



Paediatric basic life support



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1. The guideline process

The process used to produce the Resuscitation Council (UK) Guidelines 2015 has been accredited by the National Institute for Health and Care Excellence. The guidelines process includes:

- Systematic reviews with grading of the quality of evidence and strength of recommendations. This led to the 2015 International Liaison Committee on Resuscitation (ILCOR) Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.^{1,2}
- The involvement of stakeholders from around the world including members of the public and cardiac arrest survivors.
- Details of the guidelines development process can be found in the Resuscitation Council (UK) Guidelines Development Process Manual. www.resus.org.uk/publications/guidelines-development-process-manual/
- These Resuscitation Council (UK) Guidelines have been peer reviewed by the Executive Committee of the Resuscitation Council (UK), which comprises 25 individuals and includes lay representation and representation of the key stakeholder groups.

2. Summary of changes in paediatric basic life support since the 2010 Guidelines

- The duration of delivering a breath is about 1 second, to coincide with adult practice.
- For chest compressions, the lower sternum should be depressed by at least one third the anterior-posterior diameter of the chest, or by 4 cm for the infant and 5 cm for the child.

3. Introduction

These guidelines aim to provide clear advice to healthcare professionals and members of the general public about the delivery of basic life support (BLS) to children.

Cardiorespiratory arrest occurs less frequently in children than in adults; thus, both healthcare professionals and lay people are less likely to be involved in paediatric resuscitation. It is therefore important to be familiar with the

knowledge and skills required for paediatric BLS so that the best care possible can be delivered in what is often a stressful situation.

The review of these guidelines has incorporated new information from the ILCOR 2015 review of resuscitation science. They also include practical changes intended to aid training and retention of knowledge and skills required to deliver high quality BLS in children.

There is limited evidence on paediatric resuscitation as there are relatively few studies, particularly randomised controlled trials, in this area. Existing evidence derived from observational studies is of variable quality but new collaborations involving national and international registries should yield valuable data on the resuscitation of children.

What is known is that cardiopulmonary resuscitation (CPR) should start as soon as possible for optimum outcome. This should start with the first person on scene, who is often a bystander (i.e. a lay rescuer).

The majority of paediatric cardiorespiratory arrests are not caused by primary cardiac problems but are secondary to other causes, mostly respiratory insufficiency, hence the order of delivering the resuscitation sequence: Airway (A), Breathing (B) and Circulation (C).

- To promote the delivery of BLS by the general public, this section confirms that using the adult BLS sequence for a child is far better than not performing any CPR, and describes a modification to the adult BLS sequence for use by non-specialists. This modified sequence of BLS will make it more likely that potential rescuers will commence CPR and so improve the outcomes for critically ill children.
- For healthcare professionals with a duty to respond to paediatric emergencies, a more specific form of paediatric BLS is presented as they have an obligation to deliver more targeted care.

4. Guideline notes

Recognition of cardiorespiratory arrest – healthcare provider and lay person

If a layperson or healthcare provider considers that there are no 'signs of life', CPR should be started immediately.

Feeling for a pulse is not a reliable way to determine if there is an effective or inadequate circulation, and palpation of the pulse is not the sole determinant of the need for chest compressions. The presence or absence of 'signs of life', such as response to stimuli, normal breathing (rather than abnormal gasps) or spontaneous movement must be looked for as part of the child's circulatory assessment.³ If a healthcare provider does feel for a pulse in an unresponsive child, they must be certain that one is present for them NOT to start CPR. In this situation, there are often other signs of life present. Lay rescuers should not be taught to feel for a pulse as part of the assessment of need for CPR.

The decision to start CPR should take less than 10 seconds from starting the initial assessment of the child's circulatory status and if there is still doubt after that time, start CPR.

Compression:Ventilation ratios – healthcare provider and layperson

Although ventilation remains a very important component of CPR in children, rescuers who are unable or unwilling to provide breaths should be encouraged to perform at least compression-only CPR. A child is far more likely to be harmed if the bystander does nothing.

