

# Guide to paediatric medical emergencies

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## Key points

Paediatric medical emergencies are uncommon but sometimes require different management compared to their adult counterparts.

Paediatric emergency drug doses are dependent on the weight of the child.

Regular practice-based simulation training should be encouraged to ensure that all members of the dental team are aware of their roles and equipment usage.

## Abstract

Paediatric medical emergencies can be distressing for the child, parent and clinician alike. This paper aims to remind those in primary dental care how to manage these emergencies safely and effectively. Topics covered include paediatric airway management, basic life support, defibrillation, choking, asthma, paediatric emergency drug doses and epilepsy.

## Introduction

Paediatric medical emergencies in the dental setting are uncommon. Correct management of such emergencies often depends on the child's weight and as such emergency drug doses are more variable than in adult counterparts.<sup>1</sup> Increased variability in drug doses and resuscitation techniques can lead to dental practitioners feeling less familiar and confident managing emergencies in their younger patient groups. Furthermore, this lack of familiarity is often compounded by less frequent training in paediatric life support compared with adult emergencies. It is hoped that most practitioners will never see a paediatric medical emergency; however, this paper aims to act as an aide mémoire and provide helpful hints and tips to prepare those in primary care should an emergency occur.

## The basics 'DR ABCDE'

As with any medical emergency a 'DR ABCDE' approach is essential (Danger, Response, Airway, Breathing, Circulation, Disability,

Exposure).<sup>2</sup> The basics of this are covered in detail by undergraduate programmes and cardiopulmonary resuscitation (CPR) courses and for the sake of brevity will not be repeated here. ABCDE should be continually reassessed during any emergency, with one component being addressed before moving on to the next. It is important to note that paediatric vital signs are variable and depend on the size and age of the child, but a rough guide is provided by Table 1.<sup>3</sup>

For children over 2 and under 12 a useful guide to estimate the respiratory rate is the formula:<sup>3</sup>

$$\text{Respiratory rate} = 24 - (\text{age}/2).$$

## Paediatric airway management

Signs of paediatric airway obstruction may include inability to vocalise, cyanosis, 'see-saw' movements of chest and abdomen or abnormal airway noises such as wheeze, gurgling, snoring or stridor.<sup>2</sup> The mouth should be checked for any loose objects and visible easily accessible objects should be removed, with dental suction as appropriate. A head tilt chin-lift should be performed if the child is over 1 year unless a cervical spine injury is suspected, in which case a jaw thrust should be used.<sup>4</sup> Infants under 1 year should have their head kept in a neutral position (Fig. 1). In an unconscious patient, a Guedel (oropharyngeal) airway is a useful airway adjunct, available in primary care. This should be sized from the angle of the mandible to the incisors (Fig. 2). In older

children a Guedel airway should be inserted 'upside down' and rotated as it approaches the posterior pharynx (Fig. 3), while in infants they should be inserted directly to prevent trauma to the soft palate. A tongue depressor or dental mirror may help with this. The patient must be unconscious otherwise the gag reflex will be triggered. Nasopharyngeal airways can be used in conscious patients for those who have been trained in their correct usage.

## Basic life support (BLS)

Unlike adult cardiac arrests, paediatric cardiac arrest is much more likely to be secondary to respiratory arrest than primary cardiac disease. Therefore, correcting hypoxia and giving early and effective ventilations is of paramount importance in children. Key differences in paediatric cardiopulmonary resuscitation (CPR) compared with adult CPR are summarised by Table 2.

A single rescuer outside of a clinical setting should use mouth-to-mouth or a pocket mask as appropriate and should commence CPR for 1 minute before phoning for help. However, in dental practice members of the dental team should never be dealing with an emergency alone. In a team setting, two people should use the bag-valve mask, ensuring correct oxygen attachment and ventilation rate to prevent over-inflation of the lungs and also ensuring adequate recoil of the bag after each compression (Fig. 4). Overventilation of the lungs leads to increased intrathoracic

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Refereed Paper.

