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. See relevant chapters for details on individual vaccines.

Immunisation of immunocompromised persons is dealt with in Chapter 3.

This chapter provides information on the following:

- Immunisation schedules
  - Routine childhood immunisation schedule
  - Interrupted immunisation courses
  - Optimal and minimum recommended ages for vaccinations and intervals between vaccine doses
  - Vaccination before minimum recommended age or interval
  - Vaccination after the expiry date
  - Delayed immunisation / late entrants to Irish health-care system

- Contraindications and precautions for vaccination

- Conditions that are NOT contraindications to immunisation

- Immunisation of specific groups
  - Adults
  - Persons with bleeding disorder or on anticoagulants
  - Vaccination and anaesthesia or surgery
  - Preterm infants

- Immunoglobulin
  - Human Normal Immunoglobulin (HNIG)
  - Specific immunoglobulins
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• Blood products
• Guidelines for the time interval between killed and live antigens
• Vaccine preparation
• How to administer oral vaccines
• How to administer intramuscular injections
• 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
• Analgesia, antipyretics and vaccines

Epinephrine should be available at all times when giving vaccines.

Immunisation Schedules
Table 2.1 Recommended Childhood Immunisation schedule 2016

<table>
<thead>
<tr>
<th>Age</th>
<th>Immunisations</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>BCG*</td>
<td>1 injection</td>
</tr>
<tr>
<td>2 months</td>
<td>DTaP/Hib/IPV/Hep B + MenB + PCV + Rotavirus</td>
<td>3 injections + oral vaccine</td>
</tr>
<tr>
<td>4 months</td>
<td>DTaP/Hib/IPV/Hep B + MenB + Rotavirus</td>
<td>2 injections + oral vaccine</td>
</tr>
<tr>
<td>6 months</td>
<td>DTaP/Hib/IPV/Hep B + PCV + MenC (+ Rotavirus)</td>
<td>3 injections + oral vaccine</td>
</tr>
<tr>
<td>12 months</td>
<td>MMR + MenB</td>
<td>2 injections</td>
</tr>
<tr>
<td>13 months</td>
<td>Hib / MenC/ + PCV</td>
<td>2 injections</td>
</tr>
<tr>
<td>4 - 5 years</td>
<td>DTaP/IPV** + MMR</td>
<td>2 injections</td>
</tr>
<tr>
<td>12-13 years</td>
<td>Girls HPV (2 doses 6 months apart) Tdap , MenC</td>
<td>4 injections</td>
</tr>
<tr>
<td></td>
<td>Boys Tdap, MenC</td>
<td></td>
</tr>
</tbody>
</table>

* BCG vaccine not available since May 2015
** dTap/IPV can be given if DTaP/IPV is not available

DTaP  Diphtheria, Tetanus and acellular Pertussis vaccine
Hib  Haemophilus influenzae b vaccine
IPV  Inactivated Polio Virus vaccine
Hep B  Hepatitis B vaccine
HPV  Human Papillomavirus vaccine
MenB  Meningococcal B vaccine
MenC  Meningococcal C vaccine
MMR  Measles, Mumps and Rubella vaccine
PCV  Pneumococcal Conjugate Vaccine
Rotavirus  Rotavirus oral vaccine (2 or 3 dose schedule)
Tdap  Tetanus, low-dose diphtheria and low-dose acellular pertussis vaccine
Simultaneous administration of multiple vaccines is safe, effective and can significantly increase uptake rates.

Unless the Summary of Product Characteristics (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 different sites.

**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 except cholera vaccine (see Chapter 5). The course should be completed with the same brand of vaccine if possible.

**Optimal and minimum recommended ages for vaccinations and intervals between vaccine doses**

The optimal recommended ages and intervals shown in Table 2.2 provide the best immune response. Every effort should be made to comply with the recommended ages and intervals.

