Resuscitation Council UK

Paediatric Life Support (basic and advanced)

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Key points

- **Early recognition is crucial:** Timely identification of critically ill children is vital for the prevention of cardiac arrest. Use quick-look tools like the BBB-tool (Behaviour, Breathing, Body colour) or the Paediatric Assessment Triangle.

- **Team approach:** Request additional resources early and establish a team with clearly defined roles.
- **ABCDE assessment:** Immediately perform a structured ABCDE assessment on any child who appears critically ill or injured.
- **ABCDE management:** Open and maintain the airway. Provide adequate oxygenation and ventilation. Aim for adequate organ perfusion. Treat seizures and hypoglycaemia promptly.
- **Paediatric basic life support:** Check responsiveness. Call the ambulance service (out of hospital) or summon help (in hospital). Check breathing. Give five initial breaths. Start chest compressions. Use a compression-to-ventilation ratio of 15:2 if trained in paediatric basic life support; otherwise, use a ratio of 30:2.
- **Untrained rescuers:** Follow three simple steps to save a child's life: check- call- CPR. Follow the ambulance service call handler's advice.
- **Paediatric advanced life support:** Follow the PALS algorithm while considering and treating relevant reversible causes of cardiac arrest.
- **Special circumstances:** Modify your approach in some special circumstances, e.g. trauma or intoxication.
- **Post-resuscitation care:** Initiate post-resuscitation care immediately after ROSC. Implement individualised goals and bundled care.
- **Prognostication:** Use a multimodal approach to prognostication. Withhold prognostication for at least 72 h in comatose children.
- **Post-discharge care:** Discuss and plan post-discharge care for survivors. Follow-up care can help improve the long-term outcomes.
- **Family-centred approach:** Involve parents/persons with parental responsibility at all stages of care. Communicate with honesty and empathy while considering the needs of the family.
- **Systems:** Systems should aim to link all parts of the chain of survival and establish clear protocols for life-threatening conditions in children.

What is a Paediatric patient?

- Paediatric patients are defined as persons aged 0-18 years of age. In this guideline, we use the term 'children' to encompass all age categories. When distinguishing between age groups, e.g. for specific skills or techniques, we use the word 'infant' for neonates and children up to 1 year, the words 'child' for children aged 1-12 years and the word 'adolescents' for teenagers aged 13-18 years.

When should the PLS algorithms be used rather than the NLS algorithms?

- RCUK 2025 NLS guidelines can be used during neonatal unit and maternity unit stays, especially in preterm infants or term infants with primary respiratory problems.
- Use the RCUK 2025 NLS guidelines in out-of-hospital settings if the baby is less than 24 h old. In the absence of clear evidence, this is a pragmatic recommendation, and team skills and equipment should be considered.
- Using the RCUK 2025 PLS guidelines during the first hospital stay after birth can be considered in the following circumstances:
    - after cardiac surgery
    - in known cardiac arrhythmia
    - in other non-respiratory cardiac arrests.
- Organisations should develop local policies defining which guideline to use for which infants, applicable to the healthcare setting. Factors to take into consideration include:
    - individual NICU case-mix
    - algorithm familiarity and training
    - human and organisational factors.
- Teams should initiate effective resuscitation using the guideline they are most familiar with (NLS or PLS) across the team, summon appropriate help and switch guidelines if needed, in a timely, coordinated and well-communicated manner.
- These protocols should be incorporated into local resuscitation training programs.

When should the ALS algorithms be used rather than the PLS algorithms?

- If the rescuer considers a person to be an adult, they should use the adult algorithm; otherwise, they should use the paediatric algorithm.
- The differences in adult and paediatric resuscitation algorithms are primarily based on the distinct causes of cardiac arrest. However, if an adult person is mistakenly resuscitated using a paediatric algorithm, little or no harm will occur, as studies of aetiology have shown that the paediatric causes of arrest continue into young adulthood.

Weight and drug dosing in resuscitation

- While obtaining an accurate weight is important when calculating drug and fluid doses, weighing a child can be problematic in an emergency. The child's weight as reported by the parents/persons with parental responsibility is often the most accurate, and we recommend using this when available.
- When this is not available, a length-based method, corrected for body habitus, is generally more accurate than a formula for calculating actual body weight.
- For children with a **BMI in the normal range, actual body weight** should be used (as actual body weight will closely align with ideal body weight).
- For children with a **high BMI**, in most resuscitation situations, **ideal body weight** should be used. This is because using actual body weight may result in overdose and toxicity, particularly when using hydrophilic drugs (which do not distribute into excess fat tissue).
- Drugs used in resuscitation are mostly hydrophilic (e.g. adrenaline, calcium, potassium, salbutamol, magnesium, adenosine), with fewer being lipophilic (e.g. amiodarone). Therefore, it is important to adjust doses of most resuscitation drugs in obesity.
- Always refer to established paediatric emergency drug charts (e.g. Paediatric Emergency Chart) and guidelines for appropriate dosages and beware of exceeding adult doses.

Paediatric cardiac arrest

- Paediatric cardiac arrest is a rare event that can have devastating consequences for patients, their families and society.
- Even though cardiac arrest in children comprises a mere fraction of all cardiac arrests, their overall impact on society may be far-reaching, given the long-term consequences.
- These consequences may include increased lifelong healthcare costs and impaired ability to deal with daily life, which can limit participation in society during adulthood, including workforce participation.
- Despite some improvements in overall survival worldwide, the rate of survival with a good neurological outcome after paediatric out-of-hospital cardiac arrest (OHCA) remains poor, with major differences across Europe. This highlights the need for novel approaches to science, prevention, resuscitation and training.

- In adolescents, trauma, intoxications, and suicide attempts are among the leading causes of OHCA.
- Exercise-related paediatric OHCAs are rare but are associated with higher survival rates.
- Paediatric in-hospital cardiac arrest (IHCA) has better outcomes compared with paediatric OHCA.
- The main causes of paediatric IHCA are respiratory failure and shock. Common causes of peri-operative paediatric IHCA include hypoxia (e.g. airway management problems), bradycardia and haemorrhage.
- Paediatric IHCA is most common in neonates, infants, and children with complex chronic conditions, especially congenital heart disease.

Prevention

- The initial phase of prevention is most important, as cardiac arrest in children can be prevented by quick and effective treatment of a range of life-threatening illnesses.
- This approach is outlined in the prevention of cardiac arrest and special circumstances sections of these guidelines.

Prevention of cardiac arrest in children

- Cardiac arrest in infants, children and adolescents is most often secondary to progressive respiratory or circulatory failure, or to neurological emergencies and is not often due to primary cardiac causes. Therefore, for children, the recognition and proper management of critically ill children remains the best way to prevent cardiac arrest.

Recommendations for caregivers and other untrained rescuers

- All parents/persons with parental responsibility and caregivers should be encouraged to learn basic recognition of critical illness and injury and basic first-aid life-saving procedures.
- Simple recognition using triage tools and basic first-aid life-saving procedures should be taught to professional caregivers for children,

including child minders, schoolteachers, first responders, lifeguards and coaches/trainers of children and adolescents.

- Immediately call for medical help or call the ambulance service if a child has signs or symptoms that might indicate critical illness, such as those described in the BBB-tool (Behaviour-Breathing-Body colour), namely:
- **Behaviour:** A child who:
  - is not fully conscious or is difficult to rouse, floppy or rigid.
  - is having a seizure.
  - is confused, agitated, or interacting abnormally with the parents/caregivers.
  - is crying inconsolably.
  - is not able to move one or more limbs.
  - has severe pain or is unable to speak or walk, if previously able to do so.
- **Breathing:** A child who has difficulty breathing, such that they:
  - are unable to take a deep breath.
  - are working hard to take each breath (breathing fast, grunting, flaring of the nostrils, and indrawing between or under the ribs).
  - are making additional noises while breathing.
  - are breathing too fast, too slowly or irregularly, or stop breathing.
  - adopt an abnormal posture to aid breathing.
- **Body colour:**
  - The child's skin is cyanosed, mottled, abnormally pale or greyish. Look at the hand palms, soles of the feet and mucosal membranes, especially in children with dark skin tones.
- Parents/persons with parental responsibility of children with specific chronic conditions should have an emergency plan available for any sudden deterioration, and caregivers should be familiar with this and trained in initial life-saving procedures.

Recommendations for healthcare professionals

- Identify children with an increased risk of sudden cardiac arrest and formulate a care plan for these children.
- Use a dedicated quick-look tool (e.g. the above-mentioned BBB-tool or the paediatric assessment triangle) for the early recognition of a potentially critically ill child.
- Consider your own safety. Use appropriate personal protection equipment when indicated.

- Immediately perform an initial ABCDE assessment in any child who appears to be critically ill or severely injured. Initiate life-saving interventions as soon as a problem is identified.
- Activate additional resources (e.g. personnel, equipment) and establish a team with clearly defined individual roles and responsibilities as soon as possible.
- Use cognitive aids such as displayed algorithms and checklists to decrease cognitive load.
- Reassess the child after any intervention or when in doubt.
- Ask parents/persons with parental responsibility for an estimate of the child's weight or estimate this using length-based methods, which should ideally be corrected for body habitus.
- Use an individualised approach or modify interventions for children with chronic medical conditions or specific medical needs. Ask a parent/person with parental responsibility for relevant information about the condition if they have it.
- At all times, allow parents/persons with parental responsibility to stay with the child if this does not preclude their safety or the safety of the child or personnel.
- Include parents and those with parental responsibility in discussions and decision-making.
- Assign a dedicated team member to the care of parents/persons with parental responsibility, and ensure they are fully informed at all stages.