Accepted 17 June 2019

<https://doi.org/10.1038/s41415-019-0856-8>

pressure thereby decreasing venous return and coronary perfusion, reducing survival rates. It is therefore essential to use just enough force and tidal volume to make the chest rise ensuring the chest falls after each breath.<sup>5</sup> The five components of high quality CPR are shown in Box 1.<sup>6</sup> Should the patient show signs of life and start breathing normally, then they should be placed in the recovery position and supplemental oxygen given as needed via a non-rebreathe mask. The Resuscitation Council flowchart for paediatric CPR is summarised by Figure 5 and correct hand positioning for CPR in infants under 1 is shown by Figure 6.<sup>4</sup>

### Defibrillation

Automated external defibrillators (AEDs) are readily accessible and should be available in all dental practices and can be used by any member of the team during a cardiac arrest. Depending on the manufacturer of the AED, some AEDs require different assembly for use on children. Some come with paediatric pads and a flip switch or key which allows adjustment between adult or paediatric settings. Placement of the pads on a larger child is the same as an adult (Fig. 7); however, if the child is small enough to be quickly rolled then pads should be placed on the front and back of chest. It is imperative that chest compressions and ventilations continue with minimal interruption while the AED is being assembled.<sup>6</sup> Of equal importance is to ensure that all team members are safe; the team leader in the medical emergency should take responsibility for activating the defibrillator. This person should ensure no-one is touching the patient and oxygen is removed, turned off and at least 2 metres away before a shock is delivered.

### Choking

Choking is one of the more likely medical emergencies to be encountered in the dental setting.<sup>7</sup> Fragments of fillings and teeth, temporary dressings, orthodontic brackets and preformed metal crowns are some examples of potential choking hazards. Signs of choking may be subtle, especially in infants and may include sudden respiratory distress, clutching of the neck, coughing or inability to vocalise.<sup>8</sup>

Choking management is summarised by Figure 8.<sup>4</sup> The first step involves early identification of airway status. Easily removed objects should be removed if possible, but DO NOT attempt blind or repeated finger sweeps.

Table 1 Paediatric vital signs<sup>3</sup>

Age (years)	Respiratory rate (breaths/min)	Heart rate (bpm)	Systolic blood pressure (m Hg)	Diastolic blood pressure
2	25–35	100–150	95–105	50–65
4	25–30	80–120	95–110	55–70
6	20–25	75–115	95–110	55–70
8	20–25	70–110	95–110	55–70
12	15–20	60–100	100–120	65–80



Fig. 1 Infant neutral airway position



Fig. 2 Sizing a Guedel airway from incisors to angle of mandible



**Fig. 3** Insertion technique for a Guedel airway in older child; inserted upside down and then rotated 180 degrees as it approaches the posterior pharynx

Table 2 Differences between paediatric and adult CPR	
Paediatric CPR	Adult CPR
5 initial rescue breaths	Start compressions immediately
15 compressions per 2 rescue breaths	30 compressions per 2 rescue breaths
Compress chest to 1/3rd of depth	Compress chest to 1/3rd of depth using both hands
Using 2 fingers in infants <1 year	
One or two hands as needed > 1 year	
If alone, start CPR for 1 minute before phoning for help. If able, then carry child with you to the nearest telephone to continue CPR	If alone, immediately phone for help



**Fig. 4** Two person technique for bag valve mask. One person supports airway and ensures good seal, while the second person compresses the bag just enough to make the chest rise

Should the airway only be partially obstructed then this may be indicated by an *effective cough*. An effective cough is loud in nature and the child will be able to cry/talk and be able to take a breath before further coughing episodes. Management of choking with an effective cough consists of encouraging the child to cough until either relief of the obstruction or deterioration to an ineffective cough. Prompt phoning for emergency help is essential.

