

Optimal intramuscular injection techniques for paediatric vaccination

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Administering injectable vaccines to babies and children can be traumatic for all involved. Attention to good intramuscular injection technique can reduce the risk of pain, muscle trauma and local reactions, thereby reducing the distress of the immunisation consultation.

Immunisation is one of the most common reasons for children under the age of 4 years to visit a GP. Currently, 12 injections are required for a child between birth and 4 years of age if that child is to be considered fully immunised under the 2003 Australian Standard Vaccination Schedule (ASVS). This increases to 16 injections for Aboriginal and Torres Strait Island children. Most of the ASVS vaccines must be administered intramuscularly.

Parents and doctors are often distressed at the need to give injections to babies and small children. Attention to safe and effective injection technique that also reduces the risk of local reactions and pain can enhance the confidence of

parents in the immunisation program and will also reduce the emotional distress of the immunisation visit.

General considerations

Regardless of the vaccine you are administering you should always ensure that:

- the appropriate equipment and dose of adrenaline are at hand for the management of anaphylaxis
- only vaccine that has been transported and stored at the correct 'cold-chain' temperature of between 2°C and 8°C is administered
- the standard occupational health and safety guidelines are followed to minimise the risk of needle-stick injury
- a new, sterile, disposable syringe and needle are used for each injection
- the decision regarding which vaccines are to be administered at each visit is based on the child's written (not oral) vaccination history; every opportunity should be taken to check vaccination status and to provide any missing doses (plan a 'catch-up' schedule) until the child is immunised appropriately for his or her age
- a prevaccination assessment is conducted to determine the patient's medical fitness for vaccination



Figure 1. Injection equipment for various vaccine presentations.

- the current guidelines in *The Australian Immunisation Handbook*¹ (8th edition) for obtaining valid consent from the patient or the parent or caregiver are followed
- you follow the current NHMRC vaccination guidelines for individual vaccines that are published in *The Australian Immunisation Handbook*
- the recommended documentation is completed for each vaccine that is administered
- the patient remains in the practice for at least 15 minutes after the vaccination in case there is anaphylaxis
- you report any serious adverse event following immunisation (e.g. anaphylaxis, extensive limb swelling) that you think is related to the vaccination to your State or Territory health department or, if in Victoria or Tasmania, to the Australian Drug Reactions Advisory Committee (ADRAC).

In some cases, administering certain vaccines causes injection pain and discomfort even if you use the correct injection technique. This is because of the inherent properties of the vaccine: some vaccines are slightly acidic and

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Table. Injection equipment used for various vaccine presentations

Equipment	Freeze-dried vaccine in vial*	Vaccine in vial	Vaccine in ampoule	Vaccine in prefilled syringe†
19 or 21 gauge needle (to draw up)	✓	✓	–	–
2 or 3 mL syringe	✓	✓	✓	–
23 gauge 25 mm (length) needle for intramuscular vaccines	✓	✓	✓	✓
Sterile cotton wool and tape to apply to injection site after vaccination	✓	✓	✓	✓
Medical waste (sharps) container	✓	✓	✓	✓
A rattle or some type of noisy toy or distraction after the injection	✓	✓	✓	✓

* With diluent in vial or ampoule. † A prefilled syringe usually comes without a needle attached.

others always seem to cause muscle ache at the injection site (e.g. adult diphtheria–tetanus vaccine).

Equipment

Choose the appropriate injection equipment for the relevant intramuscular vaccine (Figure 1 and Table). The equipment chosen will depend on whether you are administering a reconstituted vaccine, a vaccine from an ampoule (bottle with a breakable neck) or vial (bottle with a bung), or a vaccine in a prefilled syringe.

Use the correct needle gauge and length for the size of the patient, to reduce the risk of injection pain and muscle trauma.

- Generally for infants, children or adults, use a 23 gauge 25 mm needle.
- In preterm babies (born before 37 weeks' gestation) aged 2 months or younger and in very small infants, use a 23 or 25 gauge 16 mm needle. If using a small needle for an intramuscular vaccination, ensure the vaccine is injected slowly to avoid injection pain and muscle trauma.
- In very large or obese patients, use a 23 gauge 38 mm needle.

