Paediatric basic and advanced life support guidelines: An update

In late 2005, the Paediatric Task Force of the International Liaison Committee on Resuscitation reviewed topics related to paediatric resuscitation as well as addressed new issues and emerging science. The full paediatric basic life support (PBLS) and paediatric advanced life support (PALS) guidelines can be accessed from the American Heart Association Web site at <www.circulationaha.org>. The present review by the Canadian Paediatric Society – Paediatric Emergency Medicine Section – highlights significant changes made to the recommendations for both PBLS and PALS guidelines for lay rescuers and health care providers. The new guidelines define infants as those younger than one year of age and define children as those one year of age until the onset of puberty. Neonatal resuscitation will not be discussed.

PBLS GUIDELINES: MAJOR CHANGES (1-4)
Activating emergency medical services and retrieving the automated external defibrillator

A major change in the updated guidelines for the activation of emergency medical services (EMS) and the retrieval of an automated external defibrillator (AED) relate to their order relative to initiating cardiopulmonary resuscitation (CPR). In an unwitnessed or a nonsudden collapse, first responders are advised to initiate CPR immediately for five cycles (lasting approximately 2 min) before leaving to activate EMS and retrieve an AED (if lone care provider). In a witnessed sudden collapse, which evidence reveals is more likely to be related to a sudden pulseless arrhythmia, the lone responder is advised to activate EMS and retrieve an AED, before initiating CPR and attempting defibrillation.

Many AEDs are able to recognize shockable paediatric arrhythmias (wide complex tachycardia and ventricular fibrillation) and are equipped to deliver biphasic attenuated shocks that can be safely and effectively used in children older than one year of age. Therefore, the new recommendations for use of an AED apply to all children older than one year of age.

Breathing check

First responders are advised to open the airway using a head tilt or chin lift manoeuvre for all children and infants. Breathing effort is then assessed by sight, sound and touch for no more than 10 s. If the child or infant is not breathing, rescuers are advised to give two breaths, ensuring effective chest rise, before a pulse check.

Pulse check

Studies of both lay rescuers and health care providers reveal that both types of rescuers are often unable to accurately determine the presence of pulses within a 10 s period. Based on these studies, new recommendations state that lay rescuers should begin chest compressions on unresponsive infants and children who are not breathing after the initial two rescue breaths. By contrast, health care providers should attempt to find a pulse first and proceed to CPR if they cannot feel a pulse after 10 s of trying.

CPR (chest compressions and ventilation)

The most significant change in the 2005 resuscitation guidelines is the new emphasis placed on effective and adequate chest compressions. Several studies have shown that multiple chest compressions in sequence are needed to generate adequate coronary perfusion pressure, with any interruption in chest compressions resulting in inadequate coronary perfusion. In light of this, significant emphasis is placed on minimizing the interruption of chest compressions. The biggest change for children and infants is the compression-to-ventilation ratio. To simplify universal CPR skills retention, a universal compression-to-ventilation ratio of 30:2 is recommended for the lone rescuer. Rescuers should pause compressions when rescue breaths are given until there is an advanced airway in place. For two-rescuer CPR by health care providers, a compression-to-ventilation ratio of 15:2 is recommended. Once an advanced airway is established, chest compressions are no longer interrupted for ventilation and should be performed at a rate of at least 100 compressions/min. Hyperventilation has been shown to decrease venous return to the heart as well as decrease cerebral blood flow and coronary perfusion. In a pulseless patient, 8 breaths/min to 10 breaths/min should be given. In a patient with a pulse but no breath, 12 breaths/min to 20 breaths/min should be given. To ensure adequacy of compressions and avoid fatigue, the role of the chest compressor should be changed every 2 min.

Recent studies of chest compression technique indicate that for infants, the two-thumb encircling hands technique results in more consistent depth and force of compression,
and may generate higher systolic and diastolic blood pressure as well as higher coronary perfusion pressure. Therefore, it is the recommended technique of chest compressions in two-rescuer CPR for infants. For the lone rescuer, the two-finger technique is still recommended so that ventilation may be performed with minimal interruption of chest compressions. For children, both one- and two-hand techniques are appropriate, as long as the depth of compression is one-third to one-half of the anterior-posterior chest diameter. For ease of retention, rescuers can be taught effective two-hand techniques for both children and adults. Rescuers are also advised to allow the chest to recoil fully between compressions, because there is evidence that complete chest re-expansion improves venous return and cardiac output.

Many first responders are reluctant to give rescue breaths by mouth-to-mouth technique when administering CPR. Although ventilation is preferable during CPR in paediatric patients because of the high proportion of respiratory arrests, numerous studies have shown comparable success for chest compressions with ventilation added and chest compressions alone when compared with no CPR administration. In circumstances in which a rescuer is reluctant to perform rescue breathing, CPR using only uninterrupted chest compressions is preferable to not performing CPR at all.

As with adults, the need for effective CPR applies to the PALS provider. Good PALS begins with high-quality PBLS. Rescuers must provide chest compressions of sufficient depth and rate allowing adequate chest wall recoil with minimal interruptions in chest compressions.

PBLS key message: Provide high-quality CPR

• ‘Push hard’ (one-third to one-half of the anterior-posterior chest diameter).
• ‘Push fast’ (rate of approximately 100 compressions/min).
• Minimize interruptions in chest compressions.
• Allow full chest recoil.
• Do not hyperventilate (8 breaths/min to 10 breaths/min in a pulseless patient).