However in exceptional circumstances (such as imminent international travel, measles outbreak) it may be necessary to provide one or more vaccines at less than the optimal age or intervals. In these instances the minimum recommended age and intervals as shown in Table 2.2, Chapters 5 and 12 can be used. *This accelerated schedule should not be used routinely and remaining doses should be given at recommended intervals to ensure the best protection.*

**Vaccination before minimum recommended age or interval**

If a vaccine is given before the minimum age or interval recommended, it should not be considered as part of the primary series as there may be a sub-optimal immune response. The dose should be disregarded and another dose given at the recommended time, at least 1 month after the disregarded dose. However, giving a dose 4 days or less (the “four day rule”) before the minimum age or interval is unlikely to have a significant adverse effect on the immune response to that dose, and does not need to be repeated. The 4 day rule should not be used for Rabies and Japanese Encephalitis vaccines because of their schedules (1, 7, 28 days) or the accelerated Hepatitis B schedule (0, 7, 21 days + 12 months).
### Table 2.2 Optimal and Minimum recommended ages and intervals between doses of the Primary Childhood Schedule

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Dose 1: Optimal age</th>
<th>Dose 1: Minimum age</th>
<th>Dose 1 to Dose 2: Optimal interval</th>
<th>Dose 1 to Dose 2: Minimum interval</th>
<th>Dose 2 to Dose 3: Optimal interval</th>
<th>Dose 2 to Dose 3: Minimum interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP, Hib Hepatitis B (as 6 in 1 vaccine)</td>
<td>2 months</td>
<td>6 weeks</td>
<td>2 months</td>
<td>4 weeks</td>
<td>2 months (and 4 months after Dose 1)</td>
<td>8 weeks (and 16 weeks after Dose 1)</td>
</tr>
<tr>
<td>MenB</td>
<td>2 months</td>
<td>6 weeks</td>
<td>2 months</td>
<td>4 weeks</td>
<td>2 months (and over 12 months of age)</td>
<td>8 weeks</td>
</tr>
<tr>
<td>Men C</td>
<td>6 months</td>
<td>6 weeks</td>
<td>2 months (and over 12 months of age)</td>
<td>4 weeks (and over 12 months of age)</td>
<td>&gt; 2 years</td>
<td>8 weeks</td>
</tr>
<tr>
<td>MMR</td>
<td>12 months</td>
<td>6 months¹</td>
<td>1 month</td>
<td>4 weeks²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCV</td>
<td>2 months</td>
<td>6 weeks</td>
<td>2 months</td>
<td>4 weeks</td>
<td>2 months</td>
<td>8 weeks (and over 12 months of age)</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>2 months</td>
<td>6 weeks</td>
<td>2 months</td>
<td>4 weeks</td>
<td>2 months</td>
<td>4 weeks (and less than 8 months 0 days of age)</td>
</tr>
</tbody>
</table>

¹ Children can be vaccinated with MMR before their first birthday 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 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. 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.
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.

Delayed immunisation / late entrants to Irish health-care system
Children and adults who are not immunised or who 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.

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

In the absence of reliable information/documentation to the contrary children should be assumed to be unimmunised and started on a catch up programme.

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

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 may help decision making: (For more details see Table 2.3)

1. BCG
BCG should be given to low risk children up to 15 years of age and high risk children and adults up to 35 years of age, who:
   a. do not have documented evidence of BCG vaccination and
   b. do not have a characteristic BCG scar and
   c. are tuberculin or interferon gamma negative
2. Diphtheria and Pertussis
If a child is aged 10 years or more low-dose diphtheria and pertussis containing vaccines should be used.

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 6.

4. Hib
Hib vaccine should be given to unvaccinated children up to 10 years of age. A single dose of Hib vaccine can be given if this is the only vaccine that is required.

5. Hepatitis B
A 3 dose series may be given to unvaccinated children up to the age of 10 years and to at-risk persons aged 10 years and older at 0, 1 and 6 month intervals.