Recognition of the critically ill or injured child

- **Airway**
  - Check the patency of the airway and the presence of airflow using the look-listen-feel method.
  - Consider stridor or snoring to be a sign of partial airway obstruction.
  - Allow a conscious child to adopt the most comfortable position; do not force them to lie down.
- **Breathing**
  - Check for signs of respiratory insufficiency. Assess:
    - Work of breathing (respiratory rate, recession, grunting, nasal flaring, tracheal tug, positioning).
    - Effectiveness of breathing (chest expansion, character and strength of crying/speaking, auscultation (reduced air entry, symmetry, wheeze or crepitations), skin colour (cyanosis), arterial

oxygen saturation.
        - Systemic signs (heart rate, conscious level).
    - Monitor arterial oxygen saturation by pulse oximetry (SpO_2) continuously. Be aware that a pulse oximeter can be less reliable in children with darker skin tones or poor peripheral perfusion.
    - Monitor end-tidal carbon dioxide ($ETCO_2$) in all patients with an advanced airway (i.e. a tracheal tube or supraglottic airway device (SGA)). Consider capnography in patients with non-invasive ventilation.
    - Consider point-of-care ultrasound (POCUS) of the lungs and blood gas analysis.
    - Use multiple variables to recognise respiratory failure, as no single sign in isolation is indicative of this. Trends are more important than a single value.
- **Circulation**
    - Check for signs of cardiovascular insufficiency.
        - Cardiovascular signs (heart rate, pulse volume (peripheral and central), blood pressure, preload (jugular veins, liver span, crepitations).
        - Organ perfusion (capillary refill time, skin colour and temperature, urinary output, level of consciousness).
    - Attach an ECG monitor to assess the rhythm, and a non-invasive blood pressure (NIBP) monitor/device.
    - Consider serial lactate measurements if signs of shock are present.
    - Consider POCUS, which might help to distinguish the cause and type of shock.
    - Consider a 12-lead ECG.
    - Use multiple variables to recognise circulatory failure (shock) and the type of shock; no single sign in isolation is indicative of shock. Trends are more important than a single value.
- **Disability**
    - Check conscious level using the AVPU (Alert-Verbal-Pain-Unresponsive) scale, (paediatric) Glasgow Coma Scale (GCS) total score, or the GCS motor score, pupil size, symmetry, and reactivity to light and the presence of posturing or focal neurological signs.
    - Recognise seizures as a neurological emergency.
    - Check blood glucose.
    - Consider urgent brain imaging if neurological symptoms persist after ABC resuscitation.
- **Exposure**
    - Check body temperature.

- Undress the child and look for rashes, injuries and signs of physical child abuse and neglect.
- Look for signs and symptoms of potentially life-threatening conditions as described further below (e.g. anaphylaxis, sepsis).
- Try to identify any underlying conditions that might require a specific approach (e.g. intoxication, underlying chronic conditions).
- Use AMPLE (Allergy-Medication-Past History-Last Meal-Events) to quickly establish a basic medical history.
- Be alert to conditions in which cardiac arrest is imminent, such as:
    - airway obstruction
    - flail chest
    - silent chest
    - tension pneumothorax
    - massive haemorrhage
    - cardiac tamponade
    - intracranial hypertension
    - hypoglycaemia with coma
    - hypothermia
    - severe trauma
    - thrombosis.

Table 1: Approximate normal values for respiratory rate, heart rate and blood pressure. The values change continuously as the child grows. Use intermediate values for children between the specified ages in the table.

Age	1 month	1 year	2 years	5 years	10 years	18 years
Upper limit of normal range for RR	60	50	40	30	25	20
Lower limit of normal range for RR	25	20	18	17	14	12
Upper limit of normal range for HR	180	170	160	140	120	100
Lower limit of normal range for HR	110	100	90	70	60	60
p50 for systolic BP	75	95	98	100	110	120
p10 for systolic BP	55	75	77	80	85	105
p5 for systolic BP	50	70	73	75	80	90
p50 for MAP	55	70	73	75	75	75
p10 for MAP	45	55	58	60	60	65
p5 for MAP	40	50	53	55	55	60

RR = respiratory rate, HR = heart rate, BP = blood pressure, MAP = mean arterial pressure, p50/p10/p5 = 50th/10th/5th percentile of BP for the 50th percentile of the child’s height at that age.

Table 2: Clinical signs of respiratory and circulatory failure.

- Individual deviations are common, especially in children with chronic medical conditions. Be aware that cardiovascular collapse can also occur suddenly without any preceding symptoms or signs. Always use multiple variables to diagnose failure.

	Compensated	Decompensated (risk of cardiorespiratory arrest)
Respiratory failure	• Tachypnoea • Increased work of breathing • Normal, increased or slightly decreased tidal volumes. • Wheezing • Mild to moderate hypoxaemia (e.g. SpO_2 90-93% breathing air) • Normocapnia or hypocapnia • Agitation	• Bradypnoea, irregular breathing • Decreasing work of breathing • Grunting • Diminished chest excursions and/or air entry (silent chest) • Severe hypoxaemia (SpO_2 < 90% breathing air) • Hypercapnia • Decreased level of consciousness
Circulatory failure (shock)	• Tachycardia • Impaired peripheral perfusion • Decreased peripheral pulsations • Normal blood pressure • Agitation	• Bradycardia • Diminished central pulsations • Hypotension • Decreased level of consciousness

Principles of the management of the critically ill or injured child

- **Airway**
  - Establish airway patency to allow adequate oxygenation and ventilation.
  - Open the airway and keep it open. Use adequate positioning of the head and body alignment (head tilt and chin lift or jaw thrust), and remove secretions and other obstructing materials by careful suctioning if necessary.

- Consider a nasopharyngeal or oropharyngeal airway of the appropriate size in children with a decreased level of consciousness.
- Use an appropriately sized supraglottic airway device (e.g. laryngeal mask, i-gel) when indicated.
- Intubate the trachea of a child, when indicated and only if competent and have the necessary drugs and equipment immediately available; use an intubation checklist:
    - Always have a plan for the unexpected difficult intubation (e.g. SGA insertion, additional expertise).
    - Pre-oxygenate the child before induction of anaesthesia, avoid distending the stomach.
    - Use sedative and neuromuscular blocking drugs with a rapid onset of action, unless the child is deeply comatose.
    - Do not use atropine as a routine pre-medication.
    - The oral route for tracheal intubation is preferable during emergencies.
    - Use video laryngoscopy or direct laryngoscopy for tracheal intubation, depending on local protocols and rescuer experience. Do not use equipment you are unfamiliar with.
    - Consider the use of apnoeic oxygenation, or high-flow nasal oxygen, to avoid hypoxia during the procedure.
    - Limit the number of attempts at intubation to 4. Where intubation has failed, focus on oxygenation and call for additional help.
    - Limit each attempt to 30-60 s. Monitor SpO_2, heart rate and blood pressure during intubation and stop the attempt immediately in case of bradycardia or oxygen desaturation. Immediately recommence bag-mask ventilation or insert an SGA to restore oxygenation.
    - Use cuffed tracheal tubes for all children (over 30 days corrected gestational age). Monitor and limit cuff inflation pressure according to the manufacturer’s recommendations.
    - Provide adequate analgesia and sedation during and after intubation.
    - Confirm tube placement clinically and using $ETCO_2$ monitoring (providers with expertise may use POCUS in addition). Monitor SpO_2 and $ETCO_2$ continuously in all children with an advanced airway. Confirm the tube position with X-ray as soon as practicable.
- Use a front-of-neck airway (e.g. cricothyroidotomy or surgical airway) only as a last resort option in a "cannot-ventilate-cannot-oxygenate” situation. This should be performed by an individual trained in invasive

airway techniques.
    - In children with tracheostomies who develop difficulty breathing, suspect an obstruction of the tracheostomy tube:
        - Try to relieve the obstruction by suctioning the tracheostomy tube.
        - If a suction catheter cannot be passed, the tracheostomy tube should be removed immediately and replaced.
        - If a clean tube is not available, oxygen and ventilation via bag and mask should be given until the tube is cleaned and replaced.
        - **If the child's upper airway is patent**, it may be possible to provide oxygen and bag-mask ventilation via the nose and mouth whilst the tracheal stoma site is occluded.
        - **If the upper airway is not patent**, it may be possible to provide oxygen and bag-mask ventilation at the tracheostomy stoma site using a small face mask (or the end of an LMA used as a mask) over the stoma site.
        - In an emergency, tracheal intubation via the tracheostomy or upper airway (if patent) with a tracheal tube may be needed.
        - The National Tracheostomy Safety Project (NTSP) in the UK has developed specific emergency algorithms for children with tracheostomies, which should be followed.
- **Breathing**
    - Aim for adequate oxygenation and ventilation.
    - Initially give 100% oxygen for all children with respiratory, circulatory, or neurological failure.
    - Titrate the fraction of inspired oxygen (FiO_2) as soon as the SpO_2 can be monitored and avoid sustained readings of 100% (except in special circumstances, e.g. carbon monoxide intoxication, methaemoglobinaemia, cyanide poisoning or severe anaemia).
    - In previously healthy children aim for an SpO_2 of 94-98%. The goal is to achieve an SpO_2 of at least 94% with the lowest possible FiO_2.
    - Consider individualised targets for SpO_2 and $ETCO_2$ in children with specific conditions (e.g. cyanotic congenital heart defects, chronic respiratory failure).
    - Consider high-flow nasal oxygenation or non-invasive ventilation in children with hypoxaemia not responding adequately to conventional oxygen therapy.
    - Support inadequate spontaneous ventilation, using bag-mask ventilation as the first-line method:

        - Ensure correct head positioning, mask size and proper seal between the mask and the face.
        - Use a two-person approach (using both hands to hold the mask and to keep the airway open), especially if ventilation is difficult or when there is a risk of disease transmission. Consider airway adjuncts (e.g. oropharyngeal device).
        - Use an appropriately sized bag and sufficiently long inspiratory times to make the chest visibly rise (mild chest rise). Avoid hyperinflation and high peak inspiratory pressure.
        - Aim for a normal respiratory rate for the child's age (pragmatically use the following rates per minute: 25 in infants, 20 in children >1 y, 15 in children >8 y, 10 in children >12 y).
    - Consider the early insertion of an SGA or tracheal tube in cases when bag-mask ventilation does not improve oxygenation or ventilation, or when prolonged respiratory support is anticipated.
    - Check air leak, signs of aspiration, efficacy of ventilation in patients with SGA or tracheal tube.
    - In mechanically ventilated children:
        - Use tidal volumes of 6-8 mL kg^{-1} of ideal body weight and a respiratory rate at a low-normal range for the child's age.
        - Start with a positive end-expiratory pressure (PEEP) of 5 cm H_2O and adjust PEEP and FiO_2 to improve oxygenation, always titrating these to the minimum support needed to achieve the desired targets.
        - Individualise ventilator settings in specific conditions, seek the advice of a paediatric intensivist early if possible.
        - Minimise apparatus dead space, especially in infants.
        - Avoid both hyperventilation and hypoventilation. Monitor $ETCO_2$ and aim for normocapnia. Check partial pressure of carbon dioxide in arterial blood ($PaCO_2$) as soon as practicable to assess its relationship to $ETCO_2$.
    - Use **DOPES** to help identify the cause of a sudden, rapid deterioration in a ventilated child (e.g. bag-mask ventilation or mechanical ventilation):
        - **D**isplacement (mask, SGA, tracheal tube).
        - **O**bstruction (secretions, tube, circuit, airway – head position).
        - **P**neumothorax or other pulmonary pathology.
        - **E**quipment (disconnection, oxygen supply, tubing, valves, ventilator).