Preparing the injection equipment

Having washed your hands, follow the usual preparation steps.

- Ensure that you have chosen the correct vaccine from the refrigerator and then check the expiry date.
- Check the vaccine inside the vial or ampoule for signs of deterioration, such as a change in colour or clarity.
- If the vaccine is in a vial, use a 19 or 21 gauge needle to draw up the recommended dose from the vial.
- Do not draw up more than the recommended dose even if there is excess vaccine available in the vial.
- If using a vaccine ampoule, draw up the recommended dose using a 23 gauge 25 mm needle.
- Change to a 23 gauge 25 mm needle after drawing up from a vial, but it is not necessary to change needles between drawing up from an ampoule and giving the injection.
- Note that small air bubbles do not need to be extruded through the clean needle.
- Use a 23 gauge 25 mm needle for intramuscular administration of most vaccines to most patients (infants, children and adults). A 23 gauge

needle allows you to inject the vaccine into the muscle more slowly and under less pressure. Vaccine injected under pressure through a smaller gauge needle can cause more pain and lead to local muscle trauma, including bleeding and local reactions.

- Ensure your sharps container can be easily reached for immediate disposal of used injection equipment: empty ampoules, vials and syringes, and the used oral polio vaccine spoon.
- Prepare the cotton wool ball and tape ready for post-injection care.

Reconstituting freeze-dried vaccine

If using a reconstituted vaccine (e.g. measles–mumps–rubella vaccine), use a 21 or 19 gauge needle to draw up the diluent, to insert the diluent into the vaccine vial, and to withdraw the reconstituted vaccine from the vial.

Mix the vaccine and diluent together briskly and check for signs of deterioration, such as a change in colour or clarity.

Using multidose vaccine vials

Multidose vials should not be used unless there is no alternative (e.g. as with BCG vaccine). If a multidose vial is used,



Figure 2. Correct positioning of an infant for administering an intramuscular vaccine into the anterolateral thigh.

a new sterile disposable syringe and needle must be used for each draw-up. A needle or syringe that has already been used to inject an individual must never come into contact with the vial because of the risk of cross-contamination.

Preparing the patient

Choose the correct injection site for the vaccine and the age of the patient, then position the patient accordingly. While it is very important that infants and children do not move during the injection, excessive restraint can increase their fear and result in increased muscle tension.

Position and site for injecting into the anterolateral thigh

The vastus lateralis muscle in the anterolateral thigh is preferred for intramuscular injections in infants and children under 12 months. In adults, vaccine injections should not be given in the buttocks because of the possibility that vaccines will not produce adequate antibody levels to some vaccines (e.g. hepatitis B). However, intramuscular immunoglobulin can be administered into the upper outer aspect of the buttock.

Position the infant in a semirecumbent position on the lap of the parent.

Ensure that you completely expose the area of vastus lateralis (Figure 2). It is also essential that you undo the baby's napkin so you can easily locate the anatomical landmarks of the injection site, otherwise the vaccine may be given too low or too high in the thigh.

The upper marker is the skinfold of

the groin and the lower marker is the upper part of the patella. Draw an imaginary line between the two markers down the centre of the thigh and divide the thigh into thirds. The correct site for the intramuscular injection is the outer, middle one-third area, a finger-width proximal to the junction of the upper

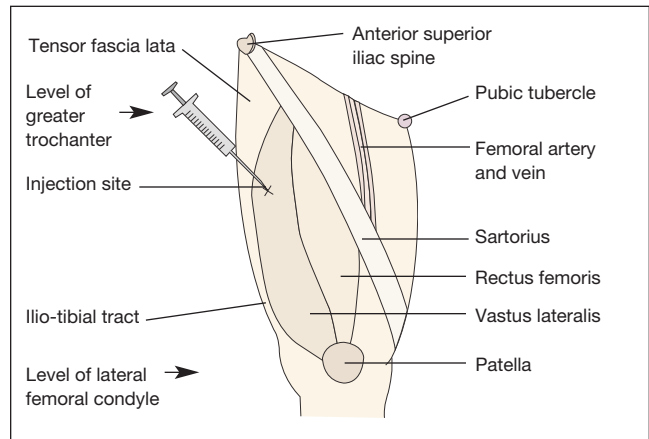


Figure 3. Diagram of the muscles of the thigh, showing the recommended site for intramuscular injection.