6. Meningococcal C
Unvaccinated persons aged 1 to < 10 years require 1 dose, with a booster dose at 13 years of age.

A child who has had a MenC conjugate containing vaccine (MenC or MenACWY) at 10 years or older does not need an adolescent booster.

Those aged 13 years to <23 years require a single dose of MenC vaccine if they have not been previously vaccinated.

7. MMR
Two doses should be given, the first dose ideally 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.

8. Pneumococcal
A single dose of pneumococcal conjugate vaccine should be given to unvaccinated children between 1 and 2 years of age.
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**Table 2.3: Catch-up schedule for children and adults**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>4 months to &lt;12 months</th>
<th>1 to &lt; 4 years</th>
<th>4 to &lt;10 years</th>
<th>10 to &lt;18 years</th>
<th>18 years and older</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BCG</strong></td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose (up to 15 years of age if in low risk group or up to 35 years of age if in high risk group)</td>
<td>1 dose (up to 35 years of age if in high risk group)</td>
</tr>
<tr>
<td><strong>6 in 1 (DTaP/IPV/Hib/Hep B)</strong></td>
<td>3 doses</td>
<td>2 doses</td>
<td>3 doses</td>
<td>2 doses</td>
<td>2 doses</td>
</tr>
<tr>
<td></td>
<td>2 months apart</td>
<td>2 months apart</td>
<td>2 months apart</td>
<td>2 months apart</td>
<td>2 months apart</td>
</tr>
<tr>
<td><strong>Men C</strong></td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose (if given after 10 years of age, adolescent MenC booster not required)</td>
<td>1 dose (up to 23 years of age)</td>
</tr>
<tr>
<td><strong>PCV</strong></td>
<td>2 doses</td>
<td>1 dose</td>
<td>2 doses</td>
<td>2 doses</td>
<td>2 doses</td>
</tr>
<tr>
<td></td>
<td>2 months apart</td>
<td>2 months apart</td>
<td>2 months apart</td>
<td>2 months apart</td>
<td>2 months apart</td>
</tr>
<tr>
<td><strong>MMR</strong></td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose</td>
<td>1 dose</td>
</tr>
<tr>
<td></td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
</tr>
<tr>
<td><strong>Tdap/IPV</strong></td>
<td>3 doses</td>
<td>1 dose</td>
<td>3 doses</td>
<td>3 doses</td>
<td>3 doses</td>
</tr>
<tr>
<td></td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
</tr>
<tr>
<td><strong>Td/IPV</strong></td>
<td>1 month after Tdap/IPV</td>
<td>2 doses</td>
<td>2 doses</td>
<td>2 doses</td>
<td>2 doses</td>
</tr>
<tr>
<td></td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
<td>1 month apart</td>
</tr>
</tbody>
</table>

**NOTE**

- Continue with routine childhood immunisation schedule from 12 months.
- Continue with routine school immunisations [4 in 1 (DTaP/IPV) at least 6 months and preferably 3 years after primary course, MMR at least 1 month after previous dose].
- Boosters of Tdap/IPV 5 years after primary course and Tdap 10 years later
- Only one dose of Tdap/IPV is required due to likely previous exposure to pertussis infection
- For healthcare workers born in Ireland since 1978 or born outside Ireland; for contacts in outbreaks born in Ireland since 1978 or born outside Ireland; for contacts in outbreaks born in Ireland since 1978 or born outside Ireland.
- Children vaccinated at 12 months of age or at least one month after the first vaccine with a further dose at 4-5 years of age. If a child aged 4-5 years of age is not vaccinated at 1 year of age, a second dose of MMR should be given at 4-5 years of age. A second dose of MMR is recommended routinely at 4-5 years, but may be administered from 18 months of age. Children vaccinated before their first birthday should have a repeat dose.
- Unless at increased risk

