Clinical Skills in Hospitals Project

Advanced Life Support (ALS) paediatric

Module 1: Paediatric airway

Module 2: Paediatric defibrillation/external pacing and ALS pharmacology

Module 3: Shock, fluid resuscitation and circulatory access

Module 4: Paediatric ALS

Module 5: Complex ALS

State Government Victoria

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Acknowledgments

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- Dr Stuart Dilley at St Vincent's Education Centre for his contributions to this package.

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Preface

In 2007 the Department of Human Services commissioned St Vincent's Hospital Melbourne, to design and develop simulation-based training packages for clinical skills trainers in Victorian hospitals.

The project provides Victorian health professionals—specifically, hospital clinical educators—with a resource to deliver simulation-based clinical skills training.

The information in this manual complements current training programs and should be considered as a resource in the workplace, rather than the definitive resource on the topic.

Every effort has been made to provide the most current literature references. Authors have consulted other health professionals and current programs when possible in development to ensure that the modules produced in this package are consistent with current health practices.

Course delivery in condensed form

Sample timetable for one-day workshop

This is an example of how the modules in Respiratory 1 could be combined into a one-day workshop. A sample timetable is provided for a course consisting of Modules 1, 2, 3, 4 and 5.

Course 1 (Modules 1, 2 and 3)

Timing	Activity	Objective
8.30 to 8.45	Introduction to faculty and participants	
8.45 to 9.30	Facilitated discussion: paediatric ABC	Module 1: all
9.30 to 10.30	Skills stations (three concurrent): ■ bag-mask ventilation ■ ETT placement ■ LMA placement	Module 1: all
10.30 to 10.40	Summary of Module 1	Module 1: all
10.40 to 11.00	Morning tea	
11.00 to 11.40	Facilitated discussion: paediatric AED	Module 2: all
11.40 to 12.40	Skills stations 1 and 2	Module 2: all
12.40 to 12.50	Summary of Module 2	Module 2: all
12.50 to 1.30	Lunch	
1.30 to 2.10	Facilitated discussion: Module 3	Module 3: all
2.10 to 2.55	Skills station: practiceof venous cannulation and intraosseous needle placement in simulated paediatric patient	Module 3: all
2.55 to 3.10	Summary of Module 3	Module 3: all
3.10 to 3.30	Afternoon Tea	
3.30 to 4.00	Summary of Module 3 Evaluation of course	Module 3: all

Course 2 (Modules 3, 4 and 5)

Timing	Activity		Objective
8.30 to 8.50	Introduction to faculty, participants and the simulator		
8.50 to 9.10	Paediatric ALS introduction and DVD		Module 3: 1
	Group 1	Group 2	
9.10 to 9.20	Simulation 1	Simulation 2	Module 3: all
9.20 to 9.50	Debrief	Debrief	Module 3: all
9.50 to 10.00	Simulation 2	Simulation 1	Module 3: all
10.00 to 10.10	Debrief	Debrief	Module 3: all
10.10 to 10.20	Summary of Module 3		Module 3: all
10.20 to 10.40	Morning Tea		
10.40 to 11.20	Facilitated discussion: external pacing		Module 4: all
11.20 to 12.05	Skills station: external pacing		Module 4: all
12.05 to 12.15	Summary of Module 4		Module 4: all
12.15 to 1.00	Lunch		
1.00 to 1.40	Facilitated discussion: CRM		Module 5: 1
	Group 1	Group 2	
1.40 to 1.55	Simulation 1	Simulation 2	Module 5: all
1.55 to 2.25	Debrief	Debrief	Module 5: all
2.25 to 2.40	Simulation 2	Simulation 1	Module 5: all
2.40 to 3.10	Debrief	Debrief	Module 5: all
3.10 to 3.30	Afternoon Tea Tea		
3.30 to 4.00	Summary of Module 5 Evaluation of course		Module 5: all

Advanced life support (ALS) paediatric

Introduction

Advanced life support (ALS) paediatric was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *ALS paediatric* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course, as described in the Module Outline.

ALS paediatric covers paediatric advanced life support and does not address issues specific to the newly born nor neonatal advanced life support.