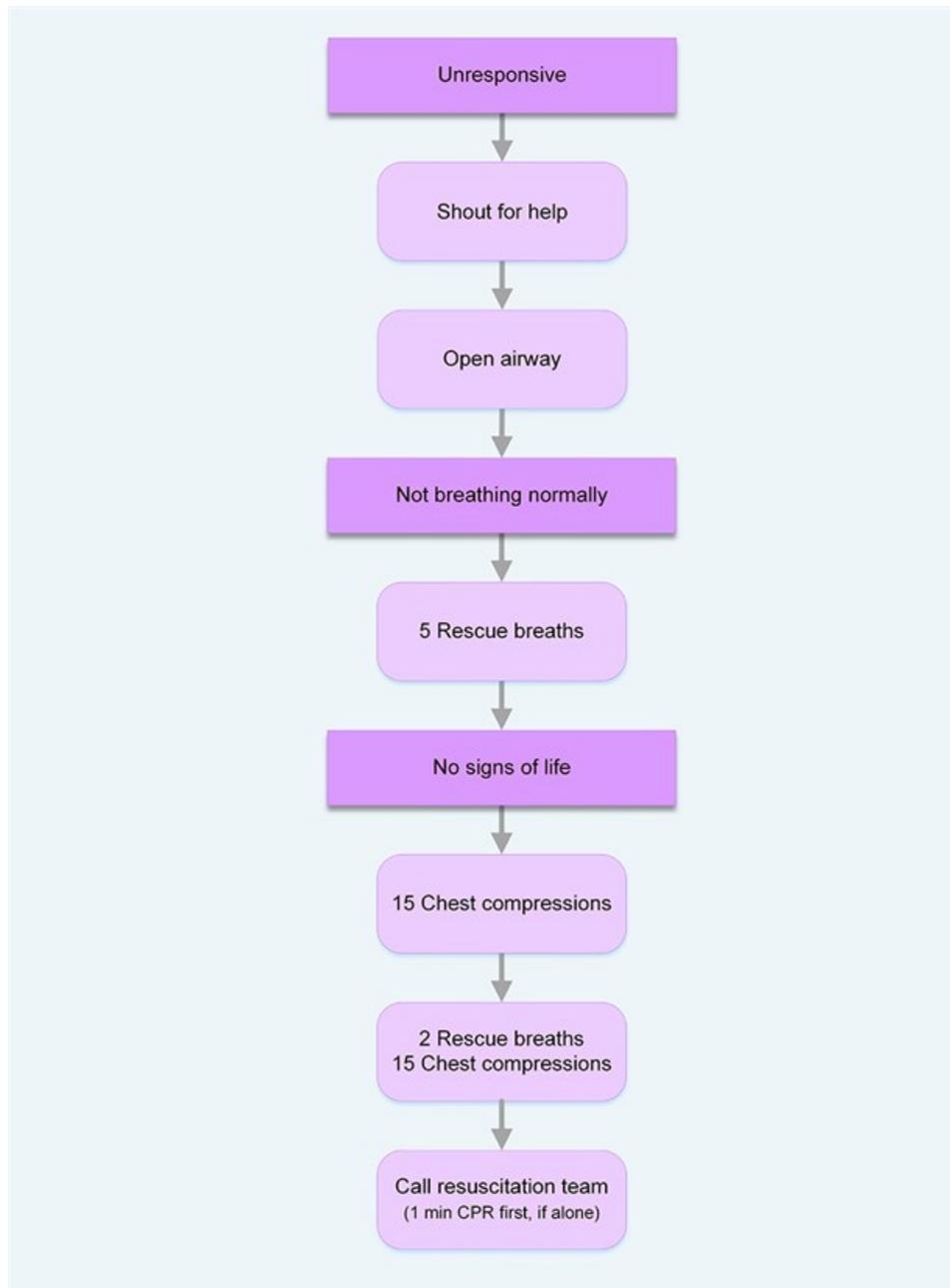
All providers should be encouraged to initiate CPR in children even if they haven't been taught specific paediatric techniques. CPR should be started with the C:V ratio that is familiar and for most, this will be 30:2. The paediatric modifications to adult CPR should be taught to those who care for children but are unlikely to have to resuscitate them. The specific paediatric sequence incorporating the 15:2 ratio is primarily intended for those who have the potential to resuscitate children as part of their role.

