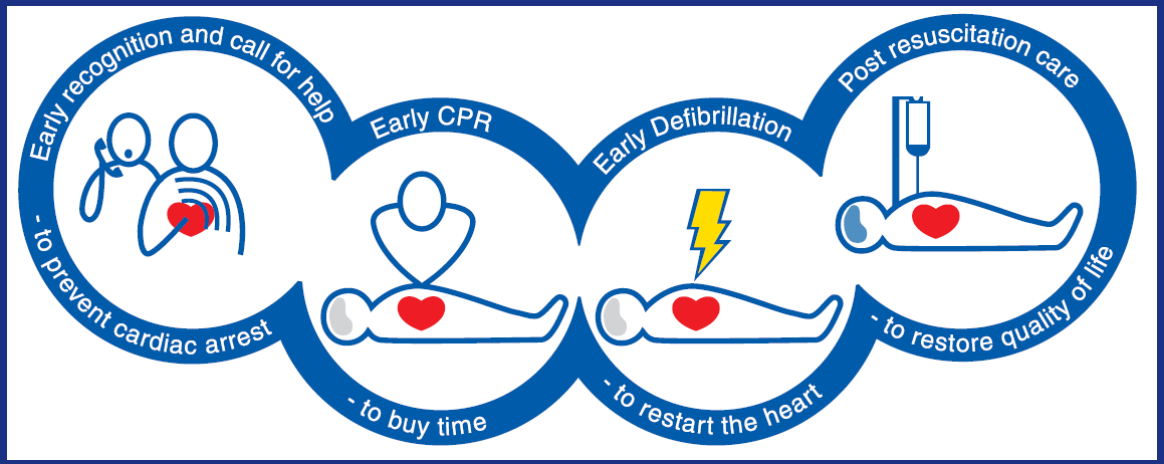
UNIVERSITATEA DE STAT DE MEDICINĂ ȘI FARMACIE
„NICOLAE TESTEMIȚANU” DIN REPUBLICA MOLDOVA

PEDIATRIC EMERGENCY



EUROPEAN RESUSCITATION COUNCIL
GUIDELINES 2021

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REASON

SARS-CoV

Hypoxic respiratory failure •
Hypercoagulable state •
Myocarditis •

Public Health Interventions

Lockdown (home isolation/quarantine)•
Social distancing •

Health Care System

Access/Treatment delays due to system demand •
Alterations of STEMI/Cardiac arrest pathways •
Shut down of primary & elective services •
Introduction of un-validated virtual care •

Occupational Health/PPE

Avoidance of aerosol generating procedures •
Treatment delays due to donning PPE •
Suspension of first responder schemes •

Clinical Governance

- Changes in clinical guidance/SOPs
- Lack of systems to monitor safety of telephone triage and telemedicine systems implemented for COVID-19

Psychological Factors

- Patients delaying/ not seeking healthcare
- Increased stress due to pandemic
- Responder's fear of infection
- Perceived futility of CPR

Social Determinants

- Increased smoking & substance use during pandemic
- Overcrowding increasing COVID-19 transmission
- Vulnerable patients more likely to be isolated
- Clustering of ACS & COVID-19 risk factors

Resource Allocation

- Telephone triage to decrease demand on hospitals
- Focus of resources on COVID-19 response
- Potential rationing of healthcare

ACS (Acute Coronary Syndrome), COVID-19 (Coronavirus disease 2019), CPR (Cardiopulmonary Resuscitation), OHCA (Out of Hospital Cardiac Arrest), SOP (Standard Operating Procedure), STEMI (ST Elevation Myocardial Infarction)

Fig. 2 – Systems level factors related to OHCA incidence and mortality during the COVID-19 pandemic (Reproduced from Christian and Couper[64]).

SYSTEMS SAVING LIVES GL 2021

5 TOP MESSAGES

EUROPEAN RESUSCITATION COUNCIL

1. RAISE AWARENESS ABOUT CPR AND DEFIBRILLATION

- Train as many citizens as possible
- Engage with World Restart a Heart Day
- Develop new and innovative systems and policies that will save more lives

2. USE TECHNOLOGY TO ENGAGE COMMUNITIES

- Implement technologies to alert first responders to cardiac arrests through smartphone apps / text messages
- Develop communities of first responders to help save lives
- Map and share the locations of public access defibrillators

3. KIDS SAVE LIVES

- Teach all school children to do CPR using "check, call and compress"
- Get children to teach their parents and relatives how to do CPR

4. CARDIAC ARREST CENTRES

- Where possible care for adult patients with OHCA in cardiac arrest centres

5. DISPATCH ASSISTANCE DURING CPR

- Provide telephone assisted CPR for people who are unresponsive with absent or abnormal breathing
- Work with dispatch staff to continually monitor and improve telephone assisted CPR

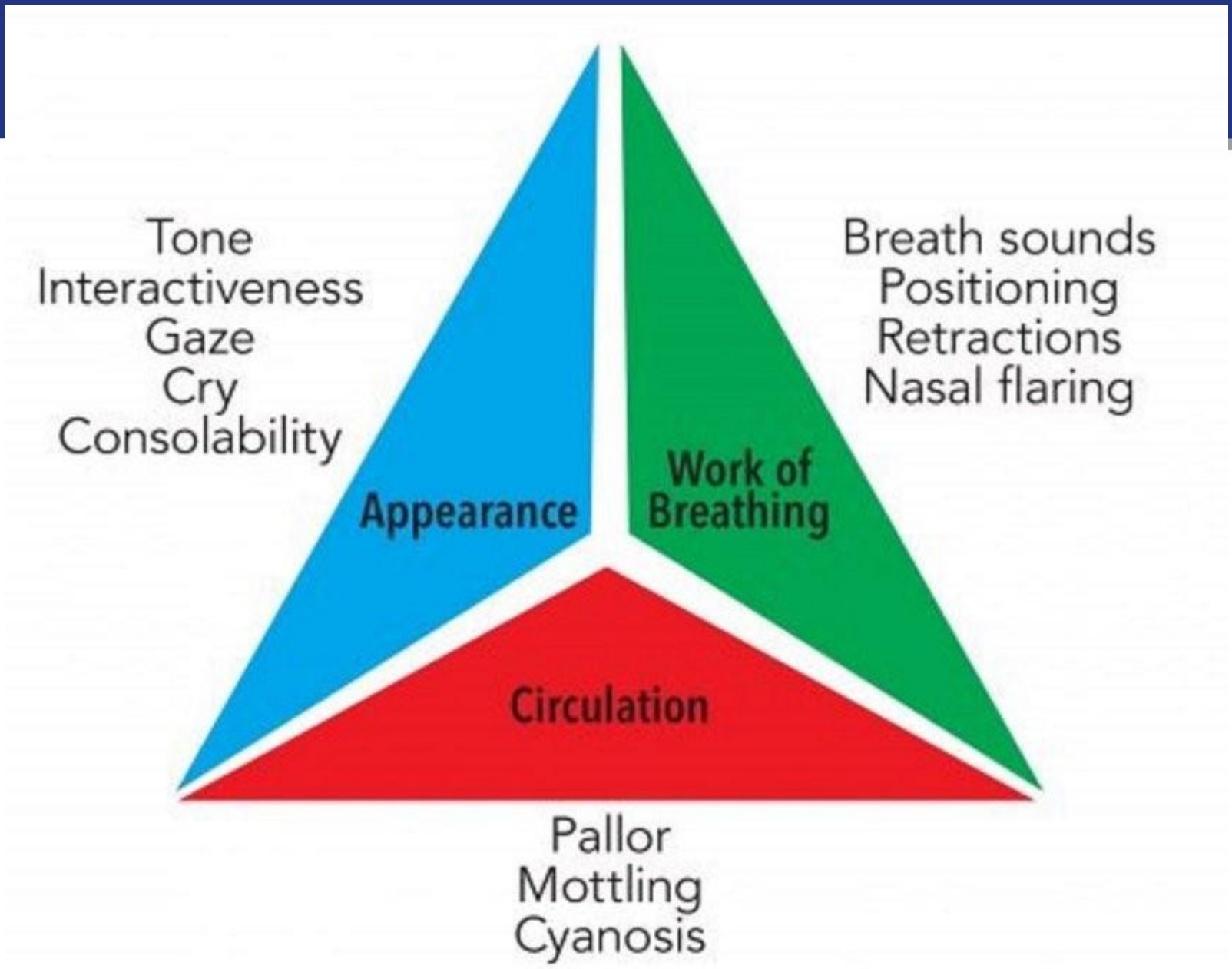
KEY EVIDENCE

With the exception of newborns at birth, all children 0-18y are best treated by paediatric guidelines. Adult guidelines can be used for patients that appear adult.

Only perform or lead procedures for which you are sufficiently competent (self-reflection – based on knowledge, skills, attitudes, expertise and ongoing training).

