SIMULATION with SKILLS: Cardiac

Skills to be practised and assessed during the cardiac simulations:

- basic life support - infant and child
- safe defibrillation with manual defibrillator
- needle thoracocentesis

Candidates should be informed that the skill will be assessed when they prepare to perform it.

These skills will have been assessed in the illness simulations but should continue to be continuously assessed:

- airway opening manoeuvres
- use of oropharyngeal and nasopharyngeal airways
- bag valve mask ventilation
- use of supraglottic airway device
- intraosseous access using EZIO or other local device

Candidates should also have the opportunity to discuss and practise the following skill:

- **Management of a blocked tracheostomy**

The following will also be discussed/demonstrated in the simulations/learning conversations:

- Choking management
- Hypothermia and cardiac arrest

SET

We are now going to practise the skills required in this simulation. These are ……..

During the simulation, the initial candidate should perform the defibrillation “in real time” and the chest compressions should similarly be performed correctly by a different candidate or candidates and assessed. Airway and breathing skills should be actioned as in a simulation but will not be assessed for all candidates in this session.

Following the closure of the simulation with any teaching points clarified as necessary, the rest of the candidates should perform chest compressions and/or defibrillation skills until competent.

The following is for background information about each of the skills and to give you context if questions are asked.

Remember however that you are coaching not teaching these skills.

Skills that are being assessed have the key assessment points listed in the tables.

BASIC LIFE SUPPORT assessment table

Paediatric life support in a health care setting	Notes	Performed (Y/N)
Safe approach	• Safety • Stimulate: Are you alright? • Shout for help – **2222** in UK	
Airway opening manoeuvres	Head tilt, chin lift (jaw thrust)	
Check for breathing (and signs of life)	Look, listen, feel for breathing and look for signs of life (10 seconds)	
5 initial rescue breaths	Use bag valve mask in hospital setting	
If still no signs of life observed during the above steps, then start chest compressions.	Signs of life • breathing or abnormal breathing (agonal breathing), • movement • cough/gag in response to breaths	
Start chest compressions	15 compressions: 2 breaths	
Infant (see details below)	Using two-thumb encircling technique over the lower half of the sternum – at least 4cm	
Child (see details below)	Using the heel of one hand (or two) over the lower half of the sternum – at least 5 cm	
Compressions	• depth of at least one-third of the depth (anteroposterior) of the chest • rate of 100 – 120 per minute • allowing adequate chest wall recoil	
Continue CPR 15:2 - for 1 minute.	If no help/cardiac arrest team has arrived after 1 minute, then leave the child to get help/call emergency services	
Once intubated, ventilations can be uninterrupted for compressions, if expansion is satisfactory, and should be at a rate of 12-20 bpm.		
Ventilation breaths should last 1 second and should see the chest rise similar to normal breathing		

Ensure that candidates are clear about:

Infant technique (see below)

- infant chest compressions are most effectively performed using the **two-thumb technique**
- the infant is held with both the rescuer's hands encircling or partially encircling the chest
- the thumbs are placed over **the lower half of the sternum** and compression performed
- the single rescuer may alternatively use the two-finger method, placing two fingers on the lower half of the sternum and employing the other hand to maintain the airway position

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Child technique (see below)

- rescuer should place the heel of one hand (or two) over the lower half of the sternum
- fingers should be lifted to ensure that pressure is not applied over the child's ribs
- best position is vertically above the child's chest and, with a straight arm (elbow extended)
- the sternum is compressed to depress it by at least one-third of the depth of the chest (at least 5 cm)
- for larger children, or for small rescuers, this may be achieved more reliably by using both hands with the fingers interlocked
- rescuer should choose one or two hands to achieve the desired compression of at least one-third of the depth of the chest
- it is important to avoid leaning and to allow for complete chest recoil in between compressions

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In all ages

- **Compression rate 100-120 per minute**
- Compressions should be at least one-third of the depth (anteroposterior) of the patient's chest – at least 5 cm for a child and at least 4 cm in an infant.
- It is important to allow the chest wall to recoil fully before the next compression starts – this will ensure that the coronary arteries fill adequately.
- The rescuer should avoid placing the hand/fingers too low so as to avoid pressing the xiphisternum into the abdomen.
- Ensure that pressure is not applied over the patient's ribs. Do not apply any pressure over the top of the abdomen or bottom tip of the sternum.