Chest compression quality

Uninterrupted, high quality chest compression is vital, with attention being paid to all components of each chest compression including the rate, depth and allowing adequate time for chest recoil to occur (approximately 50% of the whole cycle should be the relaxation phase).

Training and feedback devices are being developed for adults and children but require absolute, rather than relative, dimensions for depth. In order to facilitate this for children, the measurement data indicate that the approximate dimensions of one-third compression depths in infants and children are about 4 cm and 5 cm respectively.

To maintain consistency with adult BLS guidelines, the compression rate remains at 100–120 min⁻¹.^{2,4} Ideally chest compressions should be delivered on a firm surface otherwise the depth of compression may be difficult to achieve.



**Figure 1. Paediatric basic life support algorithm
(Healthcare professionals with a duty to respond)**

A4-size algorithm: <http://resus.org.uk/resources/assets/attachment/full/0/6456.pdf>

5. Infant and child BLS sequence

Rescuers who have been taught adult BLS, and have no specific knowledge of paediatric resuscitation, should use the adult sequence. The following modifications to the adult sequence will make it more suitable for use in children:

- Give 5 initial rescue breaths before starting chest compression.
- If you are on your own, perform CPR for 1 min before going for help.
- Compress the chest by at least one-third of its depth, approximately 4 cm for an infant and approximately 5 cm for an older child. Use two fingers for an infant under 1 year; use one or two hands for a child over 1 year to achieve an adequate depth of compression.

The compression rate should be 100–120 min⁻¹.

See adult BLS section. www.resus.org.uk/resuscitation-guidelines/adult-basic-life-support-and-automated-external-defibrillation

Those with a duty to respond to paediatric emergencies (usually healthcare professional teams) should use the following sequence:

1. Ensure the safety of rescuer and child.

2. Check the child's responsiveness:

- Gently stimulate the child and ask loudly, 'Are you all right?'

3A. If the child responds by answering or moving:

- Leave the child in the position in which you find him (provided he is not in further danger).
- Check his condition and get help if needed.
- Reassess him regularly.

3B. If the child does not respond:

- Shout for help.
- Turn the child onto his back and open the airway using head tilt and chin lift:
 - Place your hand on his forehead and gently tilt his head back.
 - With your fingertip(s) under the point of the child's chin, lift the chin.
 - Do not push on the soft tissues under the chin as this may block the airway.
 - If you still have difficulty in opening the airway, try the jaw thrust method: place the first two fingers of each hand behind each side of the child's mandible (jaw bone) and push the jaw forward.

Have a low threshold for suspecting injury to the neck. If you suspect this, try to open the airway using jaw thrust alone. If this is unsuccessful, add head tilt gradually until the airway is open. Establishing an open airway takes priority over concerns about the cervical spine.

4. Keeping the airway open, look, listen, and feel for normal breathing by putting your face close to the child's face and looking along the chest:

- **Look** for chest movements.
- **Listen** at the child's nose and mouth for breath sounds.
- **Feel** for air movement on your cheek.

In the first few minutes after cardiac arrest a child may be taking infrequent, noisy gasps. Do not confuse this with normal breathing. Look, listen, and feel for *no more than* 10 seconds before deciding – if you have any doubts whether breathing is normal, act as if it is not normal.

5A. If the child IS breathing normally:

- Turn the child onto his side into the recovery position (see below).
- Send or go for help – call the relevant emergency number. Only leave the child if no other way of obtaining help is possible.
- Check for continued normal breathing.

5B. If the breathing is NOT normal or absent:

- Carefully remove any obvious airway obstruction.
- Give 5 initial rescue breaths.
- Although rescue breaths are described here, it is common in healthcare environments to have access to bag-mask devices. Providers trained in their use should use them as soon as they are available.
- While performing the rescue breaths note any gag or cough response to your action. These responses, or their absence, will form part of your assessment of 'signs of life', described below.