Recognition and management of critically ill children

- Use the Paediatric Assessment Triangle or a similar ‘quick-look’ tool
- Follow the ABCDE approach
- Perform the necessary interventions at each step of the assessment as abnormalities are identified
- Repeat your evaluation after any intervention or when in doubt


Tone
Interactiveness
Gaze
Cry
Consolability
Appearance
Breath sounds
Positioning
Retractions
Nasal flaring
Work of Breathing
Circulation
Pallor
Mottling
Cyanosis

❑ EMERGENCY SIGNS

- ❖ There is any airway or breathing problem
- ❖ The child is in shock or has diarrhea with severe dehydration
- ❖ The child is unconscious or convulsing

❑ PRIORITY SIGNS

- ❖ Tiny infant: any sick child aged < 2 months
- ❖ Temperature: child is very hot
- ❖ Trauma or other urgent surgical condition
- ❖ Pallor (severe)
- ❖ Poisoning (history of)
- ❖ Pain (severe)
- ❖ Respiratory distress
- ❖ Restless, continuously irritable or lethargic
- ❖ Referral (urgent)
- ❖ Malnutrition: visible severe wasting
- ❖ Edema of both feet
- ❖ Burns (major)

ABCDE approach

- **A is for Airway**
- **Establish and maintain airway patency**

ABCDE approach

- **B is for Breathing**
- **Check Respiratory rate; Work of breathing, e.g. retractions, grunting, nasal flaring . . .**
- **Check air entry clinically (chest expansion; quality of cry) or by auscultation**
- **Oxygenation (colour, pulse oximetry)**

ABCDE approach

Table 1 – Normal values for age: respiratory rate.

Respiratory rate for age	1 month	1 year	2 year	5 year	10 year
Upper limit of normal range	60	50	40	30	25
Lower limit of normal range	25	20	18	17	14

ABCDE approach

- **C is for Circulation**
- **Check Pulse rate**
- **Check capillary refill time (CRT)**
- **Be aware that CRT is not very sensitive. A normal CRT should not reassure providers**
- **Preload evaluation: jugular veins, liver span, crepitations**
- **Blood Pressure**

ABCDE approach

Table 2 – Normal values for age: heart rate.

Heart rate for age	1 month	1 year	2 year	5 year	10 year
Upper limit of normal range	180	170	160	140	120
Lower limit of normal range	110	100	90	70	60

Table 3 – Normal values for age: systolic and mean arterial blood pressure (MAP). Fifth (p5) and fiftieth (p50) percentile for age.

Blood pressure for age	1 month	1 year	5 year	10 year
p50 for systolic BP	75	95	100	110
p5 for systolic BP	50	70	75	80
p50 for MAP	55	70	75	75
p5 for MAP	40	50	55	55

ABCDE approach

- **D is for Disability**
- **Check Conscious level using the AVPU (Alert-Verbal-Pain-Unresponsive) score, (paediatric) Glasgow Coma Scale (GCS) total score, or the GCS motor score**
- **AVPU score of P or less, a Glasgow motor score of 4 and total GCS score of 8 or less define a level of consciousness where airway reflexes are unlikely to be preserved**
- **Pupil size, symmetry, and reactivity to light**
- **Sudden unexplained neurological symptoms, particularly those persisting after resuscitation, warrant urgent neuroimaging**

		ADULT BEHAVIOR	PEDIATRIC BEHAVIOR
A	ALERT	Eyes open spontaneously. Appears aware of and responsive to the environment. Follows commands eyes tract peoples and objects.	Child is active and responds appropriately to SO and other external stimuli.
V	VOICE	Eye do not open spontaneously but open to verbal stimuli. Able to respond in some meaningful way when spoken to.	Responds only when his or her name is called by SO.
P	PAIN	Does not respond to questions but moves or cries out in response to painful stimuli such as pinching the skin or earlobe.	Responds only when painful stimuli is received such as pinching the nail bed.
U	UNRESPONSIVE	Patient does not respond to any stimuli.	No response at all.

Table 17-4: Pediatric Glasgow Coma Scale

		> 1 year	< 1 year	
Eyes Opening	4	Spontaneously	Spontaneously	
	3	To verbal command	To shout	
	2	To pain	To pain	
	1	No response	No response	
		> 1 year	**< 1 year**	
Best Motor Response	6	Obeys		
	5	Localizes pain	Localizes pain	
	4	Flexion—withdrawal	Flexion—normal	
	3	Flexion—abnormal (decorticate rigidity)	Flexion—abnormal (decorticate rigidity)	
	2	Extension (decerebrate rigidity)	Extension (decerebrate rigidity)	
	1	No response	No response	
		> 5 years	**2–5 years**	**0–23 months**
Best Verbal Response	5	Oriented and converses	Appropriate words and phrases	Smiles, coos, cries appropriately
	4	Disoriented and converses	Inappropriate words	Cries
	3	Inappropriate words	Cries and/or screams	Inappropriate crying and/or screaming
	2	Incomprehensible sounds	Grunts	Grunts
	1	No response	No response	No response

TEAMWORK

- **ABCDE is described in a stepwise manner**
- **In practice, interventions are best carried out by multiple team members acting in parallel in a coordinated manner**
- **Key components of teamwork include:**
  - **Anticipate: what to expect, allocate tasks . . .**
  - **Prepare: materials, checklists to support decision making, patient data . . .**

TEAMWORK

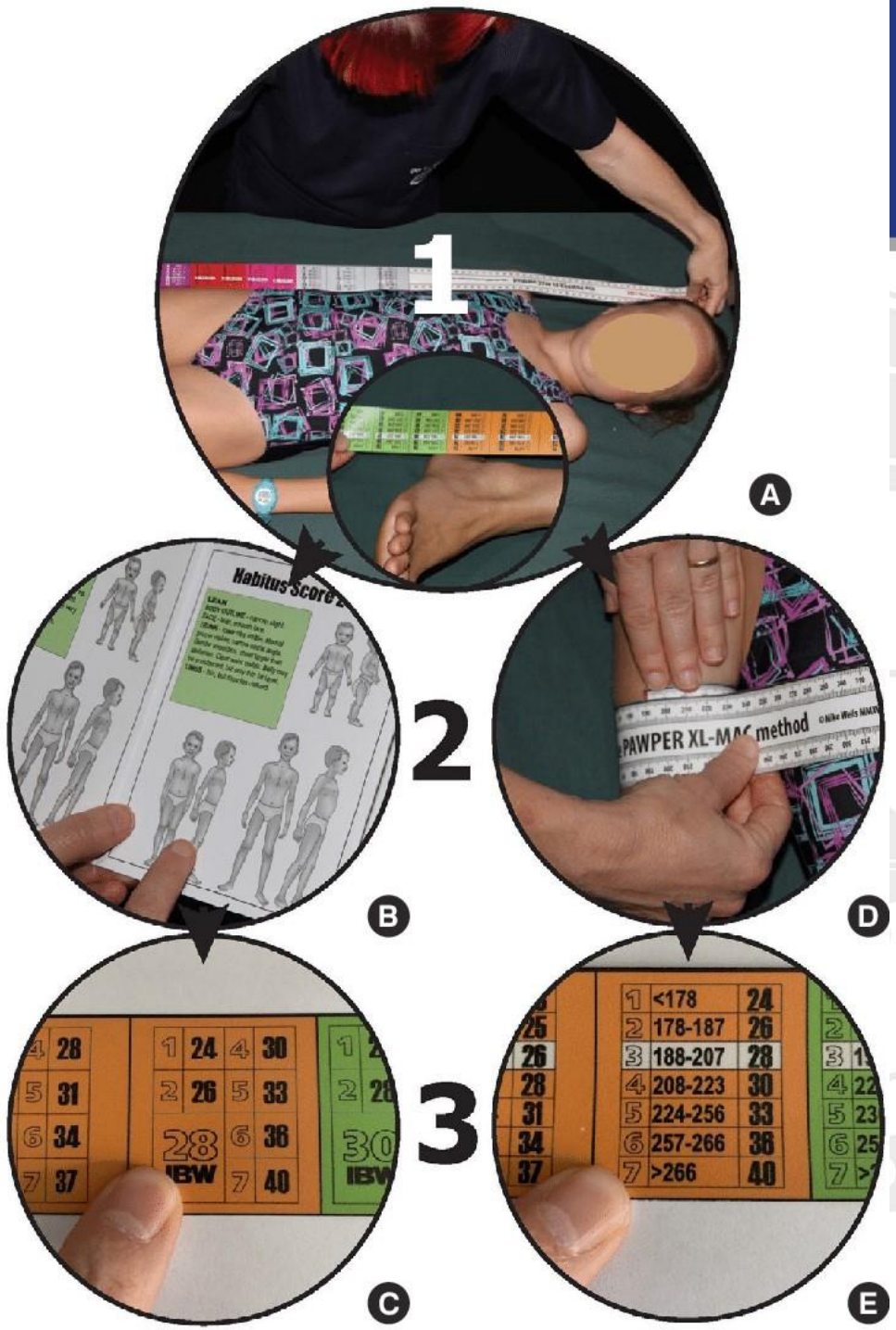
- **Choreography: where to stand, how to access the child, effective team size**
- **Communicate: both verbal, and non-verbal**
- **Use closed-loop communication and standardised communication elements (e.g. to count compression pauses, plan patient transfers)**
- **Implement a culture that strongly condemns inappropriate behaviour, be it from colleagues or family**