For effective compressions:

- the child (or infant) should be lying flat on their back, on a hard surface
- a backboard may be useful when available
- clothing should be removed only if it severely hinders chest compressions. (Clothing should be removed with minimal delay of starting chest compressions.)

Out of hospital paediatric life support

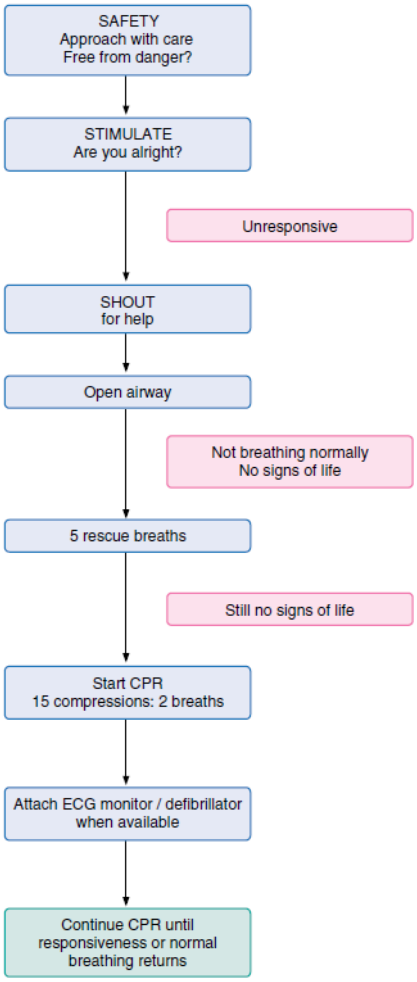
Health care providers should deliver 15:2 compressions/ventilations via mouth to mouth (or mouth to mouth-and-nose) or pocket mask or bag-valve-mask device.

For lay rescuers, the adult compression : ventilation ratio of 30 compressions to 2 ventilations is also recommended for children to simplify the guidance. It may also be appropriate for healthcare providers trained in adult resuscitation (but with limited paediatric training) to apply adult BLS techniques if this creates less confusion for them and their team. To increase the appropriateness for children, lay rescuers should be advised to precede their efforts by five rescue breaths if the victim is a child. Single healthcare professional rescuers can also perform five rescue breaths followed by a ratio of 30 compressions to 2 ventilations for children if they find difficulty in the transition from compressions to ventilations.

If either healthcare providers or lay rescuers are unable or unwilling to perform mouth-to-mouth resuscitation, they may perform compression-only CPR.

If there is only one rescuer, they should call for help immediately (preferably using a mobile phone with speaker function) and then commence cardiopulmonary resuscitation (CPR). If no phone is available, the single rescuer should perform 1 minute of CPR before leaving the child to activate the EMS system.

Paediatric basic life support



DEFIBRILLATION – HANDS FREE assessment table

Defibrillation – hands free	Notes	Performed (Y/N)
Basic life support should be interrupted for the shortest possible time (steps 8-11)		
1. Apply adhesive monitoring electrodes to the correct positions	Chest compressions continue.	
2. Turn on the defibrillator		
3. Briefly interrupt compressions to assess the rhythm. If VF/pulseless VT: Move to step 4 to prepare to deliver a shock. If PEA/Asystole then jump to 11.	Pause compressions.	
4. Select the correct energy level required whilst compressions continue.	Restart chest compressions.	
5. Shout 'CHARGING, oxygen away, continue compressions'	Chest compressions continue. Ensure oxygen removed.	
6. Press the charge button	Chest compressions continue.	
7. Wait until the defibrillator is charged.	Chest compressions continue. Ensure hand away from buttons.	
8. Shout "Stop compressions, everybody stand clear, (visual glance of monitor to check still shockable) SHOCKING". (If PEA/Asystole do not shock, but disarm/dump the charge and jump to 11)	Everyone stands back	
9. Check all personnel are clear and that the oxygen has been removed.	Everyone stands back	
10. Deliver the shock *whilst observing the patient.*	Everyone stands back	
11. Recommence CPR.	CPR resumes	

In order to achieve the optimum outcome, defibrillation must be performed quickly and efficiently. This requires correct electrode pad selection, correct electrode pad placement, good electrode pad contact and correct energy selection.