Rescue breaths for an infant:

- Ensure a neutral position of the head (as an infant's head is usually flexed when supine, this may require some extension) and apply chin lift.
- Take a breath and cover the mouth and nasal apertures of the infant with your mouth, making sure you have a good seal. If the nose and mouth cannot both be covered in the older infant, the rescuer may attempt to seal only the infant's nose or mouth with his mouth (if the nose is used, close the lips to prevent air escape).
- Blow steadily into the infant's mouth and nose over 1 second sufficient to make the chest rise visibly. This is the same time period as in adult practice.
- Maintain head position and chin lift, take your mouth away, and watch for his chest to fall as air comes out.
- Take another breath and repeat this sequence four more times.

Rescue breaths for a child over 1 year:

- Ensure head tilt and chin lift.
- Pinch the soft part of his nose closed with the index finger and thumb of your hand on his forehead.
- Open his mouth a little, but maintain the chin lift.
- Take a breath and place your lips around his mouth, making sure that you have a good seal.
- Blow steadily into his mouth over 1 second sufficient to make the chest rise visibly.
- Maintaining head tilt and chin lift, take your mouth away and watch for his chest to fall as air comes out.
- Take another breath and repeat this sequence four more times. Identify effectiveness by seeing that the child's chest has risen and fallen in a similar fashion to the movement produced by a normal breath.

For both infants and children, if you have difficulty achieving an effective breath, the airway may be obstructed:

- Open the child's mouth and remove any visible obstruction. Do not perform a blind finger sweep.
- Ensure that there is adequate head tilt and chin lift but also that the neck is not over extended.
- If head tilt and chin lift has not opened the airway, try the jaw thrust method.
- Make up to 5 attempts to achieve effective breaths. If still unsuccessful, move on to chest compression.

6. Assess the circulation (signs of life):

Take no more than 10 seconds to:

- Look for signs of life. These include any movement, coughing, or normal breathing (not abnormal gasps or infrequent, irregular breaths).
- If you check the pulse **take no more than 10 seconds:**
 - In a child aged over 1 year – feel for the carotid pulse in the neck.
 - In an infant – feel for the brachial pulse on the inner aspect of the upper arm.
 - For both infants and children the femoral pulse in the groin (mid-way between the anterior superior iliac spine and the symphysis pubis) can also be used.

7A. If confident that you can detect signs of a circulation within 10 seconds:

- Continue rescue breathing, if necessary, until the child starts breathing effectively on his own.
- Turn the child onto his side (into the recovery position) if he starts breathing effectively but remains unconscious.
- Re-assess the child frequently.

7B. If there are no signs of life, unless you are CERTAIN that you can feel a definite pulse of greater than 60 min⁻¹ within 10 seconds:

- Start chest compressions.
- Combine rescue breathing and chest compressions.

For all children, compress the lower half of the sternum:

- To avoid compressing the upper abdomen, locate the xiphisternum by finding the angle where the lowest ribs join in the middle. Compress the sternum one finger's breadth above this.
- Compression should be sufficient to depress the sternum by at least one-third of the depth of the chest, which is approximately 4 cm for an infant and 5 cm for a child.
- Release the pressure completely, then repeat at a rate of 100–120 min⁻¹.
- Allow the chest to return to its resting position before starting the next compression.
- After 15 compressions, tilt the head, lift the chin, and give two effective breaths.
- Continue compressions and breaths in a ratio of 15:2.

The best method for compression varies slightly between infants and children.

Chest compression in infants:

- The lone rescuer should compress the sternum with the tips of two fingers.
- If there are two or more rescuers, use the encircling technique:
 - Place both thumbs flat, side-by-side, on the lower half of the sternum (as above), with the tips pointing towards the infant's head.
 - Spread the rest of both hands, with the fingers together, to encircle the lower part of the infant's rib cage with the tips of the fingers supporting the infant's back.
 - Press down on the lower sternum with your two thumbs to depress it at least one-third of the depth of the infant's chest, approximately 4 cm.

Chest compression in children aged over 1 year:

- Place the heel of one hand over the lower half of the sternum (as above).
- Lift the fingers to ensure that pressure is not applied over the child's ribs.
- Position yourself vertically above the victim's chest and, with your arm straight, compress the sternum to depress it by at least one-third of the depth of the chest, approximately 5 cm.
- In larger children, or for small rescuers, this may be achieved most easily by using both hands with the fingers interlocked.

8. Continue resuscitation until:

- The child shows signs of life (normal breathing, cough, movement or definite pulse of greater than 60 min⁻¹).
- Further qualified help arrives.
- You become exhausted.