TEAMWORK

- **Interact:**
  - **Team members have pre-defined roles as per protocol and perform tasks in parallel**
  - **The team-leader (clearly recognisable) monitors team performance, prioritises tasks to achieve common goals and keeps the whole team informed**

TEAMWORK

- The "first-hour" management of different life or organ-threatening emergencies in children is important
- Quite often children present with a combination of problems that demand a far more individualised approach
- Treatment recommendations in children often differ from those in adults but will also differ between children of different age and weight
- To estimate a child's weight, either rely on the parents or caretakers or use a length-based method, ideally corrected for body-habitus (e.g. Pawper MAC)


1
A
2
B
D
3
C
E
Habitus Score
PAWPER XL-MAC method
1 <178 24
2 178-187 26
3 188-207 28
4 208-223 30
5 224-256 33
6 257-266 36
7 >266 40

Pediatric Basic Life Support

- **The sequence of actions in PBLS will depend upon the level of training of the rescuer attending:**
  - **those fully competent in PBLS (preferred algorithm)**
  - **those trained only in adult BLS and those untrained (dispatcher assisted lay rescuers)**

- **<u>Sequence of actions in PBLS</u>**
  - **Ensure safety of rescuer and child**
  - **Check for responsiveness to verbal and tactile stimulation**
  - **Ask bystanders to help**

Pediatric Basic Life Support

- If the child does not respond, open the airway, and assess breathing for no longer than 10 sec
- If you have difficulty opening the airway with head tilt, chin lift or specifically in cases of trauma, use a jaw thrust
- If needed, add head tilt a small amount at a time until the airway is open
- In the first few minutes after a cardiac arrest a child may be taking slow infrequent gasps

Pediatric Basic Life Support

- If you have any doubt whether breathing is normal, act as if it is not normal
- Look for respiratory effort, listen and feel for movement of air from the nose and/or mouth
- If there is effort but no air movement, the airway is not open
- In cases where there is more than one rescuer, a second rescuer should call the EMS immediately upon recognition of unconsciousness, preferably using the speaker function of a mobile phone

Pediatric Basic Life Support

- In the unresponsive child, if breathing is absent or abnormal: give five initial rescue breaths
- For infants, ensure a neutral position of the head
- In older children, more extension of the head will be needed (head tilt)
- Blow steadily into the child's mouth (or infant's mouth and nose) for about 1 second, sufficient to make the chest visibly rise

Fig. 1.18. Mouth-to-mouth-and-nose ventilation – infant.

Fig. 1.19. Mouth-to-mouth ventilation – child.

Pediatric Basic Life Support

- Immediately proceed with 15 chest compressions, unless there are clear signs of circulation (such as movement, coughing)
- Rather than looking at each factor independently, focus on consistent good quality compressions as defined by:
  - Rate: 100-120 min for both infants and children
  - Depth: depressing the lower sternum by at least one third of the anterior posterior (AP) dimension of the chest (infant 4 cm, child 5 cm)
  - Compressions should never be deeper than the adult 6 cm limit (approx. an adult thumb's length)
  - Recoil: Avoid leaning!!! Release all pressure between compressions and allow for complete chest recoil

Pediatric Basic Life Support

PAEDIATRIC BASIC LIFE SUPPORT

EUROPEAN RESUSCITATION COUNCIL GUIDELINES 2021

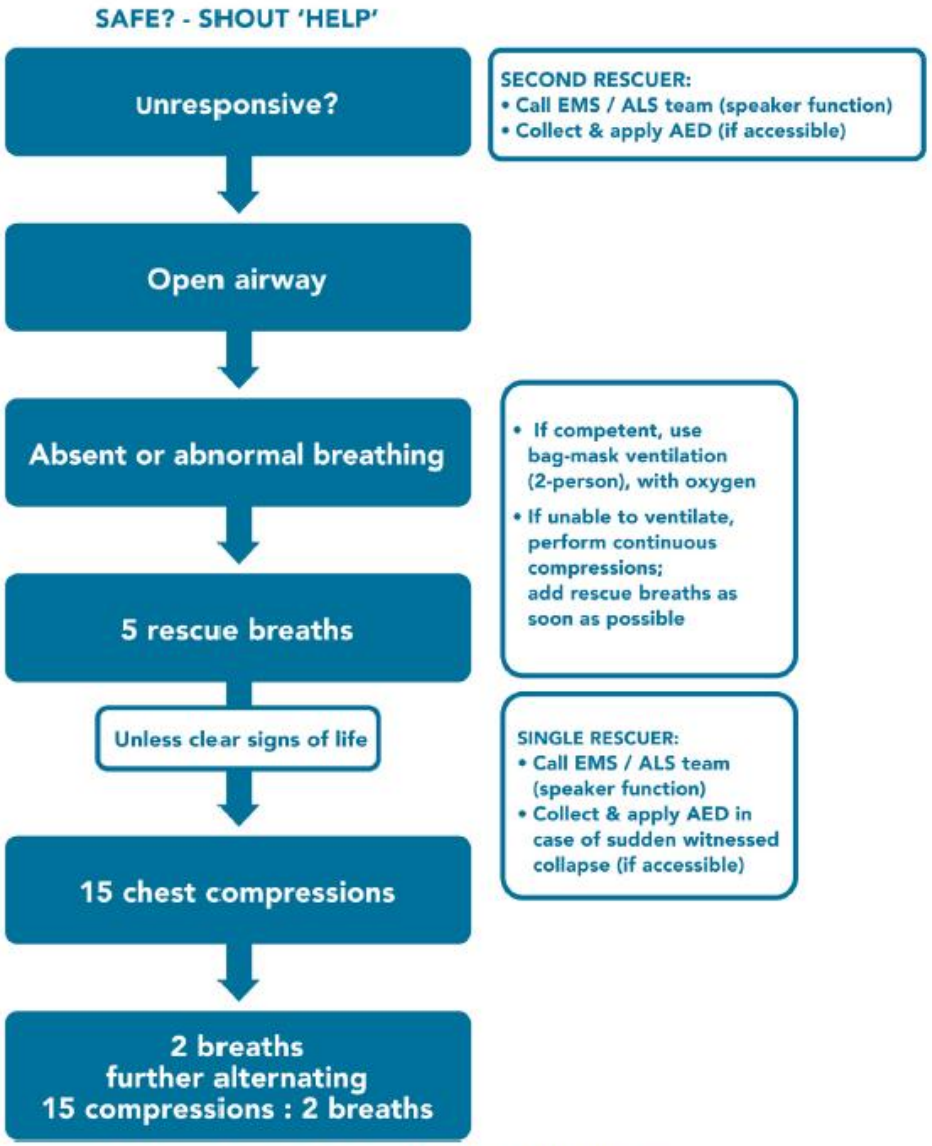


Fig. 2 – Paediatric basic life support.

Management of respiratory failure: general approach

Pulse oximetry

- Hypoxemia is often present in sick children, both in respiratory and non-respiratory illness (e.g. sepsis) and is a major risk factor for death regardless of the diagnosis
- Clinical signs may underestimate the degree of hypoxemia and ‘silent hypoxemia’ has been described in e.g. adult COVID-19 patients
- While measurement of PaO2 is considered the gold standard, pulse oximetry provides a rapid non-invasive way of assessing oxemia and is the standard of care for continuous monitoring of oxygenation

Pulse oximetry

- An SpO2 of 95% has been cited as a lower cut-off value
- Given the lack of strong evidence and in view of consistency between different RR and ease of teaching, the PWG continues to advise 94-98% as the ‘normal range’
- Many factors (including altitude, technical limitations, quality of perfusion, carbon monoxide, during sleep) must be considered when interpreting pulse oximetry values, and this knowledge should be part of any training in PLS

Supplemental oxygen

- To support oxygenation, consider supplemental oxygen and/or positive end-expiratory pressure (PEEP)
- Where it is possible to accurately measure SpO2(or partial oxygen pressure (PaO2)): start oxygen therapy if SpO2< 94%
- The goal is to reach an SpO2of 94% or above, with as little supplemental FiO2(fraction of inspired oxygen) as possible

Supplemental oxygen

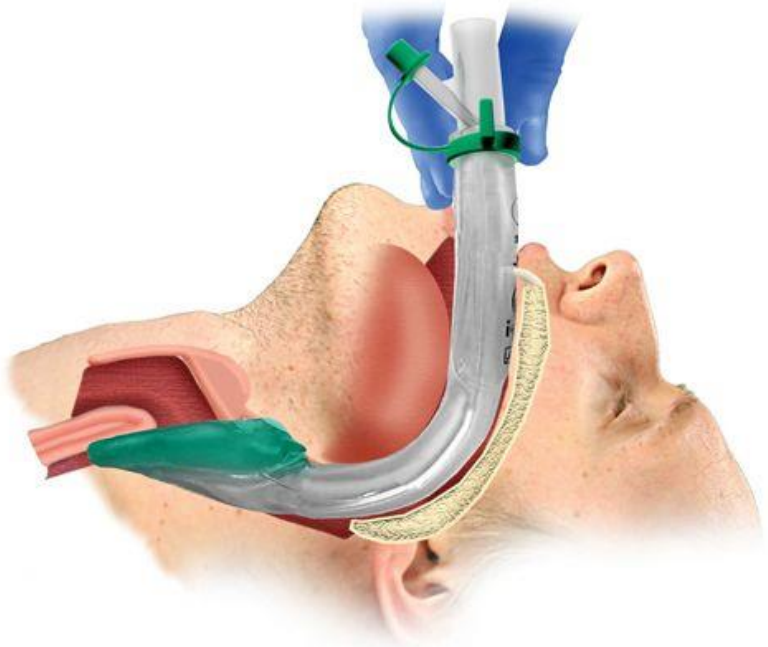
- **Where possible, competent providers should consider either high-flow nasal cannula (HFNC) or non-invasive ventilation (NIV) in children with respiratory failure and hypoxaemia not responding to low-flow oxygen**