Correct electrode selection

Defibrillators for paediatric use should be supplied with two sets of electrode pads. Adult electrode pads can be used for children aged 8 years and above and paediatric electrode pads for the younger child. Children vary in size so there is some discretion.

Correct electrode placement

Electrode pads are usually labelled pictorially to show placement positions. Pads have become the method of choice, because once placed they save time, resulting in less interruption to chest compressions and time to defibrillation, and they are also safer. They promote charging during compressions which decreases hands-off chest time.

The usual placement of pads is anterolateral. One is put over the apex in the mid-axillary line (a finger breadth below the left nipple) and the other is placed just to the right of the sternum (a finger breadth below the right clavicle) – see below left. Ensure they are at least 2 cm apart to prevent arcing.

In the infant where anterolateral is not feasible (e.g., when pads are too close to each other), the anteroposterior placement is used: one is placed just to the left side of the sternum and the other in the middle of the back between the scapulae (above middle and right).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Good electrode pad contact

Electrode pads should be placed on dry skin and smoothed on to guarantee good contact and ensure effective energy delivery.

Correct energy selection

The recommended level in cardiac arrest is 4J/kg.

Safety

A defibrillator delivers enough current to *cause* cardiac arrest. The user must ensure that other rescuers are not in physical contact with the child (or the trolley) at the moment the shock is delivered. When using electrode pads, it is advisable to charge whilst compressions are ongoing.

A high ambient oxygen concentration may lead to fire through "arcing". Any free-flowing oxygen (i.e. through a bag mask system) should be removed/turned off.

Many defibrillators are available. Providers of advanced paediatric life support should make sure that they are familiar with those they may have to use.

DEFIBRILLATION – AED

Automated external defibrillators (AEDs) are now commonplace.

- The standard adult shock is used for children over 8 years.
- For children under 8 years, attenuated paediatric pads should be used with the AED.
- For an infant of less than 1 year, a manual defibrillator which can be adjusted to give the correct shock is recommended. However, if an AED is the only defibrillator available, its use should be considered, preferably with paediatric attenuation pads.

The order of preference for defibrillation in the under 1-year- olds is as follows:

1. Manual defibrillator.
2. AED with dose attenuator.
3. AED without dose attenuator.

Many AEDs can detect ventricular fibrillation/ventricular tachycardia (VF/VT) in children of all ages and differentiate 'shockable' from 'non-shockable' rhythms with a high degree of sensitivity and specificity.

DEFIBRILLATION – MANUAL assessment table (for centres where only paddles are available)

Defibrillation – manual (using paddles)	Notes	Performed (Y/N)
Basic life support should be interrupted for the shortest possible time (steps 5–12).		
1. Apply gel pads or electrode gel.	Chest compressions continue.	
2. Select the correct paddles.	Chest compressions continue.	
3. Turn on the defibrillator and select the energy required	Chest compressions continue.	
4. Interrupt briefly to confirm VF/pulseless VT, then immediately recommence compressions.	Pause chest compressions for rhythm check.	
5. Shout 'STAND BACK'	Everyone stands back. Oxygen removed.	
6. Remove the paddles from the machine, place the paddles onto the gel/gel pads and apply firm pressure.	Ensure everyone stands back and oxygen removed.	
7. Shout 'CHARGING' whilst pressing the charge button.	Everyone stands back	
8. Wait until the defibrillator is charged.	Everyone stands back	
9. Check that all other rescuers are clear.	Everyone stands back	
10. Shout 'SHOCK, stand clear'.	Check everyone clear and oxygen has been removed.	
11. Deliver the shock.	Everyone stands back	
12. Recommence CPR.	CPR resumes	

This requires correct electrode paddle selection, correct paddle placement, good paddle contact and correct energy selection.

