults with asplenia should receive PPV, Hib and MenC vaccines, and annual influenza vaccine.

Intensive chemotherapy and bone marrow transplant recipients

It is likely that all those who receive an allogenic or autologous marrow transplant lose some or all of their natural and vaccine-derived immunity against vaccine-preventable diseases. Therefore such persons should be fully revaccinated with all age-appropriate vaccines.

Inactivated vaccines should be deferred for at least 12 months after bone marrow transplant, and at least 6 months after immunosuppressive treatment has been stopped; even then immune response may be sub-optimal.

Those with graft versus host disease should not be vaccinated if they are

receiving Intravenous Immunoglobulin (IVIG).

Live vaccines should be deferred for up to 2 years, and then given only if there is no graft versus host disease or ongoing immunosuppressive treatment.

Solid organ transplantation

Prior to surgery children should be up-to-date with routine primary and booster vaccination. Varicella vaccine should be given to non-immune persons. Those having haemodialysis prior to renal transplant should be given hepatitis B vaccine if they are unvaccinated.

After transplant, the routine schedule should continue. Pneumococcal (PPV or PCV depending on age – see Chapter 12) and annual influenza vaccines should be given.

Standard cancer chemotherapy

The degree of immune compromise varies depending on the disease and the treatment. It is often not possible to give a definite recommendation regarding when to give vaccines after such treatment has been completed.

During treatment, non-live vaccines should be given according to the schedule, as long as the child is free from infection and major organ toxicity, and is likely to remain so for 3 weeks.

Six months after treatment, a booster of DTaP/IPV/Hib, MenC, and MMR should be given. (Give Tdap if child is over 10 years of age.)

Live vaccines generally should be withheld for at least 6 months. However, the interval may vary depending on the type and intensity of immunosuppressant treatment, radiation treatment, underlying disease etc. An adequate immune response to inactivated vaccines should occur between 3 and 12 months post-treatment.

Corticosteroid therapy

The minimum amount and the duration of administration of systemic corticosteroids sufficient to cause immune suppression are not well defined. The following are empiric guidelines for administration of **live** virus vaccines to previously healthy persons receiving steroid therapy for non-immunocompromising conditions:

1. Topical (skin or inhaled) or locally injected steroids do not usually cause immunosuppression, so live vaccines are not contraindicated.
2. Children receiving less than 2 mg/kg/day of prednisolone or its equivalent can be given live viral vaccines during treatment.
3. Children getting more than 2 mg/kg/day of prednisolone or its equivalent, or more than 20 mg per day *for under 2 weeks*, can be given live viral vaccines immediately after treatment is stopped.
4. Children getting over 2 mg/kg/day of prednisolone or its equivalent, or more than 20 mg/day, for *more than 2 weeks*, and those getting 1 mg/kg/day for over 1 month should not receive live viral vaccines for at least 3 months after treatment has been stopped.
For adults the equivalent dose of prednisolone is 40 mg or more per day for more than 2 weeks.
5. For those receiving combination immunosuppressant therapy, such as corticosteroids and methotrexate, live viral vaccines should be deferred for 6 months after stopping treatment.
6. Inactivated vaccines can be given when due, but immune response may be sub-optimal.

HIV infection

Active immunisation of HIV-positive persons

HIV-infected individuals, whether symptomatic or asymptomatic, should be immunised with all inactivated vaccines recommended in the primary vaccine schedule. Pneumococcal conjugate and polysaccharide vaccines should be given as recommended in Chapter 12. Yearly influenza vaccine beginning at 6 months of age is also recommended.

MMR vaccine should be given at 12-14 months of age to HIV-infected children unless they are severely immunocompromised. The second dose should be given 1-2 months later, in order to ensure seroconversion as early as possible.

Varicella vaccine should be considered for asymptomatic or mildly symptomatic children with CD4 counts above 25%.

Since the immune response of HIV-infected children to all vaccines may be inadequate, these children may be susceptible to vaccine-preventable diseases even if they have been vaccinated. Hence, chemoprophylaxis

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or immunoglobulin treatment should be considered in the event of exposure to these diseases.

Table 2.5 Vaccination of those who are HIV positive

Vaccine	Asymptomatic HIV infection	Symptomatic HIV infection
Diphtheria, tetanus, pertussis, polio	Yes	Yes
MMR	Yes	Yes
Haemophilus	Yes	Yes
Meningococcal	Yes	Yes
PPV, PCV	Yes	Yes
Influenza	Yes	Yes
Hepatitis A and B	Yes	Yes
Varicella	Yes	Yes if CD4 >25%
BCG ^{1, 2}	No	No
OPV ¹	No	No
Yellow fever ¹	No	No

¹There is insufficient evidence at present to recommend the use of OPV, yellow fever or BCG in symptomatic HIV-infected individuals.