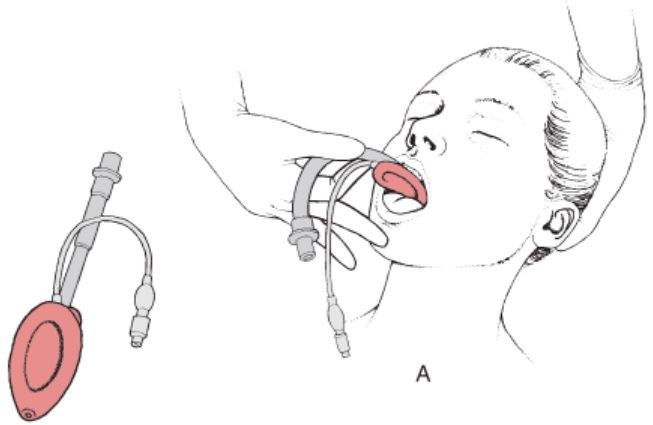
Bag-mask ventilation

- Bag-mask ventilation (BMV) is the recommended first line method to support ventilation
- Ensure a correct head position and mask size and a proper seal between mask and face
- Use an appropriately sized bag for age
- To provide adequate TV, the inspiratory time should be sufficiently long (approx. 1 s); avoid hyperinflation

Supraglottic airways

- SGAs (such as I-gel, LMA) may be an alternative way to provide airway control and ventilation, although they do not totally protect the airway from aspiration
- Easier to insert than a TT, an SGA should also only be inserted by a competent provider
- Consider 'DOPES': D stands for displacement (TT, mask) O for obstruction (TT, airway circuit, airway head position) P for pneumothorax E for equipment (oxygen, tubing, connections, valves) S for stomach (abdominal compartment)

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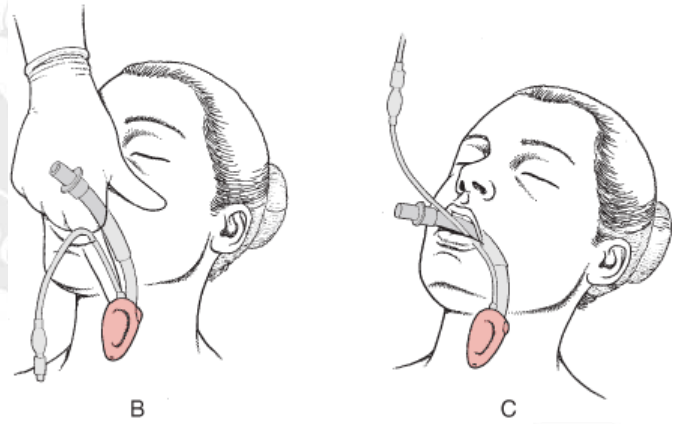

B
C

Management of anaphylaxis

- Early diagnosis of anaphylaxis is crucial and will guide further treatment
- Acute onset of an illness (minutes to hours) with involvement of the skin, mucosal tissue, or both and at least one of the following:
  - Respiratory compromise e.g. dyspnoea, wheeze-bronchospasm, stridor, reduced PEF, hypoxaemia
  - Reduced blood pressure or associated symptoms of endorgan dysfunction e.g. collapse, syncope

Management of anaphylaxis

OR

- **Acute onset (minutes to several hours) of hypotension or bronchospasm or laryngeal involvement after exposure to a known or probable allergen, even in the absence of typical skin involvement**

Management of anaphylaxis

- As soon as anaphylaxis is suspected, immediately administer intramuscular (IM) adrenaline (anterolateral mid-thigh, not subcutaneous)
- Provide further ABCDE care as needed
- Early administration of IM adrenaline might also be considered for milder allergic symptoms in children with a history of anaphylaxis

Management of anaphylaxis

- The dose for IM adrenaline is 0.01 mg/kg
- this can be administered by syringe (1 mg/ml solution) but in most settings auto-injectable adrenaline will be the only form available (0.15 mg (<6 y), 0.3 mg (6-12 y), 0.5 mg (>12 y))
- If symptoms do not improve rapidly, give a second dose of IM adrenaline after 5-10 min
- In cases of refractory anaphylaxis competent physicians might consider the use of IV or intraosseous (IO) adrenaline

Management of anaphylaxis

- Prevent any further exposure to the triggering agent
- In the case of a bee sting, remove the sting as quickly as possible Recognize cardiac arrest and start standard CPR when indicated Rescuers only having access to IM adrenaline might consider giving this when cardiac arrest has just occurred
- Consider early TI in case of respiratory compromise

Management of anaphylaxis

- **In addition to IM adrenaline, consider the use of:**
  - **Inhaled SABA (and/or inhaled adrenaline) for bronchospasm**
  - **IV or oral H1 and H2 antihistamines to alleviate subjective symptoms (especially cutaneous symptoms)**
  - **Glucocorticosteroids (e.g. methylprednisolone 1-2 mg/kg) only for children needing prolonged observation**

Management of anaphylaxis

- After treatment, further observe for potential late or biphasic symptoms
- Those children who responded well to one dose of IM adrenaline without any other risk factor can generally be discharged after 4-8 h
- Prolonged observation (12-24 h) is advised for children with a history of biphasic or protracted anaphylaxis or asthma, those who needed more than one dose of IM adrenaline or had a delay between symptoms and first adrenaline dose of more than 60 min

Management of anaphylaxis

- Efforts should be made to identify the potential trigger

- Refer patients to a dedicated healthcare professional for follow-up Every child who had an anaphylactic reaction should have auto-injectable adrenaline prescribed and receive instructions how to use it (both the child, if feasible, and their caregivers)

Anaphylactic reaction?

Airway, Breathing, Circulation, Disability, Exposure

Diagnosis - look for:
- Acute onset of illness
- Life-threatening Airway and/or Breathing and/or Circulation problems[1]
- And usually skin changes

- **Call for help**
- Lie patient flat with raised legs (if breathing allows)

Adrenaline[2]

When skills and equipment available:
- Establish airway
- High flow oxygen
- IV fluid challenge[3]
- Chlorphenamine[4]
- Hydrocortisone[5]

Monitor:
- Pulse oximetry
- ECG
- Blood pressure

[1] **Life-threatening problems:**
Airway: swelling, hoarseness, stridor
Breathing: rapid breathing, wheeze, fatigue, cyanosis, SpO_2 < 92%, confusion
Circulation: pale, clammy, low blood pressure, faintness, drowsy/coma

[2] **Adrenaline** *(give IM unless experienced with IV adrenaline)*
IM doses of 1:1000 adrenaline (repeat after 5 min if no better)

Adult	500 mcg IM (0.5 mL)
Child more than 12 years	500 mcg IM (0.5 mL)
Child 6-12 years	300 mcg IM (0.3 mL)
Child less than 6 years	150 mcg IM (0.15 mL)

Adrenaline IV to be given **only by experienced specialists**
Titrate: Adults 50 mcg; Children 1 mcg kg^{-1}

[3] **IV fluid challenge (crystalloid):**
Adult 500 - 1000 mL
Child 20 mL kg^{-1}
Stop IV colloid if this might be the cause of anaphylaxis

	[4] Chlorphenamine (IM or slow IV)	[5] Hydrocortisone (IM or slow IV)
Adult or child more than 12 years	10 mg	200 mg
Child 6 - 12 years	5 mg	100 mg
Child 6 months to 6 years	2.5 mg	50 mg
Child less than 6 months	250 mcg kg^{-1}	25 mg

Management of circulatory failure

Vascular Access

- Peripheral IV lines are the first choice for vascular access
- Competent providers might use ultrasound to guide cannulation
- In case of an emergency, limit the time for placement to 5 min (2 attempts) at most
- For infants and children, the primary rescue alternative is intraosseous (IO) access

Vascular Access

- All pediatric advanced life support (ALS) providers should be competent in IO placement and have regular retraining in the different devices (and puncture sites) used in their setting
- Provide proper analgesia in every child unless comatose
- Use a properly sized needle
- Most standard pumps will not infuse via IO, so use either manual infusion or a high- pressure bag
- Confirm proper placement and monitor for extravasation which can lead to compartment syndrome