Should the airway be completely obstructed then the patient will have an *ineffective cough*. In this scenario, coughing will be quiet or silent, the child will be unable to vocalise or breathe and may show signs of cyanosis or decreasing level of consciousness. Emergency help should have already been summoned by this point. Should the child remain conscious, management includes alternation between five back blows and five abdominal thrusts if they are aged over 1 year, briefly checking after each blow/thrust for relief of obstruction. An infant aged under 1 year should initially be held prone with their head downward, supported by the lap in order to allow gravity to aid removal of the foreign body during back blows (Fig. 9). Should back blows be ineffective, infants below 1 year should be turned in to a supine position, by supporting the occiput with a free hand and should then have chest thrusts performed, which are similar to chest compressions but are sharper, more purposeful in nature and delivered at a slower rate (Fig. 10). Abdominal thrusts should be avoided in those under 1 year due to the risk of organ damage such as spleen rupture. Should the child become unconscious then CPR should be started immediately, airway opened, five rescue breaths given before starting compressions as demonstrated previously by Figure 5.<sup>4,8</sup>

### Asthma

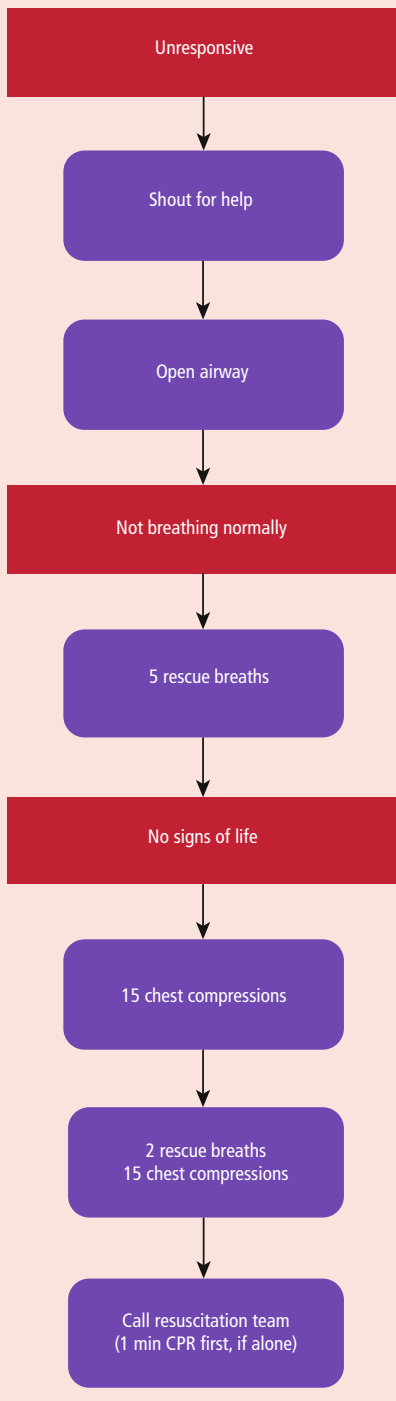
Good history taking in patients with known asthma can help prepare the dental team for the possibility of an asthma attack. History taking should include frequency of asthma attacks, known triggering factors, dates of previous hospitalisations, effectiveness of inhalers and whether any oral steroids, leukotriene-receptor antagonists ('preventer tablets') or nebulisers have been needed previously. Patients who fail to use their preventer inhalers as prescribed will be at increased risk of an attack. Patients may carry a written 'Asthma Plan' with them which may provide further information.<sup>9</sup>



**Box 1 Table showing the key components of high quality CPR**

- Five components of high quality CPR<sup>5</sup>
- Adequate rate of chest compressions
- Adequate depth of chest compressions
- Allow full recoil of chest between compressions
- Minimise interruption in compressions
- Avoid excessive ventilation

**Fig. 5 Paediatric basic life support (Reproduced with the kind permission of the Resuscitation Council UK)<sup>4</sup>**



**Fig. 6 Positioning of hands to stabilise airway and perform compressions in infant CPR**



**Fig. 7 AED pad positioning for older child. Ensure oxygen is removed prior to administering a shock**

Management of asthma attacks include sitting the patient upright and prompt use of a salbutamol inhaler. Care should be taken to check inhalers are in-date and not empty and that turquoise salmeterol (Serevent) inhalers are not confused with salbutamol. One actuation should be given every 30–60 seconds up to a maximum of ten puffs, with use of a spacer device being recommended. Failure to respond to these first doses of salbutamol or signs of

severe or life-threatening asthma (Table 3) should trigger phoning an ambulance. Should the ambulance fail to arrive within 15 minutes, give a repeated dose of up to ten actuations of salbutamol as above. The Asthma UK website has useful short videos demonstrating correct inhaler technique.<sup>10</sup> Some adolescent patients may be on MART inhalers (Maintenance and Reliever Therapies) which includes Symbicort, Fostair and DuoResp Spiromax.<sup>11</sup> These MART

inhalers may act as a reliever inhaler for emergency symptoms, it is therefore important to check these patients' written asthma plans or contact their local GMP/asthma nurse for advice during their initial dental consultation to ensure correct management should an asthma attack occur.<sup>11</sup> It is important for any patient who has an asthma attack, even if they apparently recover, that they see their GP within 24 hours for review of their asthma control.