        - **S**tomach/stacking/sedation (abdominal distention, stacked breaths or insufficient sedation).
- **Circulation**
    - Aim for adequate organ perfusion.
    - In the case of circulatory failure (shock), do not spend more than 5 min (or two attempts) to establish intravenous (IV) access. Competent providers should use POCUS to guide IV cannulation.
    - Establish intraosseous (IO) access as a rescue alternative if IV access fails or when the chances for a successful IV-cannulation are considered minimal:
        - Use an IO-needle of appropriate size.
        - Provide effective analgesia (e.g. intranasal ketamine) unless the child is comatose.
        - Use manual infusion or a high-pressure bag for fluid infusion.
        - Monitor for signs of extravasation and displacement.
    - Give one or more fluid boluses of 10 mL kg^{-1} in children in hypovolaemic, obstructive or distributive shock.
        - Use balanced isotonic crystalloids as the first-line choice of fluids. If unavailable, use normal saline, which may be the preferred fluid in diabetic ketoacidosis and severe traumatic brain injury.
        - Give repeated 10 mL kg^{-1} boluses, as necessary. A total of 40-60 mL kg^{-1} may be needed during the first hour of treatment of hypovolemic or distributive shock.
        - Reassess the child after each bolus, looking for signs of fluid overload or cardiac failure (e.g. lung crepitations, increasing liver edge, raised jugular venous pressure).
        - If the signs of shock recede, continue maintenance fluids and rehydration at a slower pace.
        - Consider vasoactive drugs and respiratory support if repeated fluid boluses are required.
    - Consider the need for fluids in cardiogenic shock on an individual basis. Fluids might still be needed, but should be given more cautiously, e.g. 5 mL kg^{-1} fluid bolus.
    - Assess the type of shock; POCUS may be of value for this.
    - Start vasoactive drugs early, as a continuous infusion via a central or peripheral line, and not later than after three to four fluid boluses (30-40 mL kg^{-1}):
        - Titrate the infusion rate according to clinical and other signs, not solely based on blood pressure targets, which may differ according to the pathology, age and response. Aim for the 5th percentile as a

minimum.
        - Use noradrenaline as a first-line vasopressor and adrenaline as a first-line inotrope. Use milrinone as a first-line inodilator.
        - Consider the use of POCUS, echocardiography, lactate and mixed venous oxygen saturation (SvO_2) to further guide clinical decision-making, if the expertise is available.
    - Treat arrhythmias if present.
    - Initiate other specific treatments according to the type of shock.
    - Seek expert advice on extracorporeal support (e.g. ECMO) in children with refractory shock or specific conditions (e.g. congenital heart disease).
- **Disability**
    - Aim for neuroprotection (see the section on post-resuscitation care).
    - Ensure adequate oxygenation, ventilation, and circulation.
    - Treat clinical and electroencephalographic seizures. Follow a time-critical protocol for the management of status epilepticus.
    - Treat hypoglycaemia, orally, if possible, with 0.3 g kg^{-1} glucose as soon as this is detected. If oral intake is not possible, give an IV bolus of 0.2 g kg^{-1} glucose (2 mL kg^{-1} 10% glucose) and re-check blood glucose after 5-10 min and repeat if necessary.
    - When IV glucose is not available, give glucagon as a temporary rescue measure: glucagon IM or SC, 0.03 mg kg^{-1} (or 1 mg if > 25 kg or 0.5 mg if < 25 kg) OR intranasally 3 mg if 4-16 yr.
    - Ensure (preferably continuous) analgesia and sedation in children with discomfort or pain. Anticipate and prevent hypotension.
    - Consider the possibility of paediatric stroke or neuroinfection and quickly seek expert help.
- **Exposure**
    - Avoid hypothermia and hyperthermia and start specific measures if present.
    - Consider antibiotics and/or antiviral medication if a bacterial or viral cause of critical illness is likely (e.g. in sepsis, meningoencephalitis, severe pneumonia).
    - Protect the best interests of the child according to the local ethical and legal policies in case of a suspicion of inflicted injury (child abuse and neglect).

Paediatric basic life support (PBLS)

Recommendations for untrained rescuers and dispatcher-assisted CPR

- If you encounter a child who appears to be unresponsive and you have no training in PBLS, ensure your own safety and that of the child and follow the **3 steps to save a life:**
  - **Check** if the child reacts to a non-painful stimulus.
  - **Call** the ambulance service immediately if the child does not react and follow the dispatcher's advice.
  - **CPR:** Start CPR immediately following the instructions of the dispatcher.

- Ambulance service call handlers should encourage bystanders to perform both rescue breaths and chest compressions in children of all ages. They should actively ask about signs confirming that the rescue breaths are effective (e.g. whether the chest rises and falls).
- Ambulance service call handlers should use a 30:2 ratio for CPR instructions with 5 initial rescue breaths for untrained bystanders or bystanders trained only in adult BLS.
- If the bystanders are not willing or able to perform rescue breathing, dispatchers should encourage compression-only CPR in all children.
- Ambulance service call handlers should instruct bystanders to use age-specific techniques for chest compressions and breathing in infants, children and adolescents.

Recommendations for PBLS in paediatric OHCA

- Ensure your own safety and that of the child.
- Use verbal and tactile stimulation to assess responsiveness. Do not use painful stimuli.
- Call, or have someone call, the ambulance service immediately, using speaker function of your mobile phone. Some ambulance services may enable you to use the video function of your phone when possible. Follow the advice of the dispatcher who can help you to recognise if you need to start CPR. If you are trained in PBLS, check the breathing as described below while waiting for the connection with the dispatcher.
- Use the head tilt chin lift manoeuvre to open the airway, assess breathing and look for signs of life for no longer than 10 s.

- Give five initial rescue breaths.
- Immediately proceed with chest compressions.
- Continue CPR. Use a compression-to-ventilation ratio of 15:2 if you are specifically trained in PBLS; otherwise, use a ratio of 30:2.
- Focus on consistently high-quality compressions and effective ventilations. Minimise chest compression pauses.
- If a second rescuer is available, they should call the ambulance service while the first rescuer starts CPR and then bring and attach an automated external defibrillator (AED) as soon as possible for children of all ages. Once attached, follow the instructions of the AED.
- If there is only a single rescuer, calling the ambulance service and starting CPR should be prioritised over fetching and attaching an AED.
- Do not interrupt CPR unless there are clear signs of life, or you are instructed to do so by the AED.
- In an unresponsive child who is clearly breathing effectively, keep the airway open by continued head tilt, chin lift or positioning the child in a recovery position, especially if there is a risk of vomiting, but not in trauma.
- Check the breathing continuously or at least every minute if the child is placed in a recovery position. If in doubt about the stability of the position or the quality of the breathing, turn the child onto their back and open the airway with the head tilt chin lift manoeuvre.
- **Airway and assessment of breathing:**
    - Keep the head in the neutral position in infants by slightly tilting the head and lifting the chin with two fingers on the chin bone without pressing on the soft tissues (head tilt chin lift manoeuvre). In older children, more head tilt will be needed. In adolescents, full extension of the head is needed as in adults.
    - Look for chest movement, listen and feel for the flow of air from the nose and/or mouth. If the chest is moving but there is no airflow, the airway is not open. Immediately try to improve the airway opening manoeuvre.
    - If you have any doubt whether breathing is normal, act as if it were not normal.
- **Rescue breaths without equipment:**
    - Ensure the airway is open and blow steadily into the child’s mouth (or infant’s mouth and nose) for about 1 s, sufficient to make the chest visibly rise and then allow the chest to fall back passively while you take your next breath.
    - If the chest does not rise, the airway may be obstructed:

        - Remove any visible obstruction in the mouth if it is easy to do so. Do not perform a blind finger sweep.
        - Reposition the head or adjust the airway opening method by further lifting the chin or tilting the head.
- **Chest compressions:**
    - Perform chest compressions on a firm surface if immediately available. Remove clothes only if they hinder chest compressions.
    - Perform chest compressions over the lower half of the sternum (breastbone) in all age groups.
    - Use the two-thumb encircling method for chest compressions in infants.

    - Use the one-hand or two-hand technique in children older than 1 year, or when unable to give high-quality chest compressions with the two-thumb-encircling technique.
    - Deliver high-quality chest compressions as defined by:
        - Rate of 100-120 min^{-1}.
        - Depress the chest by at least one third of the anteroposterior dimension. Use the adult depth recommendation of 5-6 cm in adolescents, and do not exceed a depth of 6 cm at any age.
        - Avoid leaning by releasing all pressure between compressions and allow the chest to rise again completely (chest recoil).
        - Do not interrupt chest compressions except when giving ventilations, or if you are instructed to do so by the AED.
- **Using an Automated External Defibrillator:**
    - Follow the instructions of the AED.
    - Apply the pads with minimal interruptions in CPR (one person applying the pads, a second performing CPR).
    - Activate the paediatric mode, if available, in all infants and children weighing less than 25 kg (i.e. approximately 8 years of age). In larger children and adolescents, use the AED in standard adult mode. If the AED does not have instructions for children, use it in standard adult mode.
    - Place adult-size pads as follows:
        - Use the anteroposterior position in infants and children weighing less than 25 kg: the anterior pad is placed mid-chest immediately left of the sternum, and the posterior pad on the back, placing the centre of the pad between the scapulae (shoulder blades).
        - Use either the anterolateral or the anteroposterior position in children weighing more than 25 kg and adolescents. In the anterolateral position, one pad is placed below the right clavicle

and the other in the left axilla. If the anteroposterior position is used in adolescents, avoid placing the pads over breast tissue.
    - Do not touch the patient while the AED is analysing the rhythm.
    - Restart chest compressions immediately after shock delivery.