Ongoing evaluation

The recommendations state that cardiac rhythm should be rechecked every five cycles (compressions and breaths). If the rhythm is shockable, then only one shock should be administered followed by immediate continuation of chest compressions instead of the previous practice of using stacked shocks. If the rhythm is not shockable, chest compression or ventilation cycles should be continued until ALS providers arrive or the patient improves.

PALS GUIDELINES: MAJOR CHANGES (2,4-6)

Advanced airways

Cuffed endotracheal tubes are as safe as uncuffed tubes in the in-hospital setting for infants and children, except for neonates. In specific circumstances, such as a large glottic air leak, high airway resistance or poor lung compliance, a cuffed tube may be beneficial. Particular attention should be paid to endotracheal tube size, position and cuff inflation pressure. A safe cuff inflation pressure is less than 20 cm H₂O.

Regarding the use of advanced airways, there is insufficient evidence to recommend (for or against) the routine use of a laryngeal mask airway during cardiac arrest. When endotracheal intubation is not possible, the laryngeal mask airway is an acceptable adjunct for experienced providers, but it is associated with a higher incidence of complications in young children than adults.

Exhaled or end-tidal CO₂ monitoring

Due to the concern about the possibility of incorrect tube location or displacement, the 2005 guidelines now call for clinical evaluation and assessment of exhaled CO₂ to confirm tube placement. Correct placement must be verified when the tube is inserted, during transport and whenever the patient is moved. During inter- or intrahospital transport, a colorimetric detector or capnography should be used to detect exhaled CO₂. All CO₂ detection devices require the presence of a perfusing cardiac rhythm to function correctly.

CPR (chest compressions and ventilation)

During CPR, with an advanced airway in place, rescuers will no longer perform ‘cycles’ of CPR. Although the method of chest compressions is the same as for PBLS, the rescuer performing chest compressions will perform them continuously at a rate of 100/min without pauses for ventilation. The rescuer providing ventilation will deliver 8 breaths/min to 10 breaths/min (one breath every 6 s to 8 s).

Single shock and energy dose

The recommendations state that cardiac rhythm should be rechecked after every five cycles (compressions and breaths). If the rhythm is shockable, then only one shock should be administered (instead of the previous practice of using three stacked shocks) followed by immediate continuation of chest compressions. The postshock pulse check is not performed until five cycles or 2 min of CPR have been delivered after the shock. If the rhythm is not shockable, chest compression or ventilation cycles should be continued.

The superiority and greater safety of biphasic shocks over monophasic shocks for defibrillation are emphasized. With a manual biphasic or monophasic defibrillator the initial dose remains at 2 J/kg. Subsequent shock doses are 4 J/kg. The shock dose for cardioversion has not changed and remains 0.5 J/kg to 1.0 J/kg for the first attempt. If unsuccessful, the dose should be increased to 2 J/kg.

Vascular access and drug administration

Another change is that any vascular access, intravenous (IV) or intraosseous, is preferable to endotracheal administration of drugs, such as lidocaine and epinephrine, because it provides more predictable drug delivery and pharmacological
Effect. However, if vascular access cannot be established, lipid-soluble drugs can be given via the endotracheal tube.

There is also significant change regarding the timing of drug administration during pulseless arrest. Drugs may be administered when the rhythm is checked with the understanding that they will not be circulated until CPR is resumed. Rescuers should prepare the next drug dose before it is time for the next rhythm check so that the drug can be administered during the rhythm check. This requires organization and planning and again serves to lessen interruptions in chest compressions during attempted resuscitation.

**Epinephrine**
Routine use of high-dose epinephrine is no longer recommended because evidence does not show a survival benefit.

**Amiodarone versus lidocaine**
The only change in treating ventricular arrhythmias is the de-emphasis of lidocaine compared with amiodarone. Amiodarone is now the preferred antiarrhythmic. Both drugs are still listed in the algorithm, because lidocaine can be given if amiodarone is not available.

Amiodarone (5 mg/kg IV over 20 min to 60 min) has also been added to the ‘tachycardia with pulses and poor perfusion’ algorithm for cases of refractory supraventricular tachycardia after adenosine and synchronized cardioversion have failed to convert the child's rhythm.

**Postresuscitation care**
For paediatric postresuscitation care, the 2005 American Heart Association guidelines emphasize the importance of avoiding hyperthermia. Providers should monitor temperature and treat fever aggressively.

The possible benefits of induced hypothermia are also acknowledged. A temperature of 32°C to 34°C for 12 h to 24 h may be beneficial for patients who remain comatose after resuscitation from cardiac arrest.

**PALS key messages**
- May consider cuffed endotracheal tubes for infants and children.
- Assess endotracheal tube placement with a CO₂ detection device.
- Provide high-quality CPR.
- Deliver single shocks instead of stacked shocks.
- IV or intraosseous administration of drugs is preferable to endotracheal tube administration.
- High-dose epinephrine is not recommended.
- Amiodarone is preferable to lidocaine for ventricular arrhythmias.
- Induced hypothermia of 32°C to 34°C may be of benefit to comatose, postarrest patients.

**CONCLUSION**
The Canadian Paediatric Society recommends that all paediatricians and allied health professionals caring for children review the 2005 PBLS and PALS guidelines and maintain current PALS certification.

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**REFERENCES**
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