### Paediatric emergency drug doses

Emergency drug doses for anaphylaxis, hypoglycaemia and status epilepticus vary dependant on the age and weight of the child as demonstrated by Table 4.<sup>1</sup> Paediatric doses of emergency drugs are also highlighted in the BNF for Children 'Medical Emergencies in the Community' section.<sup>14</sup>

Consideration should therefore be given to weighing patients in the surgery as part of medical history taking. Accurate knowledge of a patient's weight is not only helpful in the emergency situation but also ensures safe prescribing, avoids inadvertent local anaesthetic overdose and may identify children at extremes of weight which may potentially highlight safeguarding concerns. However, should scales not be available you can estimate a child's 'ideal' weight using the formula:<sup>15</sup>

$$\text{Age} < 9 \text{ years: Weight (kg)} = (\text{age} + 4) \times 2$$

With regard to repeating the drug doses in Table 4, intramuscular adrenaline should be repeated at 5 minute intervals if there are no signs of clinical improvement. EpiPen contains 300 µg adrenaline while EpiPen Jr contains 150 µg. Jext autoinjectors also come in 300 µg and 150 µg doses while Emerade pens cover the full range of dosages (500 µg, 300 µg and 150 µg). It is therefore important to note that should a child over 12 years of age enter anaphylaxis, they will need two administrations of EpiPen/Jext autoinjectors to reach the recommended dose of 500 µg. Equally should a dentist be faced with a young child aged under 6 entering anaphylaxis and they only have a 300 µg dose auto-injector then they should administer this dose.

Midazolam doses should not be repeated in primary care due to the risk of respiratory depression. Equally, repeated glucagon doses will offer limited benefit as this drug takes time to work and glycogen stores will have already been released.

Fig. 8 Paediatric choking management. (Reproduced with the kind permission of the Resuscitation Council UK)<sup>4</sup>

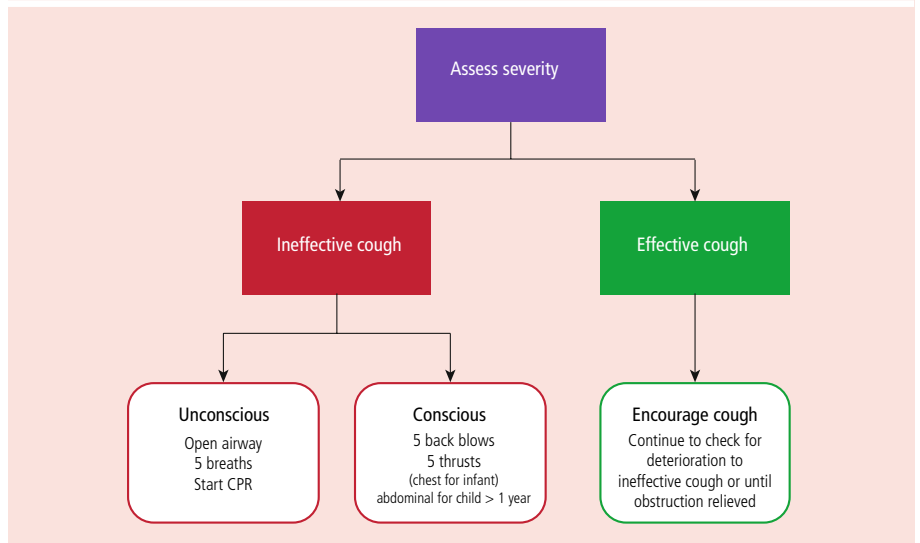


Fig. 9 Back slaps for choking infant



Fig. 10 Finger positioning for chest thrusts in a choking infant

## Seizures

Common causes for seizures in children include febrile convulsions due to pyrexia, vasovagal episodes, infection, head injury and epilepsy.