Additional considerations for PBLS and IHCA

- In the hospital, healthcare professionals should call for the help of a colleague as soon as deterioration is detected and not wait for cardiac arrest.
- They should then check for breathing and other signs of life.
- If they suspect a cardiac arrest or a critical situation, one person should call the resuscitation or emergency medical team, while the other person starts CPR as described above, using a compression-to-ventilation ratio of 15:2.
- Competent providers should use bag-mask ventilation with oxygen.
- If starting ventilations is not immediately possible (e.g. bag-mask ventilation is not immediately available and there is a contraindication to mouth-to-mouth ventilation), start chest compressions immediately and add ventilations as soon as possible.
- Competent providers can also use a pocket mask for rescue breaths to ventilate larger children when a bag and mask is not available.
- Activate the CPR mode on the bed to increase the stiffness of the mattress (if the bed is equipped with this function).
- Over-the-head chest compressions can be used in certain specific situations, such as limited space or limited personnel.
- The anterolateral pad position can be used by competent providers in children ≤ 25 kg when using paediatric pads, provided these do not touch each other.
- A single rescuer without a mobile phone should perform CPR for 1 min before going to seek help.

Foreign body airway obstruction

- Suspect choking due to a foreign body if the child is unable to speak (children and adolescents) or cry aloud (infants or smaller children), especially during feeding, eating, or playing unsupervised.
- Call or have someone call the ambulance service as soon as possible.
- Encourage an older child or adolescent to cough.

- Give up to 5 back blows if coughing is not possible or becoming ineffective:
    - Turn the infant face down on your forearm with your forearm resting on your leg. Support the head of the infant with your hand. Try to hold the head below the level of the thorax. Give a sharp blow between the shoulder blades. Repeat up to 5 times or until the obstruction is relieved.
    - Lean children and adolescents forward and give blows between the shoulder blades. Repeat up to 5 times.
- Give up to 5 chest/abdominal thrusts if back blows are not effective:
    - In infants:
        - Turn the infant onto their back and lay them on your knees.
        - Use the two-thumb encircling technique to perform chest thrusts as advised for chest compressions, but compressing the sternum more sharply. Repeat up to 5 times or until the obstruction is relieved.
    - In children and adolescents:
        - Stand behind the child and put your arms around the upper part of their abdomen.
        - Lean them forward.
        - Clench your fist and place it between the navel (umbilicus) and the end of the breastbone (xiphoid).
        - Grasp your fist with the other hand and pull sharply inwards and upwards.
        - Repeat up to 5 times or until the obstruction is relieved.
    - If the child is still conscious, repeat the back blows up to 5 times, alternating these with up to five chest/abdominal thrusts.
    - Stop back blows or chest/abdominal thrusts immediately if at any time there are signs of relief of the obstruction (coughing, loud breathing or crying).
- Do not use blind sweeps to clear the obstruction from the mouth, but use a single sweep to remove a clearly visible obstruction.
- Call for help and the ambulance service as soon as practical (if you have not already done so), at the latest when the child loses consciousness.
- Start CPR immediately with five rescue breaths as soon as the child becomes unconscious.
- RCUK and ERC are unable to make a recommendation for or against the use of suction-based devices advertised and marketed for clearing a foreign body airway obstruction, because of insufficient evidence.

Paediatric advanced life support (PALS)

- Use a team approach, define clear roles for each team member, and train in simulated scenarios (i.e. the best way for your own team to resuscitate a child, including roles and sequences of action).
- Commence or continue with high-quality chest compressions and ventilations.
- Recognise cardiac arrest on clinical grounds (e.g. no signs of life) or based on monitored vital signs (e.g. ECG, loss of SpO_2 and/or $ETCO_2$, loss of pulsatile intra-arterial blood pressure trace).
- Importantly, chest compressions should also be started in children who become bradycardic (< 60 min^{-1}) with signs of poor perfusion despite adequate respiratory support, even if there is still a detectable pulse.
- Apply cardiac monitoring as soon as possible, if not already in place, using self-adhesive defibrillator pads as the first choice, as this allows for a shorter time to defibrillation in children who require it.
- Differentiate between shockable and non-shockable cardiac rhythms.

Non-shockable rhythms

- Non-shockable rhythms are bradycardia (with poor perfusion), pulseless electrical activity (PEA) and asystole.
- Obtain vascular access and give adrenaline IV/IO (10 mcg kg^{-1}, max 1 mg) as soon as possible, followed by a flush to facilitate drug delivery. Immediately attempt IO access if IV access is likely to be difficult.
- Repeat adrenaline IV/IO every 3-5 min (i.e. every other 2 min cycle) unless being guided by pulsatile intra-arterial blood pressure monitoring and the haemodynamic response.
- Reassess the cardiac rhythm every 2 min (< 5 s). If the rhythm has changed to an organised rhythm which could produce cardiac output, check for signs of life and feel for a central pulse (max. 5 sec).
- Change the person doing chest compressions at least every 2 min. Watch for fatigue and/or suboptimal chest compressions and switch rescuers earlier if necessary.

Shockable rhythms

- Shockable rhythms are pulseless ventricular tachycardia (pVT) and ventricular fibrillation (VF).
- As soon as identified, give one defibrillation shock (regardless of the ECG amplitude). If in doubt, consider the rhythm to be shockable.
- If using self-adhesive pads, continue chest compressions while the defibrillator is charging.
- Ensure that there is no leakage of oxygen around the chest during defibrillation. In small children, the self-inflating bag may be very close to pads; direct the oxygen away from the chest or disconnect the bag, if necessary, before charging the defibrillator. Do not disconnect the tracheal tube if a closed circuit is being used, e.g. during mechanical ventilation.
- Once charged, pause chest compressions, briefly check that the rhythm is still shockable (< 5 s) and ensure all persons are clear of the child before giving a single shock.
- Minimise pauses between stopping chest compressions, delivery of the shock and restarting chest compressions (< 5 s).
- Give one shock (4 J kg^{-1}, max. 120-200 J) and immediately resume CPR for 2 min.
- Reassess the cardiac rhythm:
    - If the rhythm changes to an organised rhythm which could produce a cardiac output, check for signs of life and feel for a central pulse (< 5 s) **OR**
    - If a shockable rhythm persists, give a 2nd shock (4 J kg^{-1}) and immediately resume CPR for 2 min, then reassess and continue to repeat this cycle.
- Give adrenaline (10 mcg kg^{-1}, max. 1 mg) and amiodarone (5 mg kg^{-1}, max. 300 mg) IV/IO immediately after the third shock. Flush after each drug. Lidocaine IV (1 mg kg^{-1}) might be used as an alternative if amiodarone is not available or a local decision has been made to use lidocaine instead of amiodarone.
- Give a second dose of adrenaline (10 mcg kg^{-1}, max 1 mg) and amiodarone (5 mg kg^{-1}, max 150 mg) IV/IO immediately after the fifth shock.
- Unless there are clear signs of life, adrenaline IV/IO should be repeated every 3-5 min (i.e. every other 2 min cycle) unless being guided by pulsatile intra-arterial blood pressure monitoring and the haemodynamic response.
- Change the person doing compressions at least every 2 min. Watch for fatigue and/or suboptimal compressions and switch rescuers earlier if necessary.
- CPR should be continued unless:

- An organised rhythm is recognised at a rhythm check; It is accompanied by signs of return of spontaneous circulation (ROSC), identified clinically (e.g. eye opening, movement, normal breathing) and/or by monitoring (e.g. $ETCO_2$, SpO_2, blood pressure, echocardiogram) and/or presence of a palpable central pulse.
- Perfusion is restored by extracorporeal cardiopulmonary resuscitation.
- Criteria for withdrawing resuscitation are met (see Ethics in Resuscitation Guideline).

Defibrillation during PALS

- Manual defibrillation is the recommended method for PALS. If this is not immediately available, an AED should be used.
- Proper planning before each defibrillation will minimise hands-off time.
- Pads should be positioned either in the anterolateral or the anteroposterior position:
  - Avoid contact between pads as this can cause charge arcing.
  - In the anterolateral position, one pad is placed below the right clavicle and the other in the left axilla.
  - In the anteroposterior position, the anterior pad is placed mid-chest, immediately left of the sternum, and the posterior pad in the middle of the back between the scapulae.
  - Use the anteroposterior position in infants and children (< 25 kg) who can easily be turned onto their side for pad placement and in whom the anterolateral position is more difficult to achieve without contact between the pads.
  - Use the anterolateral position in larger children, as this leads to less interruption of chest compressions than the anteroposterior position. Avoid breast tissue in adolescents.
- Defibrillation with self-adhesive pads is standard.
- Use 4 J kg^{-1} as the standard energy dose for the initial shocks. It seems reasonable not to use doses above those suggested for adults (120-200 J, depending on the type of defibrillator).
- Increase the energy dose stepwise, increasing up to 8 J kg^{-1} (max. 360 J) for refractory VF/pVT (i.e. more than five shocks are needed).
- Charge the defibrillator with the pads or paddles on the chest. Continue chest compressions while the defibrillator is charging when using pads.
- If any period of ROSC is achieved and the child goes back into a shockable rhythm, use the defibrillation energy dose that was previously successful.