²See Chapter 16 re HIV and BCG.

Passive immunisation of individuals with HIV infection

Measles

Vaccine efficacy may be reduced in HIV-positive individuals. Human Normal Immunoglobulin (HNIG) may be used for susceptible symptomatic and asymptomatic HIV-positive individuals after exposure to measles if the response to vaccination has not been documented or is inadequate.

Tetanus

In the management of wounds classified as tetanus prone, HIV-positive individuals should receive Tetanus Immune Globulin (TIG) if the response to vaccination has not been documented or is inadequate.

Varicella

- Asymptomatic HIV-positive individuals do **not** require Human Varicella-Zoster Immunoglobulin (VZIG) after contact with chickenpox since there is no evidence of increased risk of serious illness in these individuals.

- (b) Symptomatic HIV-positive individuals should be given VZIG after contact with chickenpox unless they are known to have varicella-zoster antibodies.

Vaccination of preterm infants

Preterm infants are more vulnerable when exposed to infections, particularly pertussis – 30% of pertussis deaths in the USA occur in preterm infants. Therefore, routine vaccines should be started at 8 weeks post-natal age in preterm infants of any gestational age. If the infant is still in hospital, the first 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 who have been discharged from hospital.

When compared with infants born at term, there is less of a rise and a more rapid decline in antibody levels following vaccination of preterm infants. However, there may be less interference from maternal antibodies in this group of infants, 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. However, if a mother is HBsAg positive, her infant should be given the HepB vaccine at birth and further doses (as 6-in-1 vaccine) at 2, 4 and 6 months of age.

BCG vaccine should be given to preterm infants prior to discharge from hospital.

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

There is a lack of information regarding the effects of antenatal steroids on the immune response of preterm infants. Such infants should be vaccinated according to the current schedule.

Immunoglobulin

Human Normal Immunoglobulin (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).

Human Normal Immunoglobulin (HNIG) for intramuscular use

It usually contains antibodies to varicella, hepatitis A and other viruses currently prevalent in the population. HNIG is available in 2, 5 and 10 ml vials. It is given by deep intramuscular injection. It should be stored at 2-8°C and the expiry date on the package observed. Unused portions of an ampoule must be discarded. As recipients of intramuscular immunoglobulin can experience local pain and discomfort at the injection site, it should be administered deep into a large muscle mass, such as the gluteus maximus. Ordinarily, no more than 5 ml should be administered at any one site.

Intramuscular HNIG should not be administered to any patient with severe thrombocytopenia or with a coagulation disorder. Caution should be exercised with any patient who has a history of adverse experience following HNIG administration.

Indications for use of HNIG include post-exposure prophylaxis or modification of hepatitis A infection and post-exposure modification of measles infections (see Chapters 5 and 8).

HNIG may interfere with the immune response to live viral vaccines; these should not therefore be given from 3 weeks before to at least 3 months after an injection of HNIG. Yellow fever vaccine is an exception, as HNIG obtained from donors is unlikely to contain antibody to this virus; a similar situation applies to Oral Polio Virus vaccine when given as a booster dose.

The vaccine and HNIG should be given in different limbs. If indicated, vaccination should be repeated approximately 3 months later.

Specific immunoglobulins

At present specific immunoglobulins are available for administration following exposure to tetanus, hepatitis B, rabies* and varicella-zoster virus. They are prepared from the pooled plasma of blood donors who have high antibody titres to specific infections. Recommendations for their use are found in the relevant sections.

When medicinal products prepared from human blood or plasma are administered, infectious diseases due to the transmission of infective agents cannot be totally excluded. This applies also to pathogens of hitherto unknown origin and pathogens as yet unidentified.

* At present available from Cherry Orchard Hospital

To reduce the risk of transmission of infective agents, stringent controls are applied to the selection of blood donors and donations. In addition, virus removal and/or inactivation procedures are included in the production process.

The current procedures applied in the manufacture of medicinal products derived from human blood or plasma are effective against enveloped viruses such as HIV, hepatitis B and hepatitis C viruses, and non-enveloped viruses.

Live viral vaccines following immunoglobulin administration

Live viral vaccines, with the exception of yellow fever and BCG vaccine (see below and Chapter 16), should not be given for at least 3 months following injection of immunoglobulin because the immune response may be inhibited.