---

1. One dose of single Hib vaccine may be given to children over 12 months of age and up to 10 years of age if this is the only vaccine they require.
2. Unless at increased risk
3. The second dose of MMR is recommended routinely at 4-5 years, but may be administered from 18 months of age. Children vaccinated before their first birthday should have a repeat dose.
4. For healthcare workers born in Ireland since 1978 or born outside Ireland; for contacts in outbreaks born in Ireland since 1978 or born outside Ireland.
5. Only one dose of Tdap/IPV is required due to likely previous exposure to pertussis infection.
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Catch up schedule by age

4 months to <12 months of age
1 dose of BCG
3 doses of 6 in 1 (DTaP/IPV/Hib/Hep B) at 2 month intervals
2 doses of MenC at 2 month intervals
2 doses of PCV at 2 month intervals
Continue with routine childhood immunisations from 12 months of age

12 months to <4 years of age
1 dose of BCG
3 doses of 6 in 1 (DTaP/IPV/Hib*/Hep B) at 2 month intervals
*1 dose of Hib may be given if this is the only vaccine that is required
1 dose of MenC
1 dose of PCV (omit if >2 years of age unless at increased risk)
1 dose of MMR
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
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

4 – <10 years of age
1 dose of BCG
3 doses of 6 in 1 (DTaP/IPV/Hib*/HepB) at 2 month intervals
*1 dose of Hib may be given if this is the only vaccine that is required
2 doses of MMR separated by at least one month.
1 dose of MenC
Continue with routine school immunisations
• Booster of DTaP/IPV at least 6 months and preferably 3 years after the primary course

10 - <18 years of age
1 dose of BCG (up to 15 years of age if in low risk group or 35 years of age if in specified high risk group, see Chapter 22)
3 doses of Tdap/ IPV at 1 month intervals
2 doses of MMR separated by at least one month
1 dose of MenC (up to 23 years of age)
Booster doses of Tdap/IPV 5 years after the primary course and Tdap 10 years later

18 years and older
1 dose of BCG (up to 35 years of age if in specified high risk group, see Chapter 22)
1 dose of Tdap/ IPV followed 1 month later by 2 doses of Td/IPV at 1 month intervals

1 dose of MenC (up to 23 years of age)

Routine physical examination and procedures (e.g. measuring temperatures) are not prerequisites for vaccinating persons who appear to be healthy. The vaccinator should ask if the proposed recipient is ill and the vaccination should be postponed if there is an acute severe illness.

Contraindications and precautions to vaccines

The risks of not giving specific vaccines should be carefully considered when the events listed as precautions exist. When there are doubts whether or not to give a vaccine contact a relevant specialist.

Contraindications

- All vaccines: 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 after 8 months 0 days of age (see Chapter 19).
  Pregnancy.
  Some immunocompromising conditions due to disease or treatment (see Chapter 3).

Precautions

- Acute severe febrile illness: defer until recovery.

- Immunoglobulin administration may impair the efficacy of MMR and varicella vaccines (see Chapters 12, 15, 20 and 23).

- Topical immunomodulators (Tacrolimus e.g. Protopic etc.) Concern for potential systemic absorption resulting in possible immune suppression has led to caution with regard to the administration of live vaccines in this setting with some avoiding live vaccines for up to 28 days before initiation and after cessation of topical tacrolimus (see Chapter 3).
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- 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 begin 2-8 hours after vaccination, is more common in adults and resolves without sequelae within a week.

Persons experiencing such a reaction 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 initial dose in the primary infant series in a child younger than 6 months, it is likely due to high levels of maternal antibodies. Subsequent doses should be deferred until the child is 6 months, when circulating maternal antibodies will be greatly reduced.