ALS paediatric should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

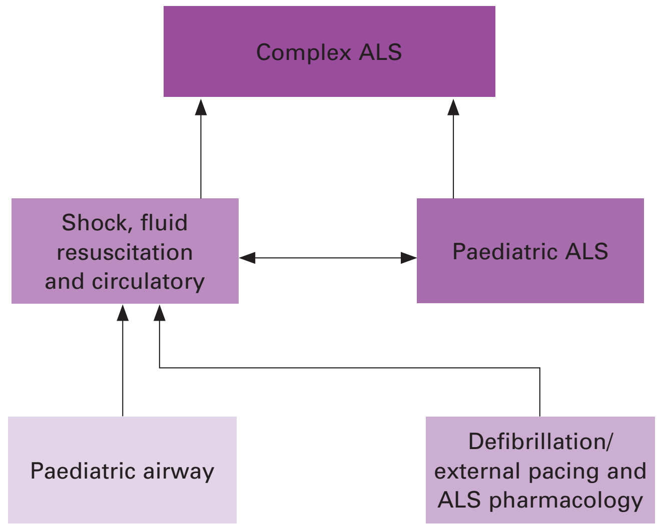
Aims

ALS paediatric aims to make participants confident in their application of advanced life support (ALS) knowledge and skills on children in different environments and settings. *ALS paediatric* is intended for use with medical and nursing participants.

Package structure

ALS paediatric contains five modules which provide learning opportunities for health professionals at all levels of experience and from medical and nursing disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate. Module 5 is more advanced and regarded as complex.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	



Paediatric ALS skills include advanced airway management (including endotracheal intubation), the recognition and management of common cardiac arrest arrhythmias, manual defibrillation, external cardiac pacing, and fluid resuscitation in shock states (including intraosseous needle placement).

As a clinical skills course, *ALS paediatric* does not cover issues relating to post-resuscitation therapy, such as therapeutic hypothermia, glycaemic control, cerebral perfusion and respiratory support. Educators and participants are referred to the Australian Resuscitation Council's Guideline 12.7: Management after resuscitation in paediatric advanced life support, February 2006 for this information.

ALS paediatric was designed to develop participants' knowledge, skills and behaviours in paediatric ALS, and to expose them to increasingly complex scenarios aimed at testing their ability to combine these individual skills, work as a team and problem solve in more difficult situations.

Educators delivering these modules should be aware of participants' level of experience and choose appropriate modules. Modules presume an increasing level of knowledge as they progress, ranging from a fundamental knowledge of anatomy and physiology for the fundamental modules, up to detailed knowledge of ALS and resuscitation for the complex modules. Novice participants (such as first-year graduates) are expected to start with the fundamental modules, and only move onto intermediate and more complex modules as they demonstrate proficiency. More experienced participants may start at the intermediate level if the educator is satisfied that they have the prior knowledge and skills. Individual educators are responsible for assessing each participant's baseline knowledge and determining which modules they need to complete. More specific descriptions of presumed knowledge are outlined in each module.

The design of these packages presumes that the clinical educators using them have knowledge and expertise in current best practice regarding the teaching of clinical skills and conducting facilitated discussions. Knowledge and expertise are presumed commensurate with the Department of Human Services' basic and advanced Train-the-Trainer programs. Clinical educators are encouraged to refer to the Department of Human Services' *Clinical Skills Facilitators Manual* for theory on:

1. Peyton's model for teaching clinical skills
2. leading small group discussions
3. giving feedback
4. crisis resource management skills.

Module 1: Paediatric airway

Introduction

ALS paediatric (advanced life support) was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *ALS paediatric* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course, as described in the Module Outline.