When to call for assistance

It is vital for rescuers to get help as quickly as possible when a child collapses:

- When more than one rescuer is available, one (or more) starts resuscitation while another goes for assistance.

- If only one rescuer is present, undertake resuscitation for about 1 min before going for assistance. To minimise interruptions in CPR, it may be possible to carry an infant or small child whilst summoning help.
- The only exception to performing 1 min of CPR before going for help is in the unlikely event of a child with a witnessed, sudden collapse when the rescuer is alone and primary cardiac arrest is suspected. In this situation, a shockable rhythm is likely and the child may need defibrillation. Seek help immediately if there is no one to go for you.

Recovery position

An unconscious child whose airway is clear and who is breathing normally should be turned onto his side into the recovery position. There are several recovery positions; each has its advocates. The important principles to be followed are:

- Place the child in as near a true lateral position as possible to enable the drainage of fluid from the mouth.
- Ensure the position is stable. In an infant, this may require the support of a small pillow or a rolled-up blanket placed behind his back to maintain the position.
- There should be no pressure on the chest that impairs breathing.
- It should be possible to turn the child onto his side and to return him back easily and safely, taking into consideration the possibility of cervical spine injury.
- Ensure the airway is accessible and easily observed.
- The adult recovery position is suitable for use in children.

6. Explanatory notes

Definitions

- A newborn is a child just after birth.
- A neonate is a child in the first 28 days of life.
- An infant is a child under 1 year.
- A child is between 1 year and puberty.

The differences between adult and paediatric resuscitation are largely based on differing aetiology, with primary cardiac arrest being more common in adults whereas children usually suffer from secondary cardiac arrest. The onset of puberty, which is the physiological end of childhood, is the most logical landmark for the upper age limit for use of paediatric guidelines. This has the advantage of being simple to determine in contrast to an age limit, as age may be unknown at the start of resuscitation. Clearly, it is inappropriate and unnecessary to establish the onset of puberty formally; if the rescuer believes the victim to be a child then he should use the paediatric guidelines. If a misjudgement is made, and the victim turns out to be a young adult, little harm will accrue as studies of aetiology have shown that the paediatric pattern of arrest continues into early adulthood.

It is necessary to differentiate between infants and older children, as there are some important differences between these two groups.

Automated external defibrillators (AEDs)

Since the publication of Guidelines 2010 there have been continuing reports of safe and successful use of AEDs in children less than 8 years demonstrating that AEDs are capable of identifying arrhythmias accurately in children and are extremely unlikely to advise a shock inappropriately. Nevertheless, if there is any possibility that an AED may need to be used in children, the purchaser should check that the performance of the particular model has been tested in paediatric arrhythmias.

Many manufacturers now supply purpose-made paediatric pads or programmes, which typically attenuate the output of the machine to 50–75 J. These devices are recommended for children between 1 and 8 years. If no such system or manually adjustable machine is available, an unmodified adult AED may be used.

Although shockable rhythms are extremely unusual in infants, and the focus of infant resuscitation should be on high quality CPR, there are rare case reports of the successful use of AEDs in this age group. For an infant in a shockable

rhythm, the risk: benefit ratio favours the use of an AED (preferably with an attenuator) if a manually adjustable model is not available.

7. Choking

Recognition of choking

The management of the choking child remains unaltered from 2010 and the sequence of reversing partial or complete obstruction of the airways is the same. Back blows, chest thrusts and abdominal thrusts all increase intra-thoracic pressure and can expel foreign bodies from the airway. In half of the episodes documented with airway obstruction, more than one technique was needed to relieve the obstruction. There are no data to indicate which technique should be used first or in which order they should be applied. If one is unsuccessful, try the others in rotation until the object is cleared.

When a foreign body enters the airway the child reacts immediately by coughing in an attempt to expel it. A spontaneous cough is likely to be more effective and safer than any manoeuvre a rescuer might perform. However, if coughing is absent or ineffective, and the object completely obstructs the airway, the child will become asphyxiated rapidly. Active interventions to relieve choking are therefore required only when coughing becomes ineffective, but they then must be commenced rapidly and confidently.