Conditions that are NOT contraindications to immunisation
1. Family history of adverse reaction following immunisation.
2. Minor infections with fever <38°C.
3. Family or personal history of convulsions.
4. History of vaccine-preventable infection.
5. Prematurity or low birth weight (defer Hepatitis B vaccine in those under 2kg until 1 month of age 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. Corticosteroid treatment
   a) short term (<14 days)
   b) long-term with less than 20mg/day (0.5mg/kg/day in children <40kgs) or equivalent
   c) long-term, alternate-day treatment with short-acting preparations
   d) maintenance physiologic doses (replacement therapy)
   e) topical (skin or eyes), or by inhalation
   f) intra-articular, bursal, or tendon injection.
9. Low dose methotrexate (< 0.4 mg/kg/week), azathioprine (<3.0 mg/kg/day) or 6-mercaptopurine (<1.5 mg/kg/day).
10. Asthma, eczema, hay fever, or food allergy.
11. Therapy with antibiotics.
12. Child’s mother is pregnant.
13. Child being breastfed unless the mother is on immune modulators.
15. Recent or imminent surgery or general anaesthesia (see below).

**Immunisation of specific groups**

1. **Adults (see relevant chapters)**
The following groups of adults should receive the vaccines listed below:

   a) Women of childbearing age
      - seronegative for rubella: MMR vaccine (unless documented evidence of having received 1 previous MMR vaccine)
      - seronegative for varicella: varicella vaccine.

   b) Pregnant women
      - Pertussis vaccine early as possible after 16 weeks (and before 36 weeks) gestation in each pregnancy.
      - Seasonal inactivated influenza vaccine at any stage of pregnancy.
      - No evidence of harm to the foetus exists from vaccinating pregnant women with inactivated virus or bacterial vaccines or toxoids.
      - Live vaccines pose a theoretical risk to a foetus; therefore, they are contraindicated during pregnancy unless the benefits outweigh this theoretical risk.

   c) Individuals in specific high-risk groups: e.g. BCG, hepatitis A, hepatitis B, Hib, influenza, MenACWY, MenB, MMR, pneumococcal and varicella vaccines.

   d) Those travelling abroad: travel vaccines.

   e) Those aged 65 years and older: pneumococcal polysaccharide vaccine (PPV23).

2. **Persons with bleeding disorders or on anticoagulants**
Individuals with bleeding disorder or receiving anticoagulant therapy may develop haematomas in IM injection sites. Some vaccines recommended for intramuscular injection may be administered subcutaneously to persons with a bleeding disorder if the immune response and clinical reaction to these vaccines are expected to be comparable by either route of injection. This only applies to MMR, influenza and yellow fever vaccines.

Those with inherited coagulopathies should receive factor replacement before intramuscular injection. It is prudent to use a 23 gauge or wider needle to reduce the pressure gradient and cause less trauma to the tissue. If using a 25 gauge needle, the vaccine should be injected into the muscle over 5 seconds to reduce the risk of tissue damage.
Prior to vaccination, inform the recipient about risk of haematoma. After vaccination, apply gentle pressure to the vaccine site for at least 2 minutes. Do not rub or massage the injection site.

3. Vaccination and anaesthesia or surgery.
There is no evidence of any effects of immunisation that have an impact on outcomes of either anaesthesia or surgery.

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 attenuated vaccines is of the same order as the risk of common febrile illnesses of childhood and so should not be considered an indication to delay either vaccination or surgery.

However, it may be wise to postpone elective surgery for 48 hours after non live vaccine administration in order to avoid diagnostic confusion should the child develop post vaccination pyrexia. This is only likely to be a problem following major surgical procedures.

Urgent or emergency surgery should never be delayed as a result of recent vaccination.

However if it is likely that vaccination will be omitted unless given under anaesthesia then this is acceptable practice.

If indicated vaccination should be given when the child has recovered, and before discharge.

4. Preterm infants
Preterm infants are more vulnerable when exposed to infections, particularly pertussis and rotavirus infections and their complications. Therefore, routine vaccines should be started at 2 months chronological age in preterm 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 until discharge. The benefits of vaccination for this at-risk population at the appropriate time on neonatal units far outweighs any potential risk of transmission of this highly attenuated vaccine virus.

If a very pre-term infant (born ≤28 weeks of gestation) 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 a smaller 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 or more. 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 may be given to preterm infants prior to discharge from hospital (see Chapter 22).