Fluid therapy

- Give one or more early fluid bolus(es) of 10 ml/kg in children with recognized shock
- Repeated fluid boluses up to 40-60 ml/ kg- might be needed in the first hour of treatment of (septic) shock
- Reassess after each bolus and avoid repeated boluses in children who cease to show signs of decreased perfusion or show signs of fluid overload or cardiac failure

Fluid therapy

- Use balanced crystalloids as first choice of fluid bolus, if available
- If not, normal saline is an acceptable alternative
- Consider albumin as second-line fluid for children with sepsis
- In non-hemorrhagic shock, blood products are only needed when blood values fall below an acceptable minimum value
- Give rapid fluid boluses in children with hypovolemic non-hemorrhagic shock
- Otherwise, fluid resuscitation of severely dehydrated children can generally be done more gradually (up to e.g. 100 ml/kg over 8 h)

Fluid therapy

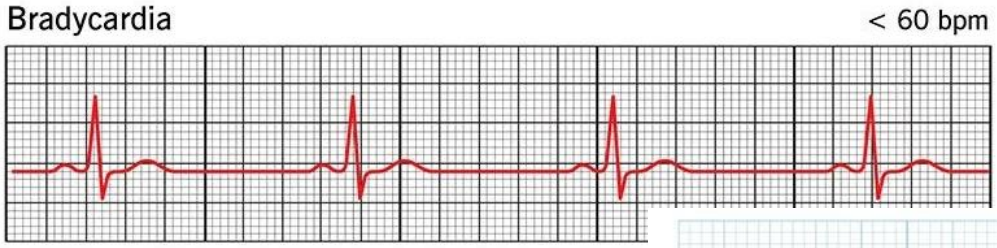
- In cases of hemorrhagic shock, keep crystalloid boluses to a minimum (max. 20 ml/kg)
- Consider early blood products or if available, full blood in children with severe trauma and circulatory failure, using a strategy that focuses on improving coagulation (using at least as much plasma as RBC and considering platelets, fibrinogen, other coagulation factors)

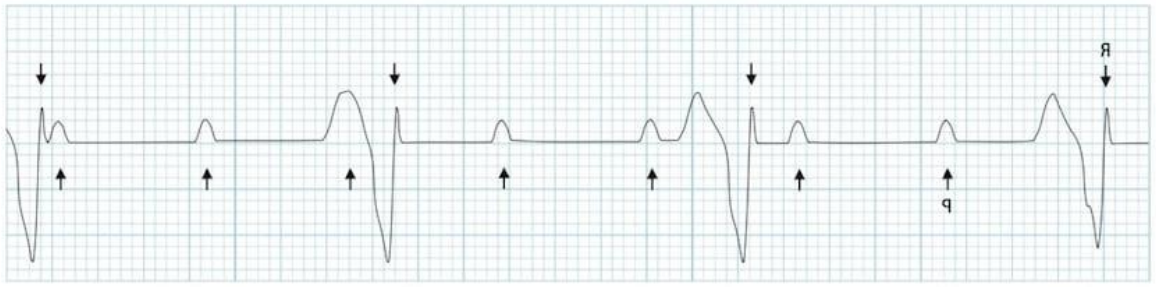
Fluid therapy

- **Permissive hypotension (MAP at 5th percentile for age) can only be considered in children when there is no risk of associated brain injury**
- **Give tranexamic acid (TxA) in all children requiring transfusion after severe trauma as soon as possible, within the first 3 h after injury and/or life-threatening hemorrhage**
- **Consider TxA in children with isolated moderate TBI (GCS 9-13) without pupillary abnormalities**
- **Use a loading dose at 15-20 mg/kg (max. 1 g), followed by an infusion of 2 mg/kg/h for at least 8 h or until the bleeding stops (max. 1 g)**

Unstable primary bradycardia

- Consider atropine (20 mcg/kg; max. 0.5 mg per dose) only in bradycardia caused by increased vagal tone
- Consider emergency transthoracic pacing in selected cases with circulatory failure due to bradycardia caused by complete heart block or abnormal function of the sinus node
- Early expert help is mandatory





Unstable primary tachycardia

- In children with decompensated circulatory failure due to either supraventricular (SVT) or ventricular tachycardia (VT), the first choice for treatment is immediate synchronized electrical cardioversion at a starting energy of 1 J/kg body weight
- Double the energy for each subsequent attempt up to a maximum of 4 J/ kg
- If possible, this should be guided by expert help
- For children who are not yet unconscious, use adequate analgosedation according to local protocol
- Check for signs of life after each attempt

Unstable primary tachycardia

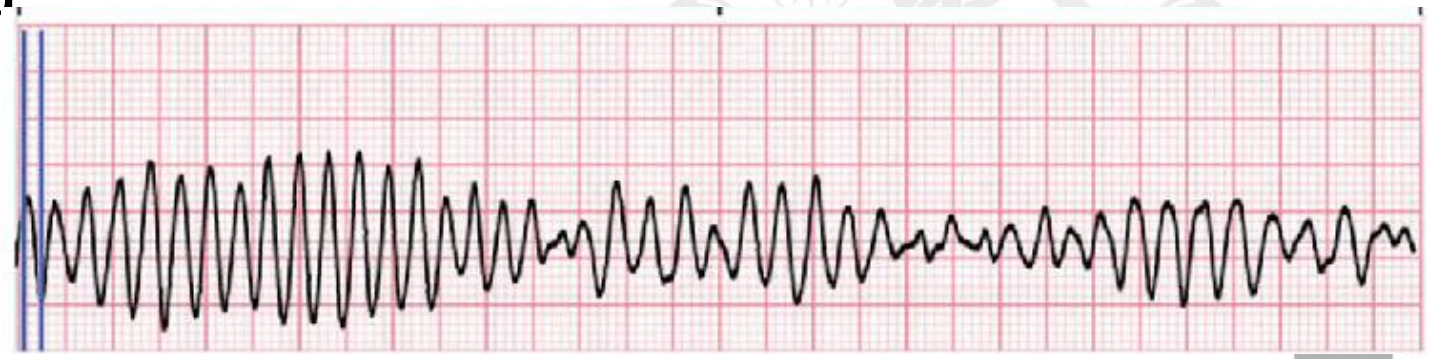
- In children with a presumed SVT who are not yet decompensated, providers can try vagal maneuvers (e.g. ice application, modified Valsalva techniques)
- If this has no immediate effect, proceed with IV adenosine
- Give a rapid bolus of 0.1-0.2 mg/kg (max 6 mg) with immediate saline flush via a large vein; ensure a rhythm strip is running for later expert evaluation
- Especially in younger children, higher initial doses are preferable

Unstable primary tachycardia

- In case of persistent SVT, repeat adenosine after at least 1 min at a higher dose (0.3 mg/kg, max 12-18 mg)
- Be cautious with adenosine in children with known sinus node disease, pre-excited atrial arrhythmias, heart transplant or severe asthma
- In such cases, or when there is no prolonged effect of adenosine, competent providers (with expert consultation) might give alternative medications

Unstable primary tachycardia

- Wide QRS tachycardias can be either VT or SVT with bundle branch block aberration, or antegrade conduction through an additional pathway
- In case the mechanism of the arrhythmia is not fully understood, wide QRS arrhythmia should be treated as VT
- Even in stable patients, electrical cardioversion should always be considered
- In case of Torsade de pointes VT, IV magnesium sulfate 50 mg/kg is indicated.