A patient with known epilepsy with regular tonic-clonic seizures should be allowed to continue for up to 5 minutes. During this time the airway should be maintained and supplemental oxygen given to prevent hypoxia.<sup>16</sup> Should the practice have access to monitoring equipment, oxygen saturation levels should be monitored. The patient should not be restrained but should be protected from further injury by clearing the area of dangerous objects and supporting the head with a cushion.<sup>17</sup> Aspiration with suction may be useful to ensure the airway is kept clear of excess saliva or vomit. Once the patient's seizure has stopped, they should be placed in the recovery position. Should the patient continue to have a seizure for longer than 5 minutes, or have repeated episodes, then an ambulance should be phoned and the correct dose of buccal midazolam should be given for status epilepticus (see Table 4). Any seizure can turn in to status epilepticus, which is defined as a prolonged seizure lasting more than 5 minutes or repetitive seizures without regaining of consciousness.<sup>16</sup> Continued monitoring of the patient is essential as respiratory depression is an unwanted side effect of midazolam usage. Should the patient stop breathing then CPR should be started immediately. It is worth noting that some parents may be experienced and willing to administer rectal diazepam to treat their child's seizure.<sup>16</sup>

Should it be a patient's first seizure or if it is unexpected in nature or should there be any other medical concerns, then an ambulance should be phoned immediately.

## Recommendations

Regular in-house training in a simulated setting is essential to account for the differences in practice layouts, teams and equipment. Practice principals should take the lead in allocating roles to each team member so they have a greater awareness of what is expected of them during an emergency scenario. Familiarity with the practice drug box and how to draw up and administer correct doses of drugs is essential alongside

**Table 3 Signs of severe and life-threatening asthma<sup>12,13</sup>**

Severe asthma	Life-threatening asthma
Difficulty completing sentences in one breath	Exhaustion
Inability to talk	Altered level of consciousness/confusion
Accessory muscle usage	Cyanosis
SpO <sub>2</sub> <92%	Hypotension
Respiratory rate >30 breaths/min (>5 years)	Reduced respiratory rate
>50 breaths/min (2–5 years)	Poor respiratory effort
Elevated heart rate >130 bpm	Reduced heart rate

**Table 4 Paediatric emergency drug doses**

Intramuscular adrenaline for anaphylaxis		Buccal midazolam for status epilepticus		Intramuscular/subcutaneous glucagon for hypoglycaemia		
Age (years)	Dose of 1:1000 adrenaline	Age (years)	Dose	Age (years)	Weight (kg)	Dose
<6	0.15 ml	<5	5 mg			
6-12	0.3 ml	5-10	7.5 mg	<8	<25	0.5 mg
> 12	0.5 ml	>10	10 mg	>8	>25	1 mg

### Box 2 Helpful hints

- Remember age ranges for anaphylaxis are multiples of '6'
- Midazolam doses follow upper and lower age limits: <5 years is 5 mg, >10 years is 10 mg and halfway between is 7.5 mg
- Glucagon only has a single division in dose depending on age and weight

correct and efficient use of oxygen equipment. Medical emergency training forms part of the GDC's core CPD requirements with dentists having to complete a minimum of 10 hours every CPD cycle.<sup>18</sup>

Aide mémoires for drug doses should be readily available. The British Dental Association (BDA) and Walsall Healthcare NHS Trust have produced posters which are highly recommended for the practice setting.<sup>1</sup> Resuscitation council guidelines are also readily accessible through their iResus and Lifesaver apps.<sup>19</sup> Some helpful hints are provided in Box 2. For those working regularly with children, consideration should also be given to attending a paediatric immediate life support (PILS) course.

## Conclusion

Ensuring familiarity with paediatric medical emergency management should maximise the chances of a successful outcome in what can be a life-threatening and stressful event.

### Acknowledgements

Thanks to Newcastle Dental Hospital Child Dental Health and Sedation staff for assistance with equipment and resources for photographs.

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