The majority of choking events in children occur during play or whilst eating, when a carer is usually present. Events are therefore frequently witnessed, and interventions are usually initiated when the child is conscious.

Choking is characterised by the sudden onset of respiratory distress associated with coughing, gagging, or stridor. Similar signs and symptoms may also be associated with other causes of airway obstruction, such as laryngitis or epiglottitis, which require different management. Suspect choking caused by a foreign body if:

- the onset was very sudden
- there are no other signs of illness
- there are clues to alert the rescuer (e.g. a history of eating or playing with small items immediately prior to the onset of symptoms).

General signs of choking	
<ul style="list-style-type: none">• Witnessed episode• Coughing or choking• Sudden onset• Recent history of playing with or eating small objects	
Ineffective coughing	Effective cough
<ul style="list-style-type: none">• Unable to vocalise• Quiet or silent cough• Unable to breathe• Cyanosis• Decreasing level of consciousness	<ul style="list-style-type: none">• Crying or verbal response to questions• Loud cough• Able to take a breath before coughing• Fully responsive

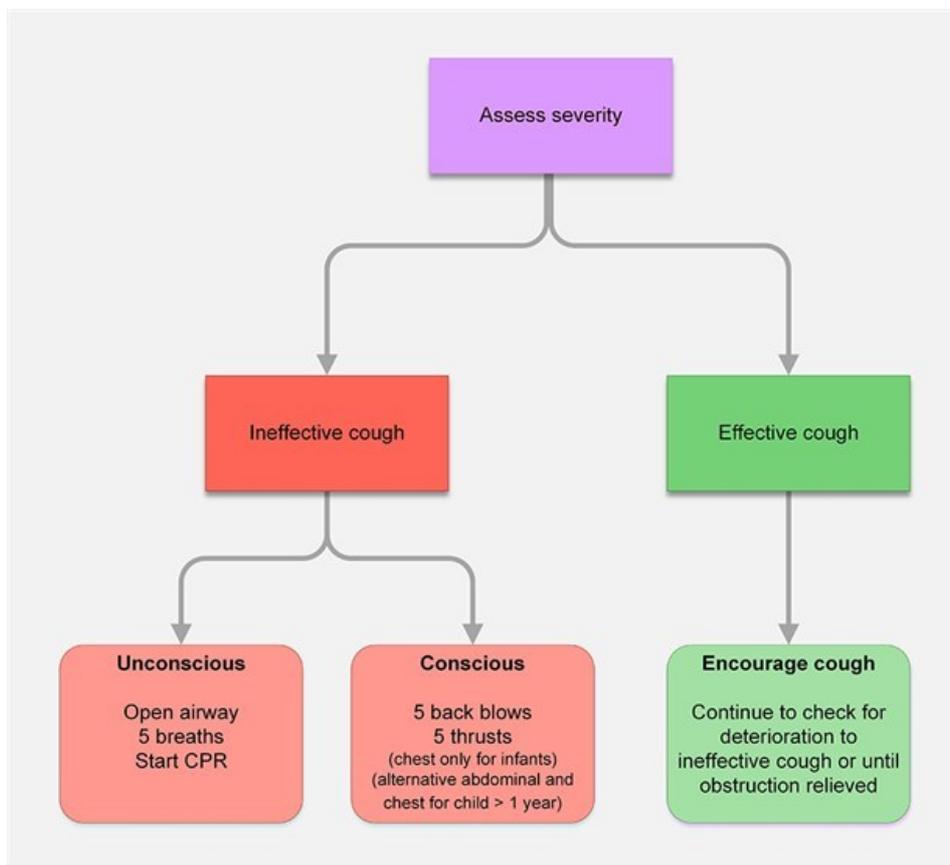


Figure 2. Paediatric choking algorithm

A4-size algorithm: <http://resus.org.uk/resources/assets/attachment/full/0/6458.pdf>

Relief of choking

Safety and summoning assistance

Consider the safest action to manage the choking child:

- If the child is coughing effectively, then no external manoeuvre is necessary. Encourage the child to cough, and monitor continuously.
- If the child's coughing is, or is becoming, ineffective, shout for help immediately and determine the child's conscious level.