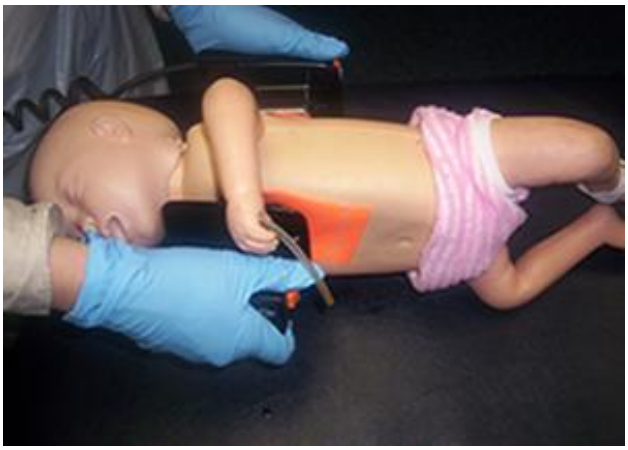
Correct electrode pad/paddle selection

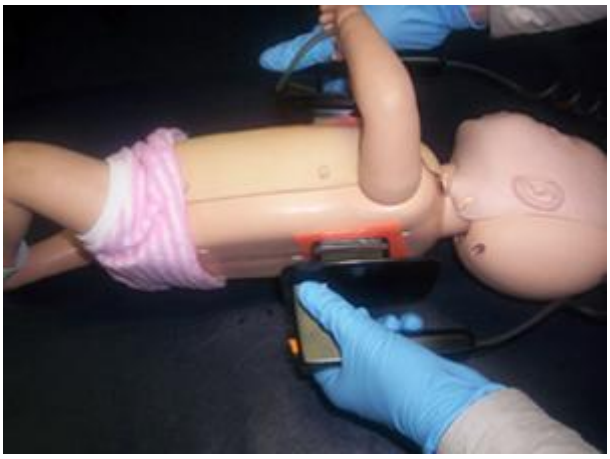
Defibrillators for paediatric use should be supplied with two sets of electrode pads/paddles. Pads have become the method of choice, because once placed they save time, resulting in less interruption to chest compressions and time to defibrillation, and they are also safer. They promote charging during compressions which decreases hands-off chest time.

Paddles may be encountered in low- and middle-income countries. Adult paddles are 13 cm diameter. If available, paddles of 4.5 cm diameter are used in infants. Paediatric/infant paddles usually will be clipped over or hidden under the adult paddles.

Correct electrode pad/ paddle placement

The usual placement of both paddles and pads is anterolateral. One is put over the apex in the mid-axillary line (a finger breadth below the left nipple) and the other is placed just to the right of the sternum (a finger breadth below the right clavicle) – see below left. Ensure they are at least 2 cm apart to prevent arcing.





In the infant where anterolateral is not feasible (e.g., when pads/paddles are too close to each other), the anteroposterior placement is used: one is placed just to the left side of the sternum and the other in the middle of the back between the scapulae (above middle and right).

Good paddle contact

Electrode gel pads (or gel) should be placed on dry skin and smoothed on to guarantee good contact and ensure effective energy delivery. Paddles should be placed on the gel/gel pads and firm pressure applied.

Correct energy selection

The recommended level in cardiac arrest is 4J/kg.

Safety

A defibrillator delivers enough current to *cause* cardiac arrest. The user must ensure that other rescuers are not in physical contact with the child (or the trolley) at the moment the shock is delivered. When using paddles, the defibrillator should only be charged when the paddles are either in contact with the child or replaced properly in their storage positions.

A high ambient oxygen concentration may lead to fire through “arcing”. Any free-flowing oxygen (i.e. through a bag mask system) should be removed/turned off.

Many defibrillators are available. Providers of advanced paediatric life support should make sure that they are familiar with those they may have to use.

Needle thoracocentesis

This procedure can be life saving and can be performed quickly with minimum equipment. It should be followed by chest drain placement.

Minimum equipment

- Alcohol swabs
- Large over-the-needle intravenous cannula (14 or 16 gauge or commercial devices are available for this procedure)
- Syringe: 20 ml