BCG vaccine

Administration of blood or plasma transfusions, hepatitis B vaccine, hepatitis B immunoglobulin and normal immunoglobulin are thought not to reduce the effectiveness of BCG vaccine. A baby who has received blood or plasma transfusions can be subsequently immunised with BCG, after the observation period for transfusion reactions has ended (24 hours).

General guidelines for spacing the administration of killed and live antigens

The following table shows the recommended minimum intervals between vaccine doses.

Table 2.6 Recommended minimum interval between vaccine doses

Antigen combination	Recommended minimal interval between doses
≥2 killed antigens	No minimum; may be administered simultaneously or at any interval between doses
Killed and live antigens	No minimum; may be administered simultaneously or at any interval between doses
≥2 live antigens	Four-week minimum interval if not administered simultaneously; however, oral polio vaccine (OPV) can be administered at any time before, with or after other live vaccines.

Specific contraindications to individual vaccines are given in the relevant sections and must be observed.

How to administer intramuscular (IM) injections

This route is used for the majority of vaccines. For individual vaccines see relevant chapters.

Needle insertion

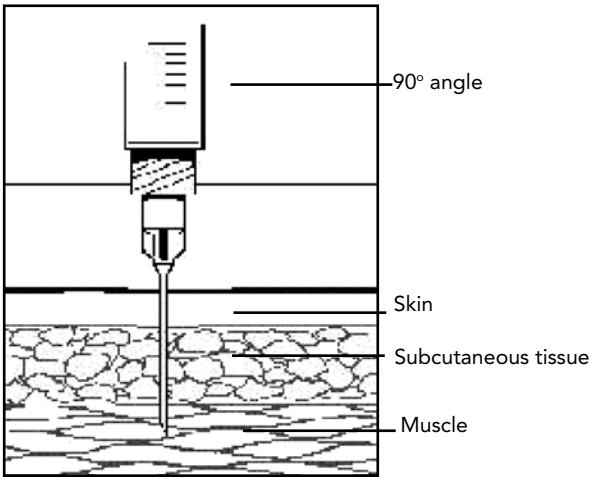
Giving an infant a carbohydrate-containing drink 1-2 minutes before injection reduces the pain of insertion.

- Insert needle at a 90° angle to the skin. The tissue around the injection site may be bunched up in young infants.
- Retain pressure on skin around injection site with thumb and index finger while needle is inserted.
- It is not necessary to aspirate before injecting, as there are no large blood vessels at the preferred injection sites.
- Multiple injections given in the same limb should be separated by at least 2.5 cm.

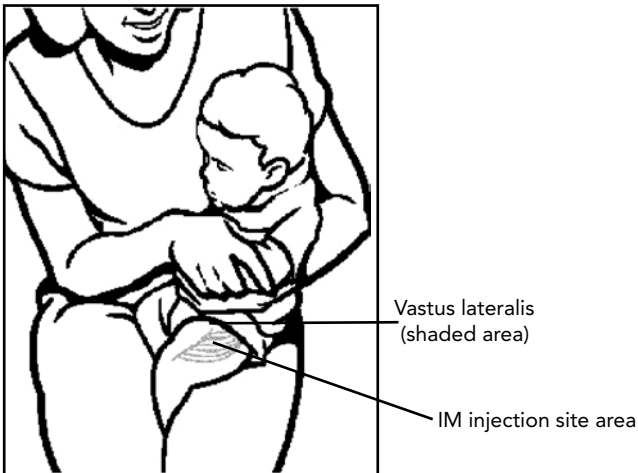
Table 2.7 Recommendations regarding preferred site and needle size for intramuscular injections

Patient's age	Site (see illustrations below)	Needle size
Birth to 12 months*	Vastus lateralis muscle in anterolateral aspect of mid- or upper thigh	25 mm needle 23-25 gauge
12 to 36 months	Vastus lateralis or deltoid muscle	25 mm needle 23-25 gauge
From 3 years upwards*	Densest portion of deltoid muscle – between acromion and muscle insertion	25 mm needle 23-25 gauge

*Note: Use a 16 mm length needle in infants under 2.5-3 kg. Use 38 mm length needle in women >90 kg, men >118 kg.