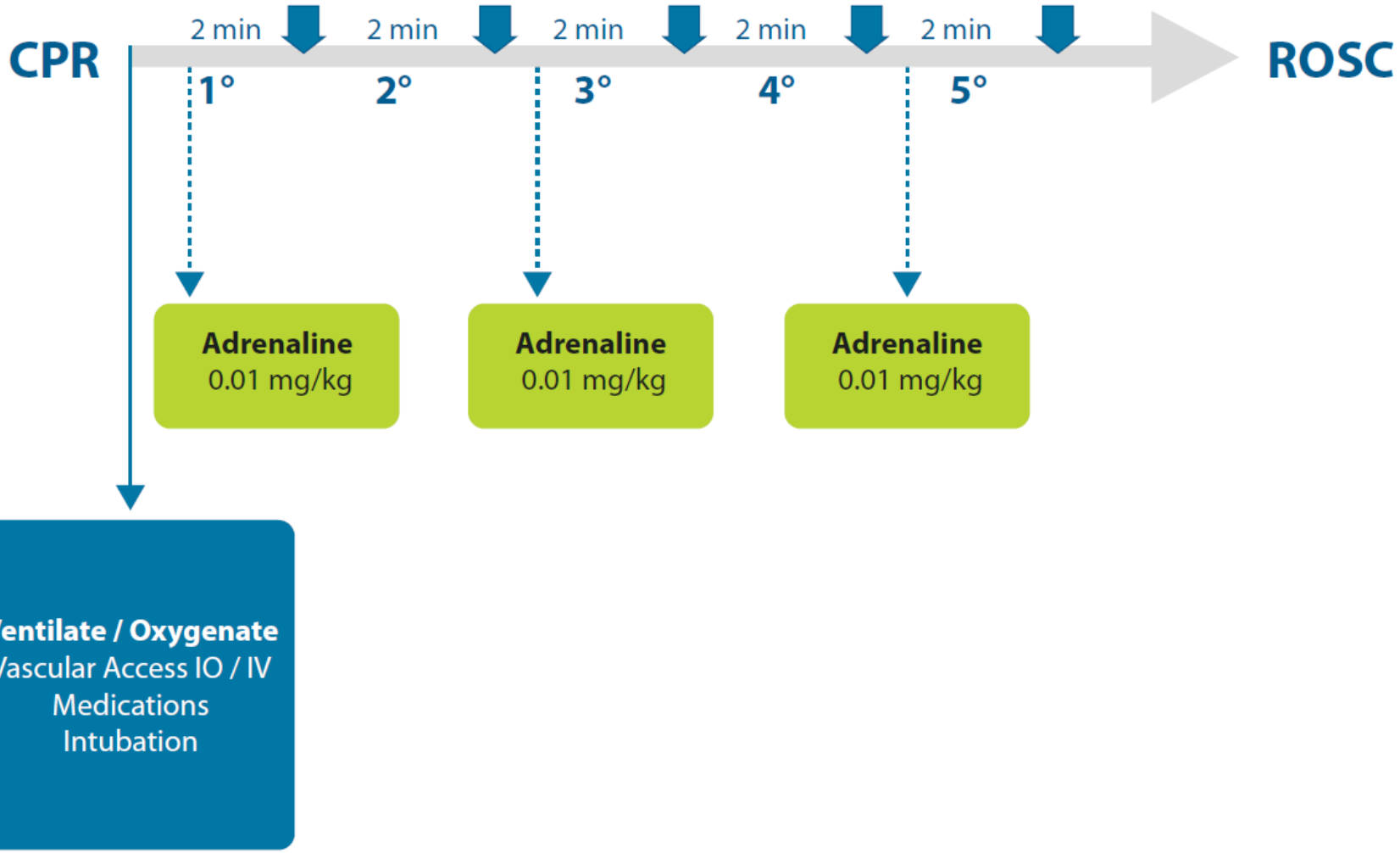
Non-shockable rhythms

- Pulseless electrical activity (PEA), bradycardia and asystole
- If bradycardia (<60 per minute) is the result of hypoxia or ischemia, CPR is needed even if there is still a detectable pulse
- Therefore, providers should rather assess signs of life and not lose time by checking for a pulse
- In the absence of signs of life, continue to provide high-quality CPR

Non-shockable rhythms

- Obtain vascular access and give adrenaline IV (10 mcg/kg, max 1 mg) as soon as possible
- Flush afterwards to facilitate drug delivery
- Repeat adrenaline every 3-5 min
- In cases where it is likely to be difficult to obtain IV access, immediately go for IO access

CARDIAC ARREST: NON SHOCKABLE RHYTHM



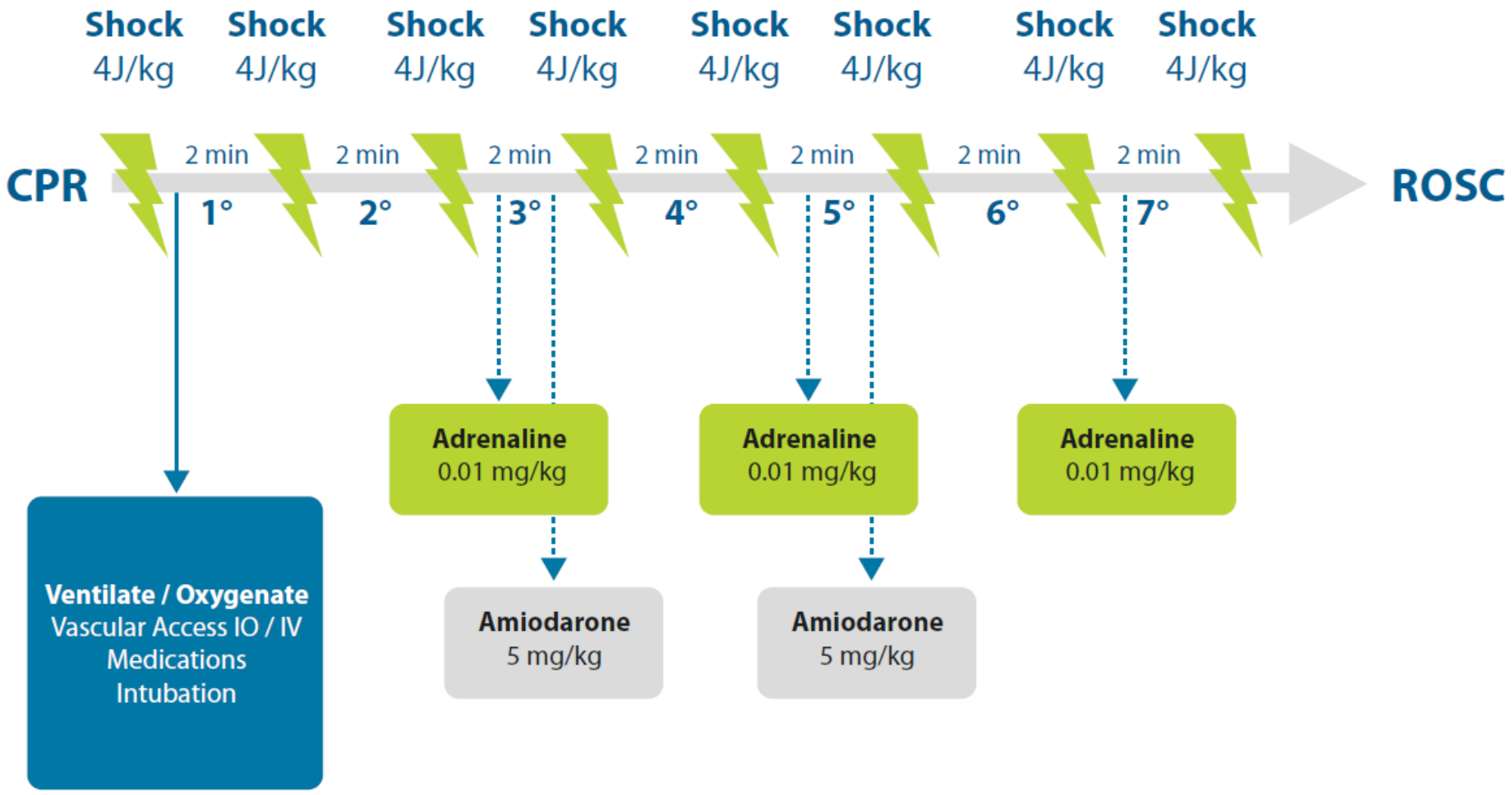
Shockable rhythms

- Pulseless ventricular tachycardia (pVT) and ventricular fibrillation (VF)
- As soon identified, defibrillation should immediately be attempted (regardless of the ECG amplitude)
- If in doubt, consider the rhythm to be shockable
- Once MD or AED charged, pause chest compressions, and ensure all rescuers are clear of the child
- Minimize the delay between stopping chest compressions and delivery of the shock (<5 s)

Shockable rhythms

- Give one shock (4 J/kg) and immediately resume CPR
- Reassess the cardiac rhythm every 2 min (after the last shock) and give another shock (4 J/kg) if a shockable rhythm persists
- Immediately after the third shock, give adrenaline (10 mcg/kg, max 1 mg) and amiodarone (5 mg/ kg, max 300 mg) IV/IO
- Give a second dose of adrenaline (10 mcg/ kg, max 1 mg) and amiodarone (5 mg/kg, max 150 mg) after the 5th shock if the child still has a shockable rhythm
- Once given, adrenaline should be repeated every 3-5 min

CARDIAC ARREST – SHOCKABLE RHYTHM



Use of an automated external defibrillator (AED)

- In cases where the likelihood of a primary shockable rhythm is very high such as in sudden witnessed collapse, if directly accessible, he or she can rapidly collect and apply an AED (at the time of calling EMS)

- In case there is more than one rescuer, a second rescuer will immediately call for help and then collect and apply an AED (if feasible)


TRAINING ONLY
TRAINING ONLY
1
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Training Mode
NOT FOR CLINICAL USE