Oxygenation and ventilation during PALS

- Effective oxygenation and ventilation combined with high-quality chest compressions are essential during CPR to generate sufficient coronary perfusion to restart the heart.
- Oxygenate and ventilate with a bag and mask, using 100% oxygen. Do not titrate FiO_2 during CPR.
- Intubate the child only if you are experienced and competent and have all the necessary equipment. If not, continue to ventilate using a bag and mask or insert a supraglottic airway (SGA). Ensure the chest rises during ventilation. If not, adjust the airway or ventilation technique.
- Use a tracheal tube or SGA if CPR is required during transport; when prolonged resuscitation is anticipated, or when it is impossible to ventilate with a bag and mask. Call for expert help if this is not already present.
- Do not interrupt chest compressions during airway management. Use $ETCO_2$ monitoring to ensure correct ventilation when a tracheal tube or SGA is in place.
- Avoid hypo- or hyperventilation.
- Give continuous chest compressions when the airway is managed with a tracheal tube or SGA and ventilate without pausing chest compressions. Pausing only briefly for each rhythm check.
- Ventilate at the lower limit of the normal rate for age, e.g. pragmatically use breaths min^{-1}: 25 (infants), 20 (> 1 y), 15 (> 8 y), 10 (> 12 y).
- If there is doubt about the effectiveness of ventilation (e.g. high air leak, diminished air entry into lungs) during continuous chest compressions, return to a chest compression to ventilation ratio of 15:2.
- For children who go into cardiac arrest on a mechanical ventilator, either disconnect the ventilator and ventilate with a self-inflating bag/anaesthetic circuit (depending on expertise) or continue to ventilate with the mechanical ventilator (ensuring the child is adequately ventilated). In the latter case, ensure that the ventilator is in a volume-controlled mode, that triggers and limits are disabled, and that the ventilation rate, tidal volume and FiO_2 are appropriate for CPR. There is no evidence to support any specific level of PEEP during CPR. Always consider ventilator dysfunction as a possible cause of cardiac arrest.
- Titrate FiO_2 to an SpO_2 of 94-98% after ROSC.

Measurable factors during PALS

- **Capnography:** Use $ETCO_2$ monitoring once a tracheal tube or an SGA is in place to assess the quality of chest compressions and to help verify ROSC.
- **Invasive blood pressure:** If a pulsatile intra-arterial line is in situ during CPR, monitor the diastolic blood pressure values in response to chest compressions and drugs (e.g. adrenaline). Aim for an intra-arrest diastolic blood pressure of at least 25 mmHg for infants and at least 30 mmHg for children and adolescents.
- **Point-of-care ultrasound:** Use POCUS only if you are competent in its use during CPR, and it does not compromise the quality of chest compressions.
- **Point-of-care blood analysis:** Check a minimum of glucose, potassium, haemoglobin, lactate and blood gas analysis, and treat as appropriate.

Reversible causes of paediatric cardiac arrest

- Seek and identify any reversible cause for cardiac arrest early and treat appropriately.
- Use the mnemonic ‘4H and 4T’

Table 3: Reversible causes of cardiac arrest

Consider	Identification	Treatment in cardiac arrest
Hypoxia	History/clinical exam/SpO_2 and/or PaO_2 pre-arrest or intra-arrest.	Ventilate with 100% oxygen. Insert an advanced airway if bag-mask ventilat Ensure adequate chest rise. Check for leaks, air entry, abdominal distentio breaths if an advanced airway is in situ.
Hypovolaemia	History (sepsis, haemorrhage, diarrhoea, anaphylaxis) POCUS.	• Fluid boluses 10 mL kg^{-1} isotonic crystallo products for major haemorrhage.
Hyper-/hypokalaemia and other metabolic derangements	Hyperkalaemia	
	History (massive haemolysis, tumour lysis syndrome, crush syndrome, acute or chronic renal failure, malignant hyperthermia, specific intoxications). Blood gas analysis with electrolytes.	In cardiac arrest with severe hyperkalaemia (> • give 0.1 unit kg^{-1} short-acting insulin (max mL kg^{-1} 10% glucose (max 250 mL) as an • an IV/IO infusion of a short-acting $beta_2$-ac (e.g. salbutamol 5 mcg kg^{-1}). • Consider extracorporeal potassium removal
	Hypokalaemia	
	History (diarrhoea, vomiting, diabetes insipidus, specific medications, hyperaldosteronism). Blood gas analysis with electrolytes.	In cardiac arrest associated with severe hypoka mmol L^{-1}), • give 1 mmol kg^{-1} (max 30 mmol) potassiu ^{1} for 10 min followed by the rest of the dos in 5-10 min. • Repeat, if necessary, until the serum potass mmol L^{-1}. Consider magnesium for concor hypomagnesaemia.
	Hypoglycaemia	

History and blood analysis.	• Give an IV bolus of 0.2 g kg^{-1} glucose (e.g. 2 mL kg^{-1} 10% glucose) and re-check blood glucose after 5-10 min. • Repeat if necessary.	
Other metabolic derangements		
History and blood analysis.	• Correct calcium, magnesium and other metabolic derangements.	
Hypo-or hyperthermia	Hypothermia	
	History/situation and core temperature.	Modify the PALS algorithm: • < 30°C: give a single dose of adrenaline un immediate initiation of extracorporeal life s maximum of three shocks if a shockable rh if this is ineffective, delay further attempts temperature > 30°C. • 30-35°C: adrenaline IV/IO every 8 min (6- dose amiodarone IV/IO after 8 min, normal defibrillation (every 2 min). • > 35°C: normal algorithm. • Consider transport to a centre for extracorp • > 32°C: warm using external rewarming m (hypothermia is unlikely to be the primary arrest). • < 32°C: use active external and internal rew including extracorporeal techniques.
	Hyperthermia	
	History and core temperature.	• External cooling. • If drug-mediated, consider antidotes or oth

Thromboembolism	History (children with indwelling central lines, cardiac conditions, cancer, recent trauma, recent surgery) and POCUS.	• Consider IV thrombolysis.
Tension pneumothorax	History (trauma, positive pressure ventilation, acute severe asthma exacerbation) Examine for symmetrical air entry and POCUS.	• Needle thoracocentesis/thoracostomy (traun
Tamponade	History (cardiac surgery, penetrating chest trauma, acute viral pericarditis) and POCUS.	• Pericardiocentesis/thoracotomy (trauma).

Extracorporeal CPR

- Consider extracorporeal CPR (ECPR) as an early intervention for selected infants and children with IHCA (e.g. children with cardiac conditions in the paediatric intensive care unit, perioperative children) and OHCA (e.g. a refractory shockable rhythm) in settings where resources allow ECPR.

Special circumstances

- This section outlines the approach to recognition and management in specific acute paediatric conditions to prevent cardiac arrest and the considerations and/or modifications that may be required to standard paediatric CPR.

Arrhythmias

- In children with **circulatory failure due to bradycardia:**
  - Seek the advice of a paediatric cardiologist early.
  - Improve oxygenation, ventilation, and circulation.
  - In patients with bradycardia and poor perfusion not responding to oxygenation and ventilation, start chest compressions.
  - Consider adrenaline as small IV bolus doses (e.g. 1-2 mcg kg^{-1}) or as a continuous infusion.

    - Consider transthoracic pacing only in specific cases of bradycardia (e.g. complete heart block, sick sinus syndrome).
    - Consider atropine only in specific cases of bradycardia (e.g. induced by increased vagal tone or by a cardiac conduction disease); dose IV atropine 20 mcg kg^{-1} (max. 0.5 mg).
- In children with **circulatory failure due to tachyarrhythmia:**
    - Seek the advice of a paediatric cardiologist early.
    - In patients with decompensated circulatory failure regardless of the origin of tachycardia (supraventricular or ventricular), perform immediate synchronised cardioversion starting with 1 J kg^{-1}, doubling the energy with each subsequent attempt up to a maximum of 4 J kg^{-1}. Have a 12-lead ECG running during the cardioversion attempt. If the child is not comatose, ensure adequate analgesia and sedation according to local protocols. Reassess signs of life and pulse after each attempt. While waiting for anaesthesia and the defibrillator, chemical cardioversion (see below) can be attempted, but it should not delay the cardioversion attempt.
    - In patients with narrow complex supraventricular tachycardia (SVT) who are not in decompensated circulatory failure:
        - Consider vagal manoeuvres (e.g. modified Valsalva or ice pack to the face).
        - Consider IV adenosine as a rapid flush of 0.1-0.2 mg kg^{-1} (max. 6 mg) via a large vein. Ensure a 12-lead ECG is running during the administration of adenosine.
        - If the SVT persists: give a second dose of 0.3 mg kg^{-1} (max. 12-18 mg) after at least 1 min.
        - Seek the advice of a paediatric cardiologist. Consider cardioversion or alternative medications (e.g. amiodarone), especially in children with sinus node disease, pre-excited atrial arrhythmias, a history of heart transplant or severe asthma.
    - In patients with a wide QRS tachycardia who are not in decompensated circulatory failure:
        - Try vagal manoeuvres, which might provide diagnostic insight (e.g. into an SVT with abnormal conduction).
        - Seek the advice of a paediatric cardiologist. Pharmacological treatment options include amiodarone, lidocaine, esmolol, magnesium sulphate, and procainamide.
        - In torsade-de-pointes VT, give IV magnesium sulphate 50 mg kg^{-1} (max. 2 g).

Asthma

- In children with **severe acute asthma** (critical asthma syndrome):
  - Give 100% oxygen.
  - Give (intermittent or continuous) short-acting $beta_2$-adrenergic agonists via pressurised metered-dose inhalers with a spacer or by nebulisation (e.g. salbutamol 100 mcg per dose at 4-10 puffs every 20 min or by nebulisation with 100% oxygen 2.5-5 mg in sterile 0.9% sodium chloride in a volume suitable for the type of nebuliser, run until empty).
  - Give inhaled ipratropium with $beta_2$-adrenergic agonists as required in the following doses:
    - 1 month to 5 years 125-250 mcg (max 1 mg day^{-1})
    - 6 to 11 years 250 mcg (max 1 mg day^{-1})
    - 12 to 17 years 500 mcg (max 2 mg day^{-1}).
  - Give prednisolone 1-2 mg kg^{-1} orally or IV (max. 40 mg) or dexamethasone 0.3-0.6 mg kg^{-1} (max. 16 mg) within the first hour.
  - Consider adding high-dose inhaled corticosteroids in a severe crisis.
  - Consider IV magnesium sulphate 40 mg kg^{-1} (max 2 g) over 20 min in children who fail to respond to initial treatment.
  - Consider a loading dose of IV short-acting $beta_2$-adrenergic agonists (e.g. 5-15 mcg kg^{-1} salbutamol over 10 min, max. doses of 250-750 mcg have been used) which may be followed by an infusion depending on clinical severity (e.g. salbutamol 1-2 mcg kg^{-1} min^{-1}). Monitor potassium levels, lactate, blood glucose and ECG.
  - Consider a trial of non-invasive ventilation provided the child still has sufficient respiratory drive.
  - Consider tracheal intubation and invasive ventilation (and anticipate potential serious side effects), or extracorporeal life-support in near-fatal asthma (e.g. exhaustion, severe hypoxia despite high flow oxygen and adequate medication).