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.

**Blood products**

Non-live vaccines and some live vaccines (BCG, rotavirus, yellow fever and zoster) can be administered at the same time or at any interval before or after blood product. If given at the same time they should be given in different limbs.

Other live viral vaccines (MMR and varicella) 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 3-11 months after the administration of other blood products as the HNIG may interfere with the immune response (see Table 2.4).

**Immunoglobulin**

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

HNIG is recommended for post-exposure prophylaxis or modification of hepatitis A infection and post-exposure modification of measles infections in certain at risk persons (see Chapters 8 and 14).

Contraindications
Intramuscular HNIG should not be administered to any patient with severe thrombocytopenia or with a coagulation disorder.

Precautions
Caution should be exercised with any patient who has a history of an 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 limbs.

HNIG may interfere with the immune response to live viral vaccines (MMR, varicella) except BCG, LAIV, oral typhoid and yellow fever and zoster vaccines. (HNIG is very unlikely to contain antibody to yellow fever virus).

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 (see Table 2.4). This does not apply to zoster vaccine. The amount of antigen in zoster vaccine is high enough to offset any effect of circulating antibody. Also, studies of zoster vaccine were performed on patients receiving antibody-containing blood products with no appreciable effect on vaccine efficacy.

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 tetanus1, hepatitis B1, rabies2 and varicella-zoster1 virus. Recommendations for their use are found in the relevant chapters.

There is minimal or no interaction between blood products or Ig preparations, and:
• inactivated vaccines
• live oral vaccines (rotavirus, oral typhoid vaccines)
• live intranasal vaccine (live attenuated influenza vaccine)

1available from the National Cold Chain Service
• Bacille Calmette-Guerin (BCG) vaccine
• yellow fever vaccine

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

MMR or varicella vaccine should not be given from 2 weeks before to 3-6 months after specific immunoglobulins as they may interfere with the immune response (see Table 2.4).

Table 2.4 Recommended intervals between blood products and MMR or Varicella vaccines

<table>
<thead>
<tr>
<th>Preparation</th>
<th>Route</th>
<th>Dose</th>
<th>Estimated IgG mgs/kg</th>
<th>Interval (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood products</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washed RBCs</td>
<td>IV</td>
<td>10mls/kg</td>
<td>Negligible</td>
<td>0</td>
</tr>
<tr>
<td>Packed RBCs and whole blood</td>
<td>IV</td>
<td>10mls/kg</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>Plasma &amp; platelets</td>
<td>IV</td>
<td>10mls/kg</td>
<td>160</td>
<td>7</td>
</tr>
<tr>
<td>HNIG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immune deficiencies</td>
<td>IV, SC</td>
<td></td>
<td>300-400</td>
<td>8</td>
</tr>
<tr>
<td>ITP treatment</td>
<td>IV</td>
<td>400mgs/kg/day</td>
<td>400</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,000 mgs/kg/day</td>
<td>1,000</td>
<td>10</td>
</tr>
<tr>
<td>Kawasaki disease</td>
<td>IV</td>
<td></td>
<td>1,600-2,000</td>
<td>11</td>
</tr>
<tr>
<td>Measles</td>
<td>SC, IM</td>
<td>0.6ml/kg</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Specific immunoglobulins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cytomegalovirus</td>
<td>IV</td>
<td>3mls/kg</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>IM</td>
<td>100-500 IU</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Rabies</td>
<td>IM, wound</td>
<td>20 IU/kg</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Tetanus</td>
<td>IM</td>
<td>250-500 IU</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Varicella</td>
<td>IM</td>
<td>15-25 IU/kg</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>
Guidelines for time interval between live and non live vaccines antigens

The following table shows the recommended intervals between vaccines. **Table 2.5 Recommended intervals between vaccine doses**