PAEDIATRIC ADVANCED LIFE SUPPORT

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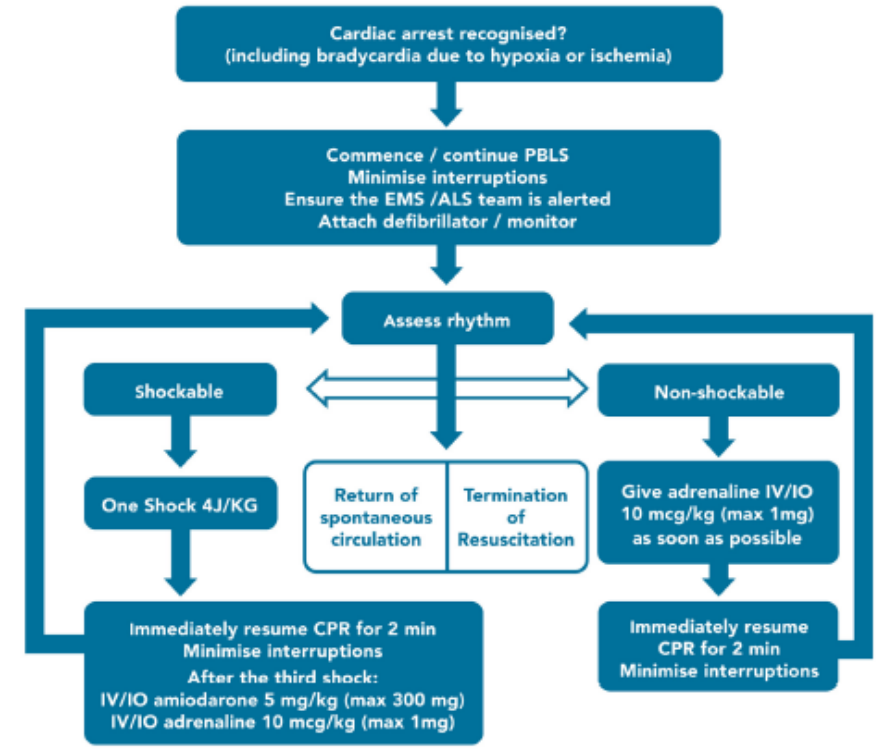

DURING CPR

- Ensure high-quality CPR: rate, depth, recoil
- Provide bag-mask ventilation with 100% oxygen (2-person approach)
- Avoid hyperventilation
- Vascular access (intravenous, intraosseous)
- Once started, give adrenaline every 3-5 min
- Flush after each drug
- Repeat amiodarone 5 mg/kg (max 150mg) after the 5th shock
- Consider an advanced airway and capnography (if competent)
- Provide continuous compressions when a tracheal tube is in place. Ventilate at a rate of 25 (infants) – 20 (1-8y) – 15 (8-12y) or 10 (>12y) per minute
- Consider stepwise escalating shock dose (max 8J/kg – max 360J) for refractory VF/pVT (≥6 shocks)

CORRECT REVERSIBLE CAUSES

- Hypoxia
- Hypovolaemia
- Hyper/hypokalaemia, -calcaemia, -magnesemia; Hypoglycaemia
- Hypothermia - hyperthermia
- Toxic agents
- Tension pneumothorax
- Tamponade (cardiac)
- Thrombosis (coronary or pulmonary)

ADJUST ALGORITHM IN SPECIFIC SETTINGS (E.G. TRAUMA, E-CPR)

IMMEDIATE POST ROSC

- ABCDE approach
- Controlled oxygenation (SpO_2 94-98%) & ventilation (normocapnia)
- Avoid hypotension
- Treat precipitating causes

Fig. 4 – Paediatric advanced life support.

SPECIFIC CONDITIONS: Corrosive compounds poisoning

Examples: sodium hydroxide, potassium hydroxide, acids, bleaches or disinfectants

- **Give milk or water as soon as possible to dilute the corrosive agent**
- **Then give the child nothing by mouth and arrange for surgical review to check for esophageal damage or rupture, if severe**
- **Do not induce vomiting or use activated charcoal when corrosives have been ingested, as this may cause further damage to the mouth, throat, airway, lungs, esophagus and stomach**

SPECIFIC CONDITIONS: Paracetamol poisoning

- If within 4 h of ingestion, give activated charcoal, if available, or induce vomiting unless an oral or IV antidote is required

- Decide whether an antidote is required to prevent liver damage: ingestion of 150 mg/kg or more or toxic 4-h paracetamol level when this is available. An antidote is more often required for older children who deliberately ingest paracetamol or when parents overdose children by mistake

- If within 8 h of ingestion, give oral methionine or IV acetylcysteine. Methionine can be used if the child is conscious and not vomiting (< 6 years: 1 g every 4 h for four doses; ≥ 6 years: 2.5 g every 4 h for four doses)

SPECIFIC CONDITIONS: Paracetamol poisoning

- If more than 8 h after ingestion, or the child cannot take oral treatment, give IV acetylcysteine. Note that the fluid volumes used in the standard regimen are too large for young children

- For children < 20 kg give the loading dose of 150 mg/kg in 3 ml/kg of 5% glucose over 15 min, followed by 50 mg/kg in 7 ml/kg of 5% glucose over 4 h, then 100 mg/kg IV in 14 ml/kg of 5% glucose over 16 h. The volume of glucose can be increased for larger children. Continue infusion of acetylcysteine beyond 20 h if presentation is late or there is evidence of liver toxicity. If liver enzymes can be measured and are elevated, continue IV infusion until enzyme levels fall

SPECIFIC CONDITIONS: Hyperthermia

- **In cases of heat stroke (i.e. a central body temperature 40-40.5°C with central nervous system (CNS) dysfunction):**
  - **Monitor central body temperature as soon as possible (rectal, esophageal, bladder, intravascular)**
  - **Prehospital treatment consists of full ABCDE management and rapid aggressive cooling. Remove the child from the heat source**
  - **Undress and fan with cold air and mist**
  - **Apply ice packs**
  - **Provide early evaporative external cooling**
  - **Consider cold-water immersion for adolescents and young adults**

SPECIFIC CONDITIONS: Hyperthermia

- Further cooling in hospital can be done by placing the child on a cooling blanket; applying ice packs to the neck, axilla and groin or alternatively on the smooth skin surfaces of the cheeks, palms, and soles; and infusion of IV crystalloids at room temperature
- Stop cooling measures once the core temperature reaches 38°C
- Benzodiazepines are suggested to avoid trembling, shivering or seizures during cooling measures
- Classic antipyretic medications are ineffective
- All children with heat stroke should be admitted to a (pediatric) intensive care unit to maintain adequate monitoring and to treat associated organ dysfunction

Pediatric foreign body airway obstruction (FBAO)

- **Suspect FBAO -if unwitnessed- when the onset of respiratory symptoms (coughing, gagging, stridor, distress) is very sudden and there are no other signs of illness; a history of eating or playing with small items immediately before the onset of symptoms might further alert the rescuer**

- **As long as the child is coughing effectively (fully responsive, loud cough, taking a breath before coughing, still crying, or speaking), no maneuver is necessary**

Pediatric foreign body airway obstruction (FBAO)

- Encourage the child to cough and continue monitoring the child's condition
- If the child's coughing is (becoming) ineffective (decreasing consciousness, quiet cough, inability to breathe or vocalize, cyanosis), ask for bystander help and determine the child's conscious level
- A second rescuer should call EMS, preferably by mobile phone (speaker function)

Pediatric foreign body airway obstruction (FBAO)

- A single trained rescuer should first proceed with rescue maneuvers (unless able to call simultaneously with the speaker function activated)
- If the child is still conscious but has ineffective coughing, give back blows
- If back blows do not relieve the FBAO, give chest thrusts to infants or abdominal thrusts to children
- If the foreign body 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
- Do not leave the child
- The aim is to relieve the obstruction with each thrust rather than to give many of them

Pediatric foreign body airway obstruction (FBAO)

- 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 or if the victim was treated with abdominal thrusts, urgent medical follow up is mandatory
- If the child with FBAO is, or becomes, unconscious, continue according to the pediatric BLS algorithm
- Competent providers should consider the use of Magill forceps to remove a foreign body

PAEDIATRIC FOREIGN BODY AIRWAY OBSTRUCTION

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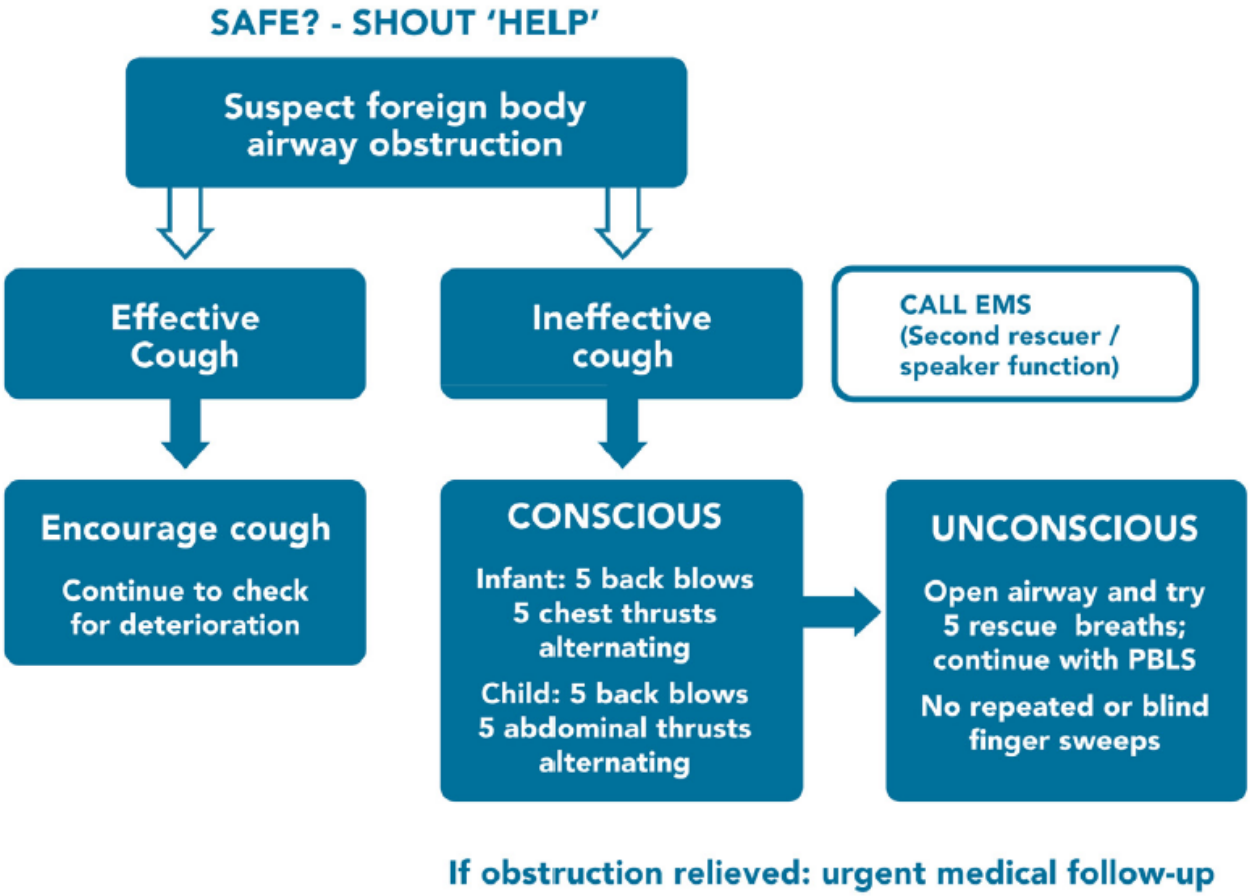