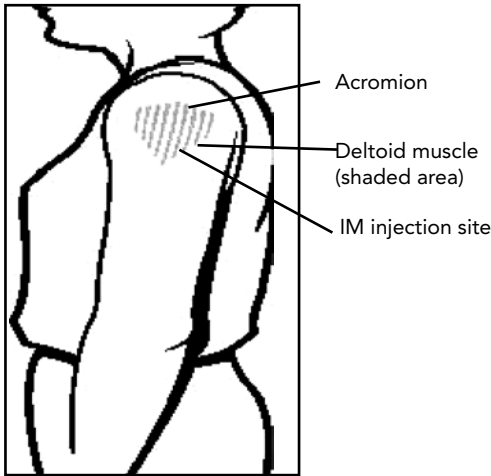


IM site for infants and toddlers (birth to 36 months of age)



Insert needle at 90° angle into anterolateral aspect of middle or upper thigh.

IM site for older toddlers, children and adults



Insert needle at 90° angle into densest portion of deltoid muscle
– between acromion and insertion.

How to administer subcutaneous (SC) injections

Use this route for varicella and yellow fever vaccines.

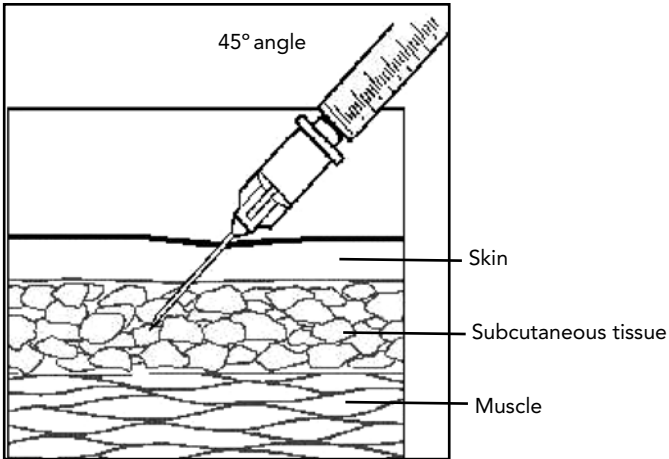
Table 2.8 Recommendations regarding preferred site and needle size for subcutaneous injections

Patient's age	Site (see illustrations below)	Needle size
Infants (birth to 12 months of age)	Fatty area of the Anterolateral thigh	16 mm needle 23-25 gauge
Toddlers (12 to 36 months of age)	Fatty area of the anterolateral thigh or triceps region	16 mm needle 23-25 gauge
Children and adults	Triceps region	16 mm needle 23-25 gauge

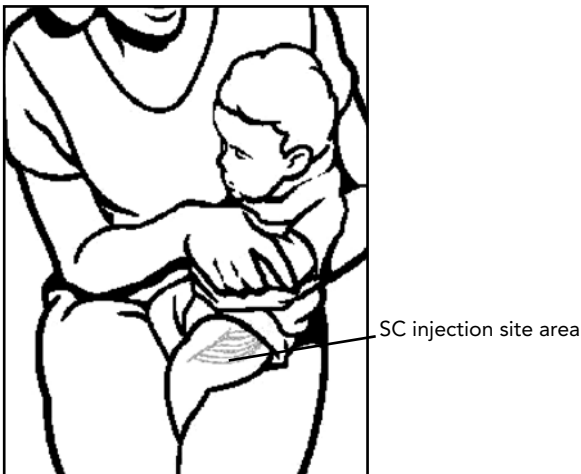
Needle insertion

Insert needle at 45° angle to the skin

- Pinch up on SC tissue to prevent injection into muscle.
- There is no need to aspirate prior to injection as there are no large blood vessels at the preferred injection sites.
- Multiple injections given in the same limb should be separated by at least 2.5cm.

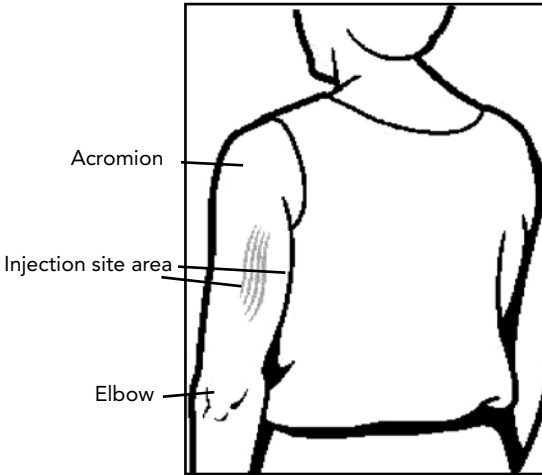


SC site for infants and toddlers (birth to 36 months of age)



Insert needle at 45° angle into fatty area of anterolateral thigh. Pinch up skin to prevent injection into muscle.