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Cautionary points

- Do not use short (16 mm) needles for intramuscular injection (except in very young preterm or very small babies). The use of short needles may lead to inadvertent subcutaneous injection and increase the risk of significant local reactions, particularly with aluminium-adsorbed vaccines (e.g. hepatitis B vaccine, DTPa, DTPa combinations or tetanus vaccine).
- When preparing reconstituted vaccine, the freeze-dried vaccine must be reconstituted with the diluent that is supplied with the vaccine. Never use water for injection or diluent supplied with another vaccine as a substitute. The diluent has properties specific to the vaccine it is packaged with.
- Reconstituted vaccines deteriorate rapidly at room temperature and should be used within the recommended time period after reconstitution (between 30 and 90 minutes, depending on the vaccine).
- Incorrect visualisation of the site for intramuscular vaccination has resulted in serious adverse events following immunisation, including:
 - radial nerve injury from vaccination into the area below or too lateral to the deltoid
 - injection of vaccine into joint spaces (shoulder, thigh and even hip joints)
 - severe local reactions and sterile abscesses after vaccines were injected too superficially or outside muscle area (e.g. being injected into the anterior thigh).

and middle thirds of the lateral aspect of the vastus lateralis at its bulkiest part. Injecting here will ensure you inject into the bulkiest part of the vastus lateralis (Figure 3). Ensure you do not inject into the anterior aspect of the thigh.

Hold the infant's hip in a flexed position to keep the muscle as relaxed as possible during the injection because this will reduce muscle resistance (and pain) while you inject the vaccine (Figure 2).

Position and site for injecting into the deltoid

The deltoid muscle is the preferred site for intramuscular injections in children aged 12 months and older and in adults.

The most convenient way to position a young child for a deltoid injection is for the child to sit sideways on the lap of the parent or caregiver. The arm to be injected is held close to the infant's body while the other arm is tucked behind the back of the parent.

Alternatively, an older child can be held more securely if positioned facing the parent with the child's legs straddled over the parent's lap. You can encourage the child to 'hug' the parent while the parent 'hugs' the child firmly (Figure 4).

It is essential to expose the arm completely from shoulder to elbow when locating the deltoid site. Insufficient retraction of a shirt sleeve may expose only the inferior portion of the deltoid area.

The best injection site is the middle of the deltoid muscle, halfway between the shoulder tip (acromion) and the muscle insertion at the middle of the humerus (deltoid tuberosity).

Position the arm to keep the deltoid as relaxed as possible.

Giving the intramuscular injection (anterolateral thigh and deltoid)

Current evidence shows that when the skin is visibly clean there is no need to wipe the skin with an antiseptic. If you feel you must continue this practice or the skin is visibly unclean, alcohol and



Figure 4. The 'cuddle' position for intramuscular injection into the deltoid in older children.



Figure 6. Intramuscular vaccination into the deltoid muscle of a child (using a 23 gauge 25 mm needle inserted at a 60° angle).

other disinfecting agents must be allowed to dry before injection of vaccine, because they can inactivate live vaccine preparations and increase injection pain.

Bunch up the thigh or deltoid muscle to increase the muscle mass. The needle should pierce the skin at an angle of 60°, pointing towards the knee when injecting into the anterolateral thigh (Figure 5) and towards the shoulder when injecting into the deltoid (Figure 6). At this angle, a 25 mm needle can be safely inserted to a depth of between 16 and 23 mm (skin to needle tip depth).