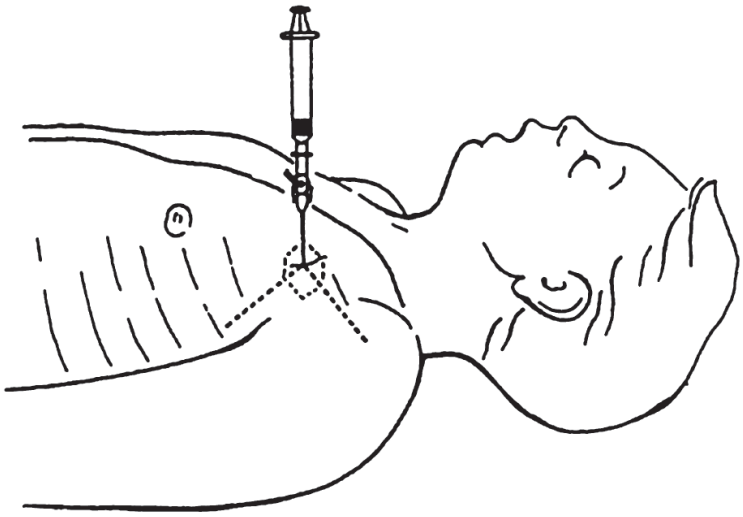


Figure 21.6 Needle thoracocentesis

Assessment table

Needle thoracocentesis	Performed (Y/N)
Administer high-flow oxygen.	
Identify the second intercostal space in the mid-clavicular line on the side of the pneumothorax.	
Swab the chest wall with surgical preparation solution or an alcohol swab.	
Attach the syringe to the cannula. Fluid in the syringe will assist in the identification of air bubbles.	
Insert the cannula perpendicular to the chest wall while aspirating the syringe, just superior to the third rib (to avoid the neurovascular bundle that runs along the inferior aspect of ribs (Figure 21.6).	
Once air is aspirated, stop advancing the needle, and advance the cannula over the needle while withdrawing the needle and syringe.	
Tape the cannula in place and proceed to chest drain insertion as soon as possible.	

Alternative method

1. Administer high-flow oxygen.
2. Attach a 10 ml syringe with 2 ml of sodium chloride to the rear of the cannula and needle.
3. Identify the fifth intercostal space in the mid-axillary line on the side of the suspected tension pneumothorax. This lateral approach provides a larger zone of safety than the anterior approach – but access may restrict its use.
4. Clean the skin and insert the cannula into the skin, just superior to the sixth rib. Once through the skin flush the needle with the sodium chloride – to expel any skin plug.
5. Remove the syringe plunger from the barrel of the syringe.
6. Advance the needle and cannula to pierce the pleura; draining of sodium chloride out of the syringe suggests penetration of the pleura.
7. Bubbling in the syringe indicates the presence of a tension pneumothorax.
8. Advance the cannula over the needle into the pleural space.
9. The cannula or needle may need flushing due to occlusion with a tissue.
10. Tape the cannula in place and proceed to chest drain insertion as soon as possible.
11. If needle thoracocentesis is attempted, and the patient does not have a tension pneumothorax, the risk of causing a pneumothorax is 10–20%. Patients who have had this procedure must have a chest radiograph, and will require chest drainage if ventilated.

In trauma, it may be better to perform an immediate slit or finger thoracostomy rather than a needle thoracocentesis. This is a more reliable and definitive method of reducing a tension pneumothorax.

Management of a blocked tracheostomy

Management of a blocked tracheostomy	Notes
Commence basic life support.	
1. Stimulate the child.	
2. Shout for help.	
3. Open and check airway with a head tilt/chin lift.	This exposes the tracheostomy tube and opens the upper airway.
4. Apply oxygen to the face and tracheostomy.	
5. Assess patency of the tracheostomy using a suction catheter.	
6. If you are unable to pass the suction catheter through the tracheostomy tube, then the tube must be changed immediately with the same size tube.	If this fails to relieve the obstruction, or you cannot insert it: • Try a half size smaller tube • If it is not possible to insert this, thread a lubricated suction catheter through the size smaller tracheostomy tube. Insert the suction catheter into the stoma and then attempt to guide the new tracheostomy tube along the catheter and into the stoma • If this is unsuccessful then remove the tracheostomy tube
7. Check for breathing. • If the child is breathing satisfactorily, place them in the recovery position and continue to assess. • If the child is not breathing, you will have to give rescue breaths.	Look, listen, feel: place the side of your face over the tracheostomy tube or patient's face to listen and feel for any breaths, and at the same time look at the child's chest to observe any breathing movement.
8. Give five rescue breaths. If you have succeeded in removing the obstructed tracheostomy and replaced it with a patent tracheostomy tube: • attach a self-inflating bag and ventilate • (or, if that is not available, perform mouth-to-tracheostomy ventilation).	If you have failed to replace the tracheostomy tube: • If child has a fully or partially patent upper airway, occlude the tracheal stoma and provide rescue breaths via the mouth by bag–valve–mask or mouth-to-mouth ventilation • If child does not have a patent upper airway these resuscitation breaths are applied directly to the stoma