Cardiac arrest in children with congenital heart disease

- Follow the standard PALS algorithm with additional considerations for pulmonary hypertension, obstructed cardiac shunt or if the child is attached to a defibrillator and has a witnessed shockable rhythm.

Pulmonary hypertension

- Suspect pulmonary hypertension in children with congenital heart disease or chronic lung disease, but also as a primary disease.
- Anticipate and prevent pulmonary hypertensive crises by avoiding triggers such as pain, anxiety, excessive tracheal tube suctioning, hypoxia, hypercapnia, and metabolic acidosis.
- Treat pulmonary hypertensive crises with a high concentration of oxygen, adequate ventilation, analgesia and sedation and with muscle relaxation as necessary.
- Search for and treat other possible reversible causes of increased pulmonary vascular resistance: inadvertent interruption of pulmonary hypertensive therapy, arrhythmia, cardiac tamponade, or drug toxicity.
- Consider inotropic and or vasopressor therapy to avoid or treat right ventricular ischaemia caused by systemic hypotension.
- Additional therapies, which are indicated if the crisis does not rapidly resolve or in the case of cardiac arrest, are inhaled nitric oxide (iNO) and/or intravenous prostacyclin.
- Consider extracorporeal life support if medical management is ineffective.

Cardiac arrest due to obstruction of a cardiac shunt

- Suspect acute obstruction due to thrombosis or mechanical kinking of connections between the systemic and pulmonary circulation in children with aortopulmonary shunts or ductus arteriosus stents as a cause of cardiac arrest.
- Give 100% oxygen to maximise alveolar oxygenation.
- Consider hypovolaemia and treat this with intravascular fluids if necessary.
- Ensure an adequate systemic blood pressure to optimise shunt and coronary perfusion pressure with vasoactive agents and inotropes.
- Ensure adequate anticoagulation, e.g. with a bolus of heparin 50-100 units kg^{-1} followed by a titrated continuous infusion.
- Call for immediate expert help and consider interventional catheterisation or surgery. In the direct post-operative period, immediate re-sternotomy may improve shunt perfusion.

Cardiac arrest in an ECG-monitored child attached to a defibrillator with a witnessed shockable rhythm

- As soon as a shockable rhythm is detected, give up to three quickly successive (stacked) shocks using the standard energy doses for the child's weight.
- Recharge the defibrillator and rapidly check for a rhythm change and signs of life after each defibrillation attempt and, if necessary, immediately give a further shock.
- Start chest compressions after the third defibrillation attempt and continue CPR for 2 min.
- If the child remains in a shockable rhythm, adrenaline and amiodarone would be given after the 5th shock, with a second dose of amiodarone after the 7th shock.

Cardiac arrest in the operating theatre

- Clarify roles and procedures during the team briefing before high-risk cases to enable coordinated actions should cardiac arrest occur.
- Treat pre-arrest states such as hypoxia and hypotension aggressively. Ventilate with 100% oxygen and give intravascular fluid and vasoactive agents.
- Recognise cardiac arrest early by continuous monitoring and a high index of suspicion, particularly during difficult airway management and massive bleeding.
- Start chest compressions if extreme bradycardia or hypotension (< 5th percentile for age) occurs suddenly despite interventions, or the waveform capnography suddenly decreases.
- Inform the whole operating team of the cardiac arrest.
- Call for help and for the defibrillator.
- Optimise the child's position and the height of the operating table to facilitate high-quality chest compressions.
- Ensure the airway is secure, review the $ETCO_2$ tracing, and deliver effective ventilation with 100% oxygen.
- Follow the general PALS algorithm and focus initially on the most likely reversible causes: hypovolaemia (haemorrhage, anaphylaxis), hypoxia, tension pneumothorax, thrombosis (pulmonary embolism) and toxic agents (medication).
- Use POCUS, when the equipment and expertise are available, to help identify the cause and guide resuscitation, provided this does not compromise the quality of the resuscitation.

- Consider causes specific to the operating room, such as gas embolism, bradycardia from axial nerve blocks, malignant hyperthermia, local anaesthetic overdose, and other drug errors.
- For hypotensive and/or bradycardic children in a pre-arrest state, give smaller incremental bolus doses of IV adrenaline initially (e.g. 1-2 mcg kg^{-1} intravenously). If the child progresses to cardiac arrest, give adrenaline according to the standard PALS algorithm.
- If the facilities and expertise are available and conventional CPR is failing, consider early ECPR or open chest cardiac compressions as an alternative if ECPR is unavailable.

Cardiac tamponade

- Suspect cardiac tamponade, especially after cardiac surgery, in penetrating chest trauma and pericarditis.
- Use clinical signs and POCUS to recognise cardiac tamponade, which is most common post-cardiac surgery, in penetrating chest trauma, and some viral illnesses.
- Perform urgent pericardiocentesis, mini-thoracotomy, resuscitative thoracotomy or re-sternotomy depending on the setting and available expertise.

Drowning

- Reverse hypoxia and treat respiratory failure early to prevent cardiac arrest following drowning.
- Manage cardiac arrest following drowning with standard PALS with additional attention to reversing hypoxia and hypothermia.
- Remove the child as quickly and safely as possible from the water.
- Do not enter the water unless you are trained to rescue a person from the water.
- Try to reach the child from the land and provide a flotation device such as a lifebuoy or other rescue equipment.
- Start ventilation in the water if you are trained to do so and have a floatation device, and the child is unconscious and not breathing.
- Start standard PBLS with five rescue breaths as soon as it is safe to do so (e.g. on land or on a boat).

- Give 100% oxygen as soon as it is available. Intubate the child if the expertise and equipment are available.
- Attach an AED after drying the chest. Uninterrupted CPR and oxygenation take priority over the AED.
- Assess ABCDE and stabilise the child if not in cardiac arrest. Prevent cardiac arrest by identifying and treating respiratory insufficiency and hypothermia.
- Rewarm a hypothermic child immediately and simultaneously with the stabilisation. Treat hypothermia in a child with an intact circulation as follows:
    - Monitor the core temperature with a thermometer suitable for low temperatures.
    - Handle the child gently in a horizontal position to reduce the risk of cardiac arrest (especially VF).
    - Start rewarming if < 35°C and rewarm at a rate of at least 1°C h^{-1}. Aim for normothermia but stop active rewarming at 35°C to avoid overshoot hyperthermia.
    - Use active external rewarming applied to the trunk (chest, abdomen, back and axillae - not the extremities) with e.g. a hot-air blanket, radiant warmer, warmed blankets or hot packs, applied according to the manufacturer's instructions.
    - Do not place warm devices directly on the skin to prevent burns. Avoid rubbing and massaging of the extremities.
    - Do not use a warm shower or warm water immersion for rewarming a child with a decreased level of consciousness.
    - Give warmed and humidified 100% oxygen and warmed IV/IO fluids (39-42°C) to prevent further heat loss and to compensate for the vasodilatation during rewarming, but avoid fluid overload by careful haemodynamic monitoring.
- Look for and treat a possible underlying cause of drowning (e.g. arrhythmia, epilepsy, intoxication, or trauma).
- Check blood glucose and electrolytes.
- Follow the PALS guideline modified for hypothermic arrest if cardiac arrest occurs (see below).
- Consider ECPR if conventional CPR is failing.

Hyperkalaemia

- Suspect hyperkalaemia in children with massive haemolysis (neonates), cellular lysis (tumour lysis syndrome, crush syndrome), in acute or chronic renal failure, malignant hyperthermia, or specific intoxications.
- Stop all exogenous sources of potassium, including fluids containing potassium, when hyperkalaemia is detected. Use normal saline if fluids are needed.
- If severe hyperkalaemia is confirmed (> 6.5 mmol L^{-1} or > 7.0 mmol L^{-1} in neonates younger than 96 h):
    - Treat the underlying cause if possible.
    - Administer rapidly acting insulin 0.1 units kg^{-1} (max. 10 units) with 10% glucose 5 mL kg^{-1} (max. 250 mL) over 30 min followed by a glucose-containing infusion. Check potassium and glucose every 15 min for 4 h.
    - Administer short-acting $beta_2$-adrenergic agonists preferably as inhalation/nebulisation (e.g. salbutamol 2.5-5 mg, repeat up to five times).
    - If inhalation is not possible, give short-acting $beta_2$-adrenergic agonists IV (e.g. salbutamol 5 mcg kg^{-1} over 5 min). Repeat if insufficient effect is seen within 15 min, up to a maximum total dose of 15 mcg kg^{-1}.
    - In patients with conduction abnormalities on the ECG, consider 10% calcium gluconate, 0.5 mL kg^{-1}, max. 30 mL.
    - Prepare a potassium removal strategy (e.g. binding agents, furosemide in well-hydrated children with preserved kidney functions, dialysis).
- For cardiac arrest caused by severe hyperkalaemia (usually above 6.5-7 mmol L^{-1}):
    - Give 0.1 unit kg^{-1} short-acting insulin (max 10 units) with 5 mL kg^{-1} 10% glucose (max 250 mL) as an IV bolus, followed by blood potassium and glucose monitoring and a glucose-containing infusion as needed. Higher concentrations of glucose solutions may be used via a central line (e.g. 2.5 mL kg^{-1} 20% glucose or 1 mL kg^{-1} 50% glucose).
    - Do not use calcium in children in cardiac arrest.
    - Continue high-quality PALS and consider ECPR.