Fig. 3 – Foreign body airway obstruction.

Hypoglycemia

- Recognise hypoglycemia using context, clinical signs, and measurement (50-70 mg/dl; 2.8-3.9 mmol/L), and promptly treat this
- Also identify and treat any underlying cause
- Specific dosage of IV glucose maintenance might be indicated in specific metabolic diseases
- Mild asymptomatic hypoglycemia may be treated with standard glucose administration, either by maintenance infusion glucose (6-8 mg/kg/min) or by oral rapid acting glucose (0.3 g/kg tablets or equivalent), followed by additional carbohydrate intake to prevent recurrence

Hypoglycemia

- **Severe paediatric hypoglycaemia (<50 mg/dl (2.8 mmol/L) with neuroglycopenic symptoms) demands:**
  - **IV glucose 0.3 g/kg bolus; preferably as 10% (100 mg/ml; 3 ml/ kg) or 20%-solution (200 mg/ml; 1.5 ml/kg)**
  - **When IV glucose is not available, providers may administer glucagon as temporary rescue, either IM or SC (0.03 mg/kg or 1 mg >25 kg; 0.5 mg <25 kg) or intranasally (3 mg; 4-16 y)**
  - **Retest blood glucose 10 min after treatment and repeat treatment if the response is inadequate**
  - **Reasonable targets are an increase of at least 50 mg/dl (2.8 mmol/L) and/or a target glycemia of 100 mg/dL (5.6 mmol/L)**
  - **Start a glucose maintenance infusion (6-8 mg/kg/min) to reverse catabolism and maintain adequate glycemia**

Status epilepticus

- Identify and manage underlying diagnoses and precipitant causes including hypoglycaemia, electrolyte disorders, intoxications, brain infections and neurological diseases, as well as systemic complications such as airway obstruction, hypoxaemia or shock
- If seizures persist for more than 5 min, give a first dose of a benzodiazepine
- Which benzodiazepine via which route to give will depend on the availability, context, social preference, and expertise of the providers

Status epilepticus

- Non-IV benzodiazepines should be used if an IV line is not (yet) available
- Adequate dosing is essential:
  - IM midazolam 0.2 mg/kg (max 10 mg) or prefilled syringes: 5 mg for 13-40 kg, 10 mg > 40 kg); intranasal/buccal 0.3 mg/kg; IV 0.15 mg/kg (max 7.5 mg)
  - IV lorazepam 0.1 mg/kg (max 4 mg)
  - IV diazepam 0.2-0.25 mg/kg (max 10 mg)/rectal 0.5 mg/kg (max 20 mg)

Status epilepticus

- If seizures persist after another 5 min, administer a second dose of benzodiazepine and prepare a long-acting second line drug for administration
- Seek expert help
- Not later than 20 min after seizures started, give second line anti-epileptic drugs
- The choice of drug will again depend on context, availability, and expertise of the provider

Status epilepticus

- **Adequate dosing is again essential:**
  - **Levetiracetam 40-60 mg/kg IV (recent papers suggest the higher dose; max. 4.5 g, over 15')**
  - **Phenytoin 20 mg/kg IV (max. 1.5 g, over 20 min; or alternatively Phosphenytoin)**
  - **Valproic acid 40 mg/kg IV (max 3 g; over 15 min; avoid in cases of presumed hepatic failure or metabolic diseases which can never be ruled out in infants and younger children, as well as in pregnant teenagers)**
  - **Phenobarbital (20 mg/kg over 20 min) IV is a reasonable second-line alternative if none of the three recommended therapies are available**

Status epilepticus

- If seizures continue, consider an additional second-line drug after the first second-line drug has been given
- Not later than 40 min after seizures started, consider anesthetic doses (given by a competent provider) of either midazolam, ketamine, pentobarbital/thiopental, or propofol; preferably under continuous EEG monitoring
- Non-convulsive status epilepticus can continue after clinical seizures cease; all children who do not completely regain consciousness need EEG monitoring

Ethics of Resuscitation & End-of-life Decisions

- **Clinicians should integrate the following patient/family support elements with shared decision making:**
  - **Provide information about the patient's status and prognosis in a clear and honest manner. This may be supported by use of a video-support tool**
  - **Seek information about the patient's goals, values, and treatment preferences**
  - **Involve patients/family members in discussions about advance care plans**
  - **Provide empathic statements assuring non-abandonment, symptom control, and decision-making support**

Ethics of Resuscitation & End-of-life Decisions

- **Provide the option of spiritual support**
- **Where appropriate, explain and apply protocolised patient centred procedures for treatment withdrawal with concurrent symptom control and patient/family psychological support**
- **Consider recording meetings with family for the purpose of audit/quality improvement**

Deciding when to start and when to stop cardiopulmonary resuscitation (CPR)

Ethics of Resuscitation & End-of-life Decisions

- **Unequivocal criteria:**
  - **When the safety of the provider cannot be adequately assured**
  - **When there is obvious mortal injury or irreversible death**
  - **When a valid and relevant advance directive becomes available that recommends against the provision of CPR**

Ethics of Resuscitation & End-of-life Decisions

- **Further criteria to inform decision making:**
  - **Persistent asystole despite 20 minutes of advanced life support (ALS) in the absence of any reversible cause**
  - **Unwitnessed cardiac arrest with an initial non-shockable rhythm where the risk of harm to the patient from ongoing CPR likely outweighs any benefit e.g. absence of return of spontaneous circulation (ROSC), severe chronic co-morbidity, very poor quality of life prior to cardiac arrest**
  - **Other strong evidence that further CPR would not be consistent with the patient's values and preferences, or in their best interests**

Ethics of Resuscitation & End-of-life Decisions

- **Criteria that should not alone inform decision-making:**
  - **Pupil size**
  - **CPR duration**
  - **End-tidal carbon dioxide (CO2) value**
  - **Co-morbid state**
  - **Initial lactate value**
  - **Suicide attempt**

Ethics of Resuscitation & End-of-life Decisions

- **Bystander CPR Systems should:**
  - **Recognise the importance of bystander CPR as a core component of the community response to OHCA**
  - **Recognise bystander CPR as a voluntary act, with no perceived moral or legal obligation to act**
  - **Support bystanders in minimising the impact on their own health of performing bystander CPR**

Ethics of Resuscitation & End-of-life Decisions

- In the context of transmissible disease (such as COVID-19), bystanders also have a responsibility of preventing further disease transmission to other individuals in the immediate vicinity and the wider community
- Aim to identify cases where bystander CPR is likely to be beneficial and cases where it is unlikely to be beneficial
- Never evaluate the value of (bystander) CPR in isolation but as part of the whole system of healthcare within their region
- (Bystander) CPR seems feasible in settings where resources and organisation support the integrity of the chain of survival

Ethics of Resuscitation & End-of-life Decisions

- A ‘slow code’ is slang for the deceptive practice of purposely delivering sub-optimal CPR with the pretence of attempting to save the patient's life
- There is evidence that slow codes continue to be performed both in IHCA and OHCA, even when CPR is considered of no benefit to the patient
- Use of the slow code is extremely ethically problematic, although some have advocated for it in certain circumstances
- Several alternatives have been described that are ethically more acceptable, such as informed non-dissent, tailored code or early advance care planning with open communication
- More education on ethics in resuscitation might positively affect this

The Network of 33 National Resuscitation Councils (NRCs) deliver guidelines, resuscitation training and quality control

Slide

QUESTIONS