Figure 5. Intramuscular vaccination into the thigh of an infant (using a 23 gauge 25 mm needle inserted at a 60° angle).



Figure 7. Distraction by shaking a noisy toy gives a calming effect to infants.

Inserting the needle at a 60° angle results in less tissue resistance as the needle penetrates the muscle, allows for deep intramuscular penetration, and avoids the risk of subcutaneous injection of the intramuscular vaccine.

Once you have inserted the needle briskly at the correct site and angle, inject the vaccine slowly over a slow count of five (i.e. 'one and two and three and four and five'). This allows time for the muscle to absorb the vaccine and so reduce the risk of injection pain that can occur if the vaccine is injected using

strong pressure on the syringe plunger. Some experts, including the World Health Organization, no longer recommend withdrawing the syringe plunger before injecting a vaccine. However, it is still acceptable to do so gently if preferred. If a flash of blood appears in the needle hub, the needle should be withdrawn and a new site selected for injection.

Keeping the muscle bunched, withdraw the needle briskly and dispose of it immediately into the sharps container.

Cover the site quickly with a dry cotton wool ball and tape, and gently apply pressure for one or two minutes. Do not rub the site, because this will encourage the vaccine to leak back up the needle track and can cause pain and, in some cases, lead to local irritation. Remove the cotton wool after a few minutes and leave the injection site exposed to the air.

Comfort measures and distraction techniques – including shaking a noise toy (for infants and very young children), playing music or encouraging the child to pretend to blow away the pain (for older children) – have been found to help children cope with the discomfort associated with vaccination (Figure 7). Administering sweet-tasting fluid orally immediately before injection has also been found to cause a calming or analgesic effect among some infants.

Administering multiple injections at the same visit Children under 12 months of age

When three injectable vaccines are to be given at the same visit, two injections can be administered in the same anterolateral thigh, but the injection sites should be separated by at least 2.5 cm, so that local reactions will not overlap.

The third injection (preferably using the vaccine that may cause slightly more swelling or redness than others, such as pneumococcal conjugate vaccine [7vPCV]) should be administered in the opposite thigh. The location of each

injection should be recorded so that the vaccine associated with a local reaction can be differentiated.

Children 12 months of age and older

When you need to give three intramuscular vaccines at the same visit for a child aged 12 months and over, you can use both deltoid muscles (a single injection into each muscle).

The site of the third injection should be determined as follows. In children over 18 months of age, there may be sufficient muscle mass to deliver two intramuscular injections into one deltoid, spaced by 2.5 cm, with a third into the other deltoid. This will ordinarily be the case in older children and adults but will require your clinical judgement. If you think there is insufficient deltoid muscle mass for this technique, then one injection should be given into each deltoid, and an anterolateral thigh used for the third injection. If you are injecting the thigh, the vaccine least likely to cause swelling and redness should be selected for this site and the vaccine should be injected slowly so as to reduce the risk of local reactions and pain.

Post-immunisation care

Although paracetamol is not advised routinely at the time of vaccination it may be used later in children who experience fever or injection site discomfort. Advise parents to administer extra fluids and not to overdress the baby in the case of fever, and that local reactions – soreness, redness, itchiness, swelling – at the site are not uncommon. Sometimes an injection site nodule may occur and persist for some weeks or months; this should not be a cause of concern and requires no treatment as long as there is no evidence of infection.

Conclusion

Giving a vaccination to a child or infant can be traumatic for all involved. The current recommendations for giving

an intramuscular injection can reduce injection pain, deep muscle trauma and the risk of local reactions and increase the effectiveness of the vaccines you administer. Parents and patients will be grateful and surprised by the reduction of injection pain and will be less anxious about future immunisation visits. **MT**

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Reference

1. Australian Technical Advisory Group on Immunisation. The Australian immunisation handbook. 8th ed. Canberra: Australian Government Department of Health and Ageing, 2003 (available at <http://immunise.health.gov.au/handbook.htm>).

DECLARATION OF INTEREST: None.

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