Other metabolic derangements

- **Hypokalaemia:** give 1 mmol kg^{-1} (max 30 mmol) potassium at 2 mmol min^{-1} for 10 min, followed by the rest of the dose (if necessary) in 5-10 min in children with severe hypokalaemia (< 2.5 mmol L^{-1}) with life-threatening symptoms or in cardiac arrest. Repeat, if necessary, until the serum potassium is > 2.5 mmol L^{-1}. Follow this with an IV infusion (e.g. 0.5-1 mmol

kg^{-1} h^{-1}, maximum 20 mmol h^{-1}, depending on the potassium level for 1-2 h). Consider magnesium sulphate 30-50 mg kg^{-1} IV for concurrent hypomagnesaemia.

- **Hypoglycaemia:** Treat hypoglycaemia < 3.9 mmol L^{-1} with symptoms, or < 3.0 mmol L^{-1} if asymptomatic. Give a bolus of 0.2 g kg^{-1} IV glucose (e.g. 2 mL kg^{-1} 10% glucose) and re-check the glucose after 5-10 min. Repeat as needed.
- In other metabolic derangements (hypocalcaemia, hypercalcaemia, hypomagnesaemia, hypermagnesaemia): Correct the metabolic derangement during cardiac arrest, while continuing high-quality CPR. Consider extracorporeal life support.

Hyperthermia/heat stroke

- Identify patients with exertional or environmental hyperthermia or heat stroke (core temperature above 40°C, not due to fever) as soon as possible. Look for an elevated body temperature associated with confusion, agitation or disorientation, which can progress to coma and/or seizures.
- Remove the child from the heat source and/or stop exercise and loosen or remove clothing.
- If the temperature is above 40°C, start cooling aggressively, preferably using immersion up to the neck in cold/cool water.
- Call the ambulance service at the same time as initiating cooling.
- Monitor the core temperature to prevent overcooling. Aim to reduce this by about 0.1-0.2°C min^{-1}. If the core temperature cannot be measured, cool for 15 min or until neurological symptoms subside.
- Hydrate orally if possible, or intravenously. Give room-temperature intravenous fluids as an adjunct to cooling and avoid fluid overload.
- Monitor symptoms and vital signs, including mental status.
- Start resuscitation if circulatory collapse supervenes (often around 41°C) and follow the standard PALS guidelines while continuing cooling.
- Stop aggressive cooling (e.g. cold-water immersion) when core temperature reaches 39°C. Stop all active cooling at 38°C but continue to monitor core temperature.
- Stabilise the child according to the ABCDE assessment.
- All children with heat stroke should be admitted to a paediatric intensive care unit for continued monitoring in anticipation of sequelae and complications.

- In the case of malignant hyperthermia (MH), stop all potential triggering agents immediately (e.g. anaesthetics), cool the child actively, ensure adequate oxygenation and ventilation, correct severe acidosis and hyperkalaemia, and administer dantrolene.

Hypothermic cardiac arrest

- Individualise approaches depending on the cause of cardiac arrest: accidental hypothermia, or other possible causes such as drowning, suffocation, or intoxication.
- Start standard CPR in every case of hypothermic cardiac arrest as soon as possible (e.g. before full extrication from an avalanche or in the water).
- If standard CPR is not possible and the child is deeply hypothermic (< 28°C), consider delayed or intermittent CPR.
- Modify the standard PALS algorithm according to the core temperature. The revised Swiss Staging for Hypothermia can be used when the core temperature cannot be measured.
- Start rewarming the child as rapidly as possible while monitoring the core temperature as soon as this is practicable.
- Below 30°C, give a single dose of adrenaline unless planning immediate initiation of extracorporeal life support. Do not give amiodarone until the temperature is above 30°C. Prolong the administration intervals of resuscitation drugs while the core temperature remains between 30-35°C (e.g. adrenaline every 8 min, second dose of amiodarone after 8 min).
- Attempt defibrillation a maximum of three times if a shockable rhythm is present under 30°C. If this is ineffective, delay further attempts until the core temperature exceeds 30°C. Then use the standard sequence of defibrillation (every two minutes).
- Transport a child considered to have a chance of a favourable outcome from hypothermic cardiac arrest as soon as possible to an appropriate centre for extracorporeal life support.
- Extracorporeal life support is potentially indicated in all children with hypothermic cardiac arrest who do not achieve ROSC in the field.
- Hypothermic patients with risk factors for imminent cardiac arrest (e.g. P or U on the AVPU scale, associated trauma, ventricular arrhythmia, or hypotension) should also be transported to an extracorporeal life support centre.
- Stop resuscitation if ROSC is not achieved within 30 min when cardiac arrest is due to trauma or asphyxia (i.e. avalanche burial for > 60 min, core

temperature ≥ 30°C and an obstructed airway).

Pulmonary thromboembolism

- Suspect PE in case of tachycardia, tachypnoea and hypoxia, especially in children with central lines, cardiac conditions, cancer, unilateral limb swelling, recent trauma/surgery, prior thromboembolism, anaemia and/or leucocytosis.
- Consider echocardiography if the expertise (e.g. a paediatric cardiologist) is available.
- For thrombolytic therapy, refer to local protocols and call for expert help. Consider systemic or catheter-directed administration of thrombolysis, which is more effective than systemic anticoagulation.
- Consider extracorporeal life support and surgical embolectomy when thrombolysis fails or the child progresses towards cardiac arrest.
- In cardiac arrest due to pulmonary thromboembolism, consider thrombolysis, e.g. IV alteplase 0.3-0.5 mg kg^{-1} (max 50 mg) over 2 min, which may be repeated after 15 min.

Seizures

- Monitor the time from the start of the seizures closely. Manage ABC, monitor vital functions and ECG. Consider possible causes for seizures (e.g. infection, intoxication, metabolic disorders, hypoxia, hypoglycaemia, hyperthermia, intracranial hypertension, channelopathies) and treat these appropriately. Anticipation is important when treating seizures, as several interventions may be necessary.
- Any seizure lasting 5 min or longer (status epilepticus) requires treatment with a benzodiazepine (first-line medication). Use the intravenous (IV) route if available. If an IV/IO access has not yet been established, use an alternative route (e.g. nasal, buccal or IM).
- If the seizures continue, give a second dose of a benzodiazepine IV or IO after 5-10 min and prepare to administer a second-line medication.
- If the seizures persist after two doses of the first-line medication (< 15-20 min from the start of the seizures), give levetiracetam IV or IO 40-60 mg kg^{-1} (max. 4.5 g) over 5 min (second-line medication). If levetiracetam is not available, give phenytoin IV 20 mg kg^{-1} over 20 min or phenobarbital IV 20

mg kg^{-1} (max 1 gram) by slow injection at a maximum rate of 1 mg kg^{-1} min^{-1} as a second choice instead. Do not use valproic acid where there is the potential for pregnancy.

- If the seizures continue for ≥ 30 min despite the administration of a second-line drug (refractory status epilepticus), prepare for intubation and refer the child to the paediatric intensive care team. If you are not ready for intubation and anaesthesia, then giving another, different second-line drug is an alternative.
- Start anaesthesia (e.g. with midazolam, ketamine, phenobarbital, thiopental, or propofol) within 40 min of the onset of seizures, with intubation and mechanical ventilation. Aim for termination of clinical seizures and burst suppression on electroencephalography (EEG). Monitor for respiratory and haemodynamic instability, metabolic disturbances, renal failure, rhabdomyolysis, and adverse drug effects.
- Seek the advice of a paediatric neurologist.
- Consider continuous EEG monitoring and brain imaging.

Shock

- In children with **septic shock**:
  - Obtain blood samples for blood culture and PCR (polymerase chain reaction) if possible, and start broad-spectrum antibiotics as soon as possible (within 1 h) after initial ABCDE management.
  - Consider hydrocortisone 1-2 mg kg^{-1} if the child is not responding to fluids and vasoactive support, and in children with specific pathologies (e.g. adrenal insufficiency) or who are receiving specific medications.
- In children with **cardiogenic shock**:
  - Seek the advice of a paediatric cardiologist early. Use echocardiography to guide treatment.
  - Start inotropic support and consider mechanical ventilation. Anticipate possible cardiac arrest during tracheal intubation, use medication with minimal cardiovascular side effects (e.g. use ketamine and avoid propofol).
  - Consider IV furosemide only in children without concomitant hypovolaemia.
  - Consider extracorporeal life support in refractory cardiogenic shock.
- In children with **haemorrhagic shock**:
  - Activate local protocols for massive haemorrhage and control bleeding using pressure and tourniquets as indicated.

    - Minimise the use of IV crystalloid boluses (max. 20 mL kg^{-1}). Give blood products or full blood as soon as they are available.
    - Use vasoactive drugs in fluid-refractory shock, especially when there is also a loss of sympathetic drive (e.g. during anaesthesia or analgesia and sedation), or in children with concomitant traumatic brain injury. Target MAP to above the 50th percentile to attain sufficient cerebral perfusion pressure in traumatic brain injury. Support cardiac function if this is necessary to achieve MAP above the threshold.
    - Use a strategy that focuses on improving coagulation in children with severe blood loss.
    - Use tranexamic acid as soon as possible (at least within 3 hours) in all children requiring transfusion after trauma or with life-threatening haemorrhage. Give a loading dose of 15-20 mg kg^{-1} (max. 1 g) IV over 10 min, followed by an infusion of 2 mg kg^{-1} h^{-1} (max. 1 g) for at least 8 h or until the bleeding stops.

Tension pneumothorax

- Suspect tension pneumothorax, especially in trauma, following central venous cannulation and during positive pressure ventilation.
- Use clinical signs to diagnose a tension pneumothorax. POCUS is helpful, but it is not necessary to make the diagnosis.
- Perform a needle thoracocentesis in the fourth or fifth intercostal space in the anterior axillary line or second intercostal space in the mid-clavicular line; followed by chest drain insertion usually in the axilla.
- In trauma, perform a finger thoracostomy in the fourth or fifth intercostal space in the anterior axillary line, followed by emergency chest drain insertion.
- Perform bilateral thoracostomies in traumatic cardiac arrest with or without signs of a tension pneumothorax.