<table>
<thead>
<tr>
<th>Antigen combination</th>
<th>Recommended interval between doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMR and yellow fever*</td>
<td>MMR and yellow fever should <strong>not</strong> be administered on the same day. They should be given at least 4 weeks apart</td>
</tr>
<tr>
<td>MMR, varicella and zoster vaccine</td>
<td>Can be given on the same day, if not they should be given at least 4 weeks apart</td>
</tr>
<tr>
<td>BCG, rotavirus, live attenuated influenza vaccine (LAIV), MMR, oral typhoid vaccine, varicella, yellow fever, and zoster</td>
<td><strong>Apart from the combinations listed above, can be given on the same day or at any time before or after each other</strong></td>
</tr>
<tr>
<td>Non live vaccines</td>
<td>May be administered simultaneously or at any interval between doses</td>
</tr>
<tr>
<td>Non live and live vaccines</td>
<td>May be administered simultaneously or at any interval between doses</td>
</tr>
</tbody>
</table>

*MRR 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 a four week interval should be left between them. If protection is required rapidly the vaccines may be given at any interval and an additional dose of MMR given at least 4 weeks later.

**Vaccine preparation**

Vaccines should be prepared according to the SmPC.

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

It is not necessary to change needles after a vaccine dose has been drawn into a syringe It is also unnecessary to change the needle if it has passed through two stoppers, which is done when a lyophilized vaccine is reconstituted.

Separate vaccines must not be mixed in the same syringe, and must be administered in different sites.

Filter needles are not indicated for drawing up vaccines, 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, and using an alcohol swab when opening the ampoule will reduce the risk of glass shards entering the ampoule contents.

**For prefilled syringes**

Where needle is provided separately break rubber seal on prefilled syringe and remove.
Attach needle and break the seal of the needle cap without removing the cap.

Where needle is attached to prefilled syringe break the seal of the needle cap.

Hold syringe upright by the barrel.

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.

How to administer oral vaccines

**Oral typhoid vaccine**
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**
Rotarix (RV1): Remove the protective tip cap from the applicator. The child should be seated in a reclining position. Administer the entire contents of the vaccine applicator into the child’s mouth, towards the inner cheek.

Rotateq (RV5): Tear open the pouch and remove the dosing tube. Clear the fluid from the dispensing tip by holding tube vertically and tapping cap. Puncture the dispensing tip by screwing cap clockwise until it becomes tight. Administer dose by gently squeezing liquid into infant’s mouth until dosing tube is empty. (A residual drop may remain in the tip of the tube.)

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 vaccine contains sucrose it will help reduce the pain of the 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.
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How to administer intramuscular (IM) injections
This route is used for the majority of vaccines. For individual vaccines see relevant chapters.

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). Using these sites reduces the chance of involving significantly sized nerves or blood vessels. The site depends on the age and the muscle mass of the individual.

Do not administer a vaccine in a limb that is likely to be 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 administered into the arm used for BCG administration for at least 3 months because of the risk of regional lymphadenitis.

Table 2.6 Preferred site and needle size for intramuscular injections

<table>
<thead>
<tr>
<th>Patient’s age</th>
<th>Site (see illustrations below)</th>
<th>Needle length and size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to &lt;12 months</td>
<td>Vastus lateralis muscle in anterolateral aspect of mid or upper thigh</td>
<td>25 mm* 23-25 gauge</td>
</tr>
<tr>
<td>12 to &lt;36 months</td>
<td>Vastus lateralis or deltoid muscle (depending on muscle mass)</td>
<td>25 mm 23-25 gauge</td>
</tr>
<tr>
<td>3 years and older</td>
<td>Deltoid muscle (see diagram page 17)</td>
<td>25 mm** 23-25 gauge</td>
</tr>
</tbody>
</table>

* Use a 16 mm needle in infants under 2.5-3 kg.
** Use 40 mm needle in females >90 kg, males >118 kg.

Technique
It is not necessary to use gloves for routine intradermal, subcutaneous and intramuscular injections, unless likely to come into contact with potentially infectious body fluids or unless the health care worker has a lesion on his or her 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 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 muscle mass the tissue around the injection site may be gently bunched up.