For more information see:
National Tracheostomy Safety Project paediatric tracheostomy emergency management algorithm

Paediatric foreign body airway obstruction

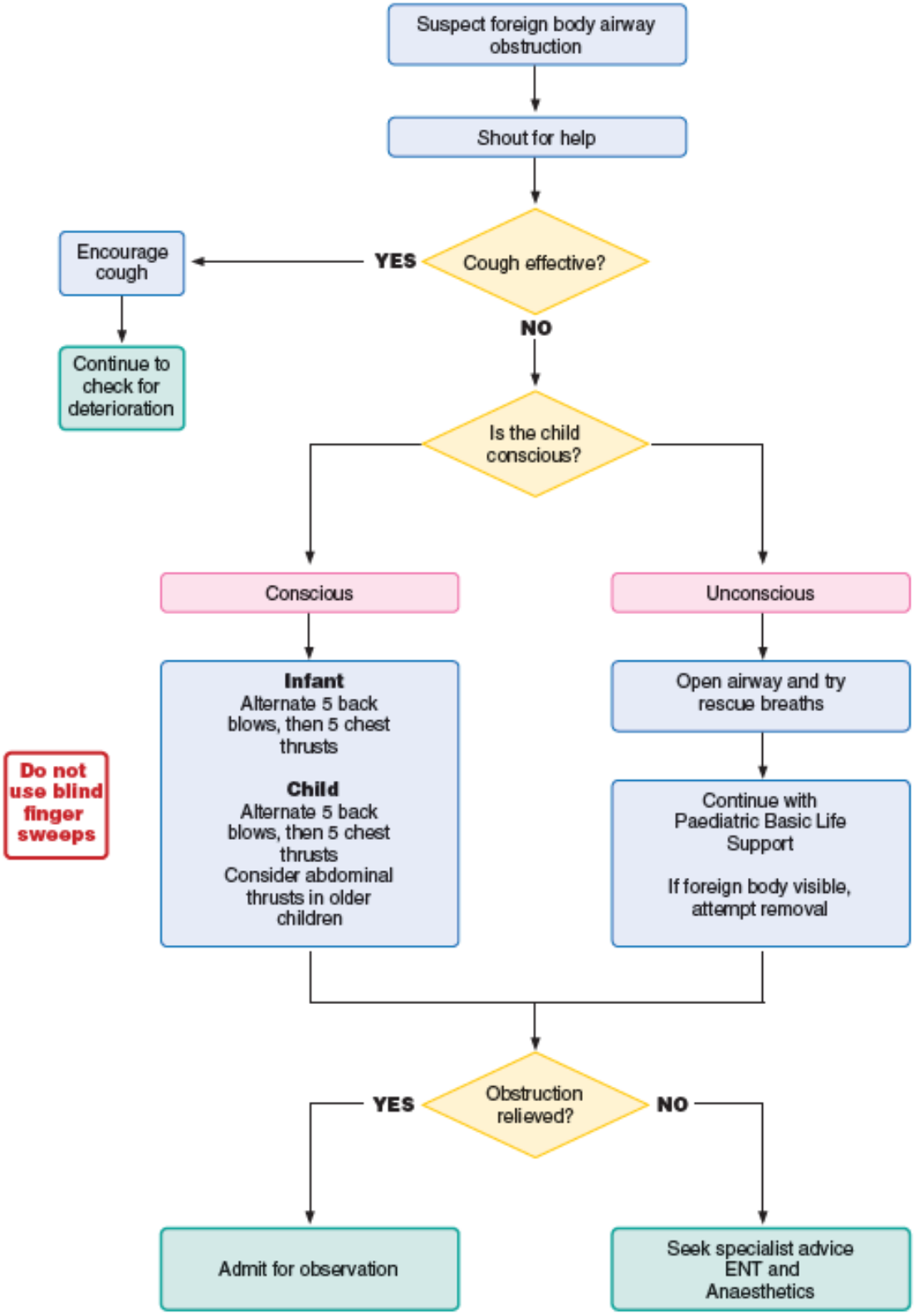


Figure 16.13 Paediatric foreign body airway obstruction algorithm