SC site for toddlers, children and adults



Insert needle at 45° angle into outer aspect of upper arm. Pinch up skin to prevent injection into muscle.

How to administer intradermal injections

Use for BCG and tuberculin PPD (Mantoux).

Site:

The BCG is given into the skin at one site over the distal insertion of the deltoid muscle (approx. one third down the upper arm); tuberculin is generally injected into the ventral surface of the forearm

Technique:

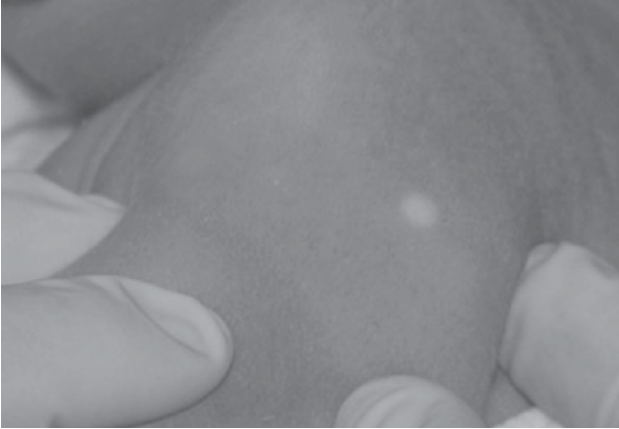
A 1 ml syringe with a 10-16 mm, 25-26G short-bevelled needle is used for BCG. A 1 ml tuberculin syringe can also be used for the Mantoux test. All air bubbles are removed. The skin is slightly stretched with thumb and index finger of one hand. The needle is inserted almost parallel to the surface, with the bevel upwards, to a length of approx. 5 mm and the dose is slowly injected.

A bleb 7-10 mm in diameter should result (3 mm if the dosage is 0.05 ml as for neonatal BCG). 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:

- for BCG the needle should be withdrawn and the same needle reinserted intradermally at a site at least 5 cm away
- for Mantoux the test should be repeated at least 5 cm away from the first injection.

No further immunisation should be given in the arm used for BCG immunisation for at least 3 months because of the risk of regional lymphadenitis.

BCG intradermal injection



How to hold a child during immunisation

This method involves the parent/carer in 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 parent hold the child on parent's lap.



1. One of the child's arms embraces the parent's back and is held under the parent's arm.
2. The other arm is controlled by the parent's arm and hand. For infants, the parent can control both arms with one hand.
3. Both legs are anchored with the child's feet held firmly between the parent's thighs, and controlled by the parent's other arm.

For older children

Hold the child on parent's lap or have the child stand in front of the seated parent.



1. Parent's arms embrace the child during the process.
2. Both legs are firmly between parent's legs.

Analgesia, Antipyretics and Vaccines

Fever is a normal part of the inflammatory response, and is well-known to occur after vaccination. It is associated with improved antigen recognition, increased T-cell activity and immune responses. Fever which occurs after vaccination is generally benign and self-limiting; it rarely rises above 39.5°C. When fever does occur after vaccination it can cause concern in parents and health-care professionals, who fear it is a pathological reaction, and that it may cause a febrile convulsion.

Prophylactic use of antipyretics such as paracetamol and ibuprofen, at or shortly after vaccination, has become common. A study has shown a substantial reduction in the primary antibody responses to all serotypes of PCV 10 and to Hib, diphtheria, tetanus and pertactin antigens of concurrently administered Hib and DTaP vaccines in those given prophylactic paracetamol at the time of vaccination. It is likely that this reduction in the immune response is due to interference with the inflammatory response at the injection site. It is known that ibuprofen can interfere with such a local response, although no studies similar to the referenced study have been carried out with Ibuprofen. Antipyretic drugs do not prevent febrile convulsions in at-risk children.

A study has demonstrated an analgesic effect with the use of sweet solutions (sucrose or glucose) immediately prior to vaccination in infants between 1 and 12 months of age.

In light of the above it is recommended that:

1. Prophylactic antipyretics should not routinely be given at the time of vaccination. Either paracetamol or ibuprofen may be considered for treatment of fever $>39.5^{\circ}\text{C}$ or for a significant reaction at the site of vaccination.
2. Parents or vaccinators should consider administering glucose or sucrose solutions of 24-30% or greater concentration to infants immediately before vaccination.

Information on Analgesia, Antipyretics and Vaccines added August 2010.

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