Toxins

Prevention of Cardiac Arrest

- Provide supportive care based on the ABCDE approach to prevent cardiorespiratory arrest whilst awaiting toxin elimination. Look for evidence

of non-accidental injury.
- Provide early advanced airway management if decreased conscious level.
- Administer IV boluses of 10 mL kg^{-1} isotonic crystalloids for hypotension. Noradrenaline may be required if hypotension persists.
- Perform a 12-lead ECG in certain poisonings (e.g. antipsychotics, 3,4-methylenedioxymethamphetamine (MDMA) and other amphetamines) or in children with altered consciousness, abnormal heart rate or blood pressure. Cardiovert life-threatening tachyarrhythmias.
- Take blood for electrolytes, blood glucose and blood gas analysis and correct any abnormalities. Take blood and urine for toxicological analysis.
- Check for and correct hyperthermia (ecstasy, cocaine, salicylates) and hypothermia (ethanol, barbiturates).
- Take a thorough history (relatives, friends, ambulance crew) and perform a complete physical examination to identify diagnostic clues (e.g. odours, needle puncture marks, pupils, tablet residues).
- Administer antidotes, where available.
- Consult a regional or national poisons centre for information on treatment.

Cardiac Arrest

- Suspect toxic agents as an infrequent cause of cardiac arrest after more common causes have been excluded.
- Provide standard PBLS and PALS.
- Do not use mouth-to-mouth ventilation in the presence of chemicals such as cyanide, hydrogen sulphide, corrosives and organophosphates.
- Exclude all reversible causes of cardiac arrest, including electrolyte abnormalities, which can be indirectly caused by a toxic agent.
- Be prepared to continue resuscitation for a prolonged period while the toxin concentration falls.
- Consult regional or national poison centres for information on treatment.
- Consider ECPR for selected patients when conventional CPR is failing.

Traumatic cardiac arrest

- Identify and treat reversible causes to prevent cardiac arrest.
- Ensure proper team collaboration.
- Additional recommendations for PBLS in traumatic cardiac arrest:
    - Follow standard CPR, start by opening the airway and ventilating.

    - Competent providers should open the upper airway with a jaw thrust and minimise spinal movement without hampering CPR.
    - Stop significant external bleeding immediately with manual pressure, haemostatic dressing or tourniquet.
    - Use an AED only if there is a high likelihood of a shockable rhythm (e.g. following electrocution).

PALS in traumatic cardiac arrest

- Professional rescuers should look for and treat reversible causes. Use the acronym ‘HOTT’ to identify reversible causes:
    - **H**ypotension
    - **O**xygenation (hypoxia)
    - **T**ension pneumothorax
    - cardiac **T**amponade
    - In cardiac arrest, treating these has priority, or should run concurrently with chest compressions and the administration of adrenaline IV/IO.
- Use POCUS when available to diagnose reversible causes.
- The optimal sequence of action will depend upon the setting and the number of rescuers, but consider:
    - Correct hypoxia. Open the airway using a jaw thrust manoeuvre and minimise spinal movement, without hampering CPR. Ensure adequate ventilation and intubate the child as soon as the expertise and equipment are available. Use an SGA if intubation is not possible.
    - Correct hypovolaemia with intravascular fluid replacement, including early use of blood products in haemorrhagic shock.
    - Perform bilateral thoracostomies in traumatic cardiac arrest with or without signs of a tension pneumothorax. Chest drain placement may be required to maintain patency of the tract.
    - Perform a resuscitative thoracotomy, if competent, for suspected cardiac tamponade. Otherwise, perform pericardiocentesis via a mini-thoracotomy or insert a wide-bore drain, preferably guided by POCUS.
- Attach an AED directly if there is a high likelihood of a shockable underlying rhythm, such as following electrocution or in cardiac contusion. Otherwise, HOTT has priority over the AED.
- High-quality resuscitation is the standard in cardiac arrest due to a medical cause coincidental to the trauma or to a non-hypovolemic, non-obstructive aetiology (e.g. isolated traumatic brain injury, cardiac contusion, or asphyxia) or due to electrocution.

Post-resuscitation care

- Post-resuscitation care starts immediately after return of spontaneous circulation (ROSC) is achieved.

Recommendations for healthcare providers in the pre-hospital setting and limited-resource healthcare

- The general ABCDE principles described in the section on the prevention of cardiac arrest also apply to post-resuscitation care.
- Ensure adequate oxygenation and ventilation.
- Intubate the trachea only if you are competent and equipped to do so safely.

- Always use anaesthetic drugs and muscle relaxants for intubation unless the child is deeply comatose (GCS 3). Provide 100% oxygen during intubation.
- Monitor $ETCO_2$ continuously if an advanced airway is in place.
- Titrate FiO_2 to achieve a peripheral oxygen saturation of 94-98% as soon as a reliable measurement is available. When ABG analysis is available, aim for normoxaemia.
- In the absence of ABG analysis, aim for a normal respiratory frequency for the child's age and mild chest rise (just visible).
- Monitor capnography and aim for normocapnia. When ABG analysis is available, confirm normocapnia.
- Use tidal volumes of 6-8 mL kg^{-1} of ideal body weight, and PEEP of 5 cm of H_2O for mechanical ventilation in previously healthy children.
- Use the minimum airway pressures needed to achieve oxygenation and ventilation goals, adjusting these in special circumstances (e.g. chronic lung disease).
- Check for signs of shock and treat it immediately if present. Treat shock with fluids, vasoactive drugs or inotropes or combinations of these.
- Aim for a systolic and mean arterial blood pressure above the 10th percentile for the child's age.
- Treat seizures immediately if they emerge.
- Check blood glucose after cardiac arrest and treat hypoglycaemia.
- Use analgesia and sedation to treat pain and discomfort after cardiac arrest in children of all ages. Avoid bolus medications that can cause abrupt fluctuations in blood pressure.

- Always treat hyperthermia or fever with active cooling.
- Try to establish the cause of cardiac arrest and treat it to avoid re-arrest.
- Enable parents/persons with parental responsibility or caregiver presence during the pre-hospital care or transport whenever this can be done safely.

Recommendations for healthcare providers in a hospital

- Use individualised goals and bundles of care rather than specific single targets during post-resuscitation care. Treat underlying disease(s) as well as post-cardiac arrest syndrome.
- Establish invasive arterial blood pressure monitoring and central venous access with (mixed venous saturation) SvO_2 measurement as a minimum in all sedated or comatose children.
- If no individualisation is needed, continue targeting normoxaemia, normocapnia, and maintain systolic and mean arterial blood pressure above the 10th percentile for at least 24 h after cardiac arrest.
- Use available non-invasive or invasive techniques to diagnose the probable cause of cardiac arrest as well as to make individualised decisions in the management of post-cardiac arrest syndrome.
- Diagnose, monitor, and treat pain, discomfort and delirium.
- Keep temperature control as an integral part of post-resuscitation care for at least 24 h after cardiac arrest. Avoid fever for at least 72 h.
- Prevent, diagnose, and treat acute kidney injury or renal failure.
- Optimise nutrition.
- Start rehabilitation early.
- Allow unrestricted access of parents/persons with parental responsibility and primary caregivers to the child as a part of family-centred care. Be sensitive to cultural and religious issues.
- Communicate clearly and honestly with parents/persons with parental responsibility while also paying attention to their understanding and needs; decision-making should be shared. Involve concerned stakeholders (e.g. extended family, religious support) in the communication.
- Seek the assistance of specialised multidisciplinary teams early (e.g. paediatric neurologists, psychologists, paediatric palliative care team, social workers and, if necessary, an interpreter) to address the needs and concerns of the child, parents, family and other caregivers.
- In case of sudden cardiac arrest, whether fatal or not, use a standardised diagnostic protocol to identify the cause. If the sudden cardiac arrest might have been due to an inherited condition, such as certain arrhythmias and

cardiomyopathies, ensure appropriate screening of family members to prevent sudden cardiac arrest in future patients.

Prognostication after cardiac arrest

- Avoid both false optimism and false pessimism, be honest, open and transparent.

Recommendations for healthcare providers

- Delay prognostication in children with a decreased level of consciousness or who are sedated for at least 72 h following cardiac arrest.
- Use a multimodal approach to prognostication. Accurate prognostication for both good and poor outcomes involves:
  - Pre-arrest: knowledge of the child's baseline health and neurological status.
  - The context of the cardiac arrest: e.g. location of the cardiac arrest, bystander BLS, first rhythm, cause of cardiac arrest and duration of the cardiac arrest.
  - Post-cardiac arrest care: a comprehensive assessment supplemented with repeated evaluations.
- Combinations and timing of investigations and signs predicting good outcomes differ from those predicting poor outcomes. No single modality can be used in isolation for prognostication with high accuracy.
- Use the suggested standardised minimal set of diagnostic modalities for better comparability and research.
- Visual aids and presentations might help parents/persons with parental responsibility to understand certain specifics of prognostication, enabling them to participate better in the decision-making.

Post-discharge care

- Assess outcomes with standardised measurements using validated instruments and involve paediatric psychologists, neurologists, rehabilitation physicians and/or intensivists in post-discharge care.

- Plan and discuss the post-discharge care with parents/persons with parental responsibility and caregivers before hospital discharge.
- Organise multidisciplinary post-discharge care to minimise the number of hospital visits for the child and family.
- Consider a virtual consultation when an on-site visit to an outpatient clinic is challenging due to financial, travel or work limitations.
- Screen patients, parents/persons with parental responsibility, and family members for symptoms of post-intensive care syndrome regularly and refer to a professional (e.g. psychologist) as soon as any physical or mental health issues arise.
- Seek and signpost supportive structures for patients and parents/persons with parental responsibility, such as parent groups, cardiac arrest survivors' groups and bereavement groups.

Downloads

Paediatric in-hospital BLS algorithm 2025 38.4 KB
Paediatric out-of-hospital BLS algorithm 2025 43.15 KB
Paediatric choking algorithm 2025 38.87 KB
Paediatric advanced life support algorithm 2025 66.13 KB
Paediatric arrhythmia algorithm 2025 51.67 KB
Paediatric emergency drug 2025 52.03 KB