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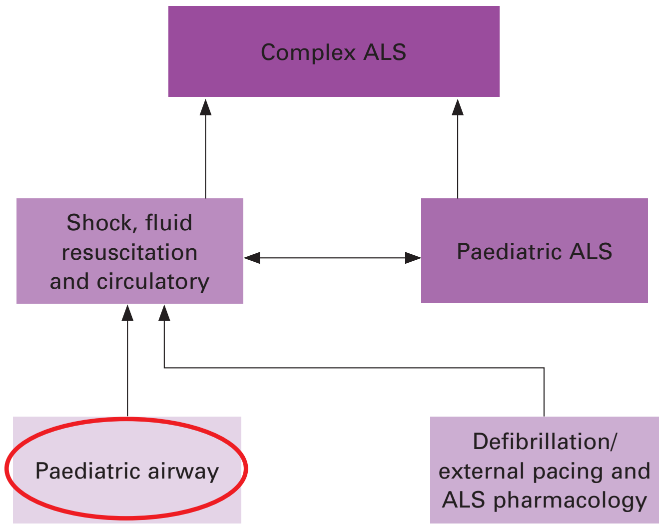
ALS paediatric should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

Aims

ALS paediatric—Module 1: Airway aims to make participants confident in their application of advanced life support (ALS) knowledge and skills on children in different environments and settings. *ALS paediatric* is intended for use with medical and nursing participants.

Package structure

ALS paediatric contains five modules which provide learning opportunities for health professionals at all levels of experience and from medical and nursing disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate. Module 5 is more advanced and regarded as complex.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	

Paediatric ALS skills include advanced airway management (including endotracheal intubation), the recognition and management of common cardiac arrest arrhythmias, manual defibrillation, external cardiac pacing, and fluid resuscitation in shock states (including intraosseous needle placement).

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Module 1: Paediatric airway

Authors: Dr Nicole Shilkofski, Dr Robert O'Brien, Mr Julian Van Dijk

Definition

For the purposes of these modules, a 'child' is defined as approximately 1–8 years of age and an infant is less than approximately 1 year of age. These modules do not deal with newborn infants or neonates (under 28 days old).

Aims

The purpose of *ALS paediatric—Module 1: Airway* is for participants to learn how to safely perform, or assist others in performing, advanced airway skills, including endotracheal intubation, in the setting of paediatric advanced life support (ALS).

Presumed knowledge

This module is targeted to health professionals with minimal experience in advanced airway management. However, they are expected to have a basic knowledge of:

1. upper airway anatomy in paediatric patients: mouth, tongue, mandible, pharynx, larynx
2. respiratory physiology in children: breath sounds, ventilation cycles
3. paediatric basic life support (BLS) airway skills (airway management, bag-mask ventilation).

Participants may have previously undertaken *BLS paediatric—Module 1: ABC*, and therefore been exposed to the teaching of airway skills relevant to paediatric BLS. If not, this module offers a chance to practise these skills.

Objectives

By the end of this module, participants should have:

1. practised basic airway manoeuvre techniques on child and infant manikins, including use of an oropharyngeal (OP) airway
2. practised bag-mask ventilation on child and infant manikins choosing appropriately sized equipment
3. identified the indications for escalation to advanced airway management in the setting of cardiac arrest and paediatric ALS
4. practised endotracheal intubation on child and infant manikins
5. practised laryngeal mask (LMA) insertion on child and infant manikins.

Background information for educators

Basic airway manoeuvres and bag-mask ventilation may be sufficient for initial management of a child in cardiac arrest, because rapid defibrillation may result in return of spontaneous circulation and breathing, and because many cases of paediatric cardiac arrest are secondary to respiratory arrest with inadequate ventilation and oxygenation. When ALS attempts are more prolonged, advanced airway management may be indicated, including endotracheal intubation or laryngeal mask insertion.

Basic airway management

The airway should be inspected and cleared of foreign bodies which might cause obstruction and prevent adequate ventilation:

1. Turn the patient on their side to drain secretions (recovery position).
2. Use suction to remove blood and/or secretions if it is available.
3. Manually remove solid foreign bodies with fingers only if it is visualised. Do not perform a blind finger sweep because this can worsen obstructions due to the small airway in children. Magill's forceps may also be used to extract a foreign body, if the operator has experience in using this device.

Figure 1: Airway inspection and then visualised finger sweep

An in-drawing of the chest wall and/or distension of the abdomen with each inspiratory effort without expiration of air indicates an obstructed airway.

The patient's head and neck should be positioned appropriately to help maintain an airway in preparation for assisted ventilation. This involves flexion of the neck and extension of the head with the responder standing at the top of the patient's head. If cervical spine injury is suspected or likely, minimise neck movement, maintain the airway via the jaw thrust manoeuvre and immobilise the cervical spine with a cervical collar or by in-line manual stabilisation.