Conscious child with choking

- If the child is still conscious but has absent or ineffective coughing, give back blows.
- If back blows do not relieve choking, give chest thrusts to infants or abdominal thrusts to children. These manoeuvres create an 'artificial cough' to increase intrathoracic pressure and dislodge the foreign body.

Back blows

- **In an infant:**
 - Support the infant in a head-downwards, prone position, to enable gravity to assist removal of the foreign body.
 - A seated or kneeling rescuer should be able to support the infant safely across his lap.
 - Support the infant's head by placing the thumb of one hand at the angle of the lower jaw, and one or two fingers from the same hand at the same point on the other side of the jaw.
 - Do not compress the soft tissues under the infant's jaw, as this will exacerbate the airway obstruction.
 - Deliver up to 5 sharp back blows with the heel of one hand in the middle of the back between the shoulder

blades.

- The aim is to relieve the obstruction with each blow rather than to give all 5.

• **In a child over 1 year:**

- Back blows are more effective if the child is positioned head down.
- A small child may be placed across the rescuer's lap as with an infant.
- If this is not possible, support the child in a forward-leaning position and deliver the back blows from behind.

If back blows fail to dislodge the object, and the child is still conscious, use chest thrusts for infants or abdominal thrusts for children. Do not use abdominal thrusts (Heimlich manoeuvre) for infants.

Chest thrusts for infants:

- Turn the infant into a head-downwards supine position. This is achieved safely by placing your free arm along the infant's back and encircling the occiput with your hand.
- Support the infant down your arm, which is placed down (or across) your thigh.
- Identify the landmark for chest compression (lower sternum approximately a finger's breadth above the xiphisternum).
- Deliver up to 5 chest thrusts. These are similar to chest compressions, but sharper in nature and delivered at a slower rate.
- The aim is to relieve the obstruction with each thrust rather than to give all 5.

Abdominal thrusts for children over 1 year:

- Stand or kneel behind the child. Place your arms under the child's arms and encircle his torso.
- Clench your fist and place it between the umbilicus and xiphisternum.
- Grasp this hand with your other hand and pull sharply inwards and upwards.
- Repeat up to 4 more times.
- Ensure that pressure is not applied to the xiphoid process or the lower rib cage as this may cause abdominal trauma.
- The aim is to relieve the obstruction with each thrust rather than to give all 5.

Following chest or abdominal thrusts, reassess the child:

- If the object has not been expelled and the victim is still conscious, continue the sequence of back blows and chest (for infant) or abdominal (for children) thrusts.
- Call out, or send, for help if it is still not available.
- Do not leave the child at this stage.

If the object is expelled successfully, assess the child's clinical condition. It is possible that part of the object may remain in the respiratory tract and cause complications. If there is any doubt, seek medical assistance.

Unconscious child with choking

- If the choking child is, or becomes, unconscious place him on a firm, flat surface.
- Call out, or send, for help if it is still not available.
- Do not leave the child at this stage.

Airway opening:

- Open the mouth and look for any obvious object.
- If one is seen, make an attempt to remove it with a single finger sweep.

Do not attempt blind or repeated finger sweeps – these can push the object more deeply into the pharynx and cause injury.

Rescue breaths:

- Open the airway and attempt 5 rescue breaths.
- Assess the effectiveness of each breath: if a breath does not make the chest rise, reposition the head before making the next attempt.

Chest compression and CPR:

- Attempt 5 rescue breaths and if there is no response, proceed immediately to chest compression regardless of whether the breaths are successful.
- Follow the sequence for single rescuer CPR (step 7B above) for approximately 1 min before summoning an ambulance (if this has not already been done by someone else).
- When the airway is opened for attempted delivery of rescue breaths, look to see if the foreign body can be seen in the mouth.
- If an object is seen, attempt to remove it with a single finger sweep.
- If it appears that the obstruction has been relieved, open and check the airway as above. Deliver rescue breaths if the child is not breathing and then assess for signs of life. If there are none, commence chest compressions and perform CPR (step 7B above).
- If the child regains consciousness and is breathing effectively, place him in a safe side-lying (recovery) position and monitor breathing and conscious level whilst awaiting the arrival of the ambulance.

8. Acknowledgements

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