Insert the needle rapidly and fully at a $90^\circ$ angle to the skin.

Inject the vaccine into the muscle 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.

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

If some of the vaccine leaks out of the syringe during administration this vaccine would not be a valid dose. A further dose of the vaccine should be administered at a separate site at the same visit.
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 the deltoid at any one time.

**IM site for older toddlers, children and adults**

The light triangle indicates site for IM injection into the deltoid (upper border of the triangle is approximately 2 finger-breadths below the acromion process and the apex is at the mid point of the humerus).

The recommended site is in the middle of the triangle.

To avoid causing an injury, do not inject too high (near the acromion process) or too low. Insert needle at 90° angle.
How to administer subcutaneous (SC) injections

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

Site

There are only two routinely recommended SC sites for administration of vaccines, the middle third of the anterolateral thigh and the deltoid region (upper arm).

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

<table>
<thead>
<tr>
<th>Patient’s age</th>
<th>Site (see illustrations below)</th>
<th>Needle size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to &lt;12 months</td>
<td>Middle third of the anterolateral thigh</td>
<td>16 mm 23-25 gauge</td>
</tr>
<tr>
<td>12 to &lt;36 months</td>
<td>Middle third of the anterolateral thigh or deltoid region</td>
<td>16 mm 23-25 gauge</td>
</tr>
<tr>
<td>3 years and older</td>
<td>Deltoid region</td>
<td>16 mm 23-25 gauge</td>
</tr>
</tbody>
</table>

Technique

Insert needle at $45^\circ$ angle to the skin.
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 preferred injection sites.
Multiple injections given in the same limb should be separated by at least 2.5cm.
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**SC site for infants and toddlers (birth to 36 months of age)**

**SC site for older toddlers, children and adults**
**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 upper arm).

PPD is generally injected into the ventral surface of the 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 to the surface, bevel upwards, to a length of approximately 5 mm and slowly inject the dose.

A bleb 7-10 mm in diameter should result (~3 mm if the dose 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 the needle should be withdrawn and the procedure repeated correctly at the same visit at a site at least 5 cm below.

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.
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. One of the child’s arms embraces the carer’s back and is held by the carer’s arm.
2. 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.
3. 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.

1. The carer’s arms embrace the child during the process.
2. Both legs are firmly between the carer’s legs

Pain reduction
The following have been shown to reduce pain:

Distraction techniques
Age-appropriate, non-pharmacologic techniques may provide distraction from pain associated with injections. 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).

Ingestion of sweet-tasting liquids or breastfeeding
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. Breastfeeding has also been shown as a soothing measure for infants receiving injections, and there is some evidence that breastfeeding can decrease the incidence of fever after immunisations.

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

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.
**Tactile stimulation**
Rubbing, or 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.

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

**Simultaneously administering vaccines at separate sites**
The evidence for or against this technique is insufficient to make a recommendation at this time.

**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°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°C, for a significant reaction at the site of vaccination or if the child is distressed.

Prophylactic use of paracetamol at the time of or closely after MenB vaccination is recommended as there is a high incidence of fever above 39°C when MenB vaccine is given with other childhood vaccines in infancy. This has been shown to reduce the incidence and severity of fever in children under 1 year of age by up to 50%.

Children should be given three doses of paracetamol after the MenB vaccine given at 2 and 4 months.
- Dose 1 of liquid infant paracetamol (2.5 ml /60 mg) is recommended at or just after the vaccine is given.
- Dose 2 (2.5 ml /60 mg) should be given 4-6 hours after Dose 1.
- Dose 3 (2.5 ml / 60 mg) should be given a further 4-6 hours after Dose 2.
- If a fever above 39°C persists a fourth dose (2.5 ml / 60 mg) may be given 4-6 hours after Dose 3.
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A post vaccination fever may still develop after paracetamol administration but this is less severe and not as long lasting.

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.

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

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