Oropharyngeal (Guedel) airways may assist in obtaining and maintaining an airway. Oral airways should be sized and inserted as follows:

1. Measure from the centre of the lips to the angle of the mandible for appropriate length.
2. In children, it is helpful to use a tongue depressor to assist in opening the mouth/jaw and inserting the Guedel airway in under direct visualisation.
3. If a tongue depressor is not readily available, use another method of insertion:
   - First insert the oropharyngeal airway upside-down.
   - Rotate it 180 degrees as the device is introduced further into the mouth.
   - This can cause damage to the mucosal membranes of the hard palate in young infants or patients with friable mucosa. In these cases, a tongue depressor and the direct visualisation method are recommended.

Figure 2: Correct infant oropharyngeal size measurement and tongue depressor assisted insertion

Figure 3: Alternative oropharyngeal insertion technique in a child

Bag-mask ventilation

Most health professionals in the hospital setting favour a bag-mask device for rescue breathing. Paediatric and neonatal bag-mask devices are available for use in smaller children. These devices have smaller ventilation bags and reservoirs, and deliver smaller tidal volume breaths, which may be more appropriate for smaller children, toddlers and infants. Responders should be familiar with the parts of such a device:

1. facemask
2. valve
3. pressure relief valve (not fitted to all devices, this prevents excessive pressure being delivered to the patient's lungs)
4. ventilation bag
5. oxygen inlet connection
6. oxygen reservoir bag.

For bag-mask ventilation, the responder should:

1. Position themselves at the patient's head.
2. Connect bag-mask device to maximal oxygen flow.
3. Obtain and maintain an open airway.
4. Hold the mask firmly in position with one hand.
5. Place the narrow end of the mask over the bridge of the nose.
6. Push firmly on the mask with thumb and index finger while simultaneously using the third, fourth and fifth finger on the bony mandible to lift the jaw into the mask to create a seal. Caution is needed in children that fingers are placed on the bony portion of the mandible and not accidentally placed in the submandibular soft tissue space, thereby creating an obstruction.
7. Blow oxygen into the patient's lungs by compressing the ventilation bag.
8. Look for a rise in the patient's chest.
9. Allow for expiration, observing for fall of the chest wall.
10. Two hands may be required to hold the mask in place, in which case, a second person may be employed to compress the ventilation bag.

In paediatric ALS protocols, if two health care rescuers are available, chest compressions and ventilations should be performed at a ratio of 15:2 while bag-mask ventilation continues[1]. This differs from the BLS rescue guidelines for one or two rescuers.

Figure 4: Correct placement of mask for infant single-operator technique for infant (over the nose to the chin)

Figure 5: Correct placement of mask for child (over the nose to the chin)

Endotracheal intubation

The endotracheal tube (ETT) is generally considered the gold standard method of managing the airway and providing ventilation during cardiac arrest, but no evidence exists that insertion of an ETT leads to better outcomes. In children, bag-valve-mask ventilation is associated with fewer complications than endotracheal intubation in an out-of-hospital *prospective* controlled study[2] and is no less appropriate than endotracheal intubation during cardiac arrest or trauma in retrospective studies[3, 4].

Tracheal intubation should not be attempted at the expense of prolonging hypoxemia. If intubation cannot be accomplished easily, oxygenation should be established by assisted or controlled ventilation with a mask technique before reattempting intubation.

The advantages of intubation in children are:

- establishment and maintenance of a patent airway
- facilitation of mechanical ventilation with 100% oxygen
- minimisation of pulmonary aspiration and pulmonary oedema
- facilitation of tracheal suctioning
- establishment of a route of administration for selected drug therapy.

If resuscitation attempts are ongoing and a trained provider is available, intubation is more practicable for airway maintenance and ventilation than the bag-valve-mask during prolonged management. However, cardiopulmonary resuscitation (CPR) must continue and interruptions to chest compressions should be less than 20 seconds duration[1].

It is critical that bag-mask ventilation and chest compressions continue while preparations are made to intubate. In the cardiac arrest situation, the patient will be apnoeic, unresponsive and have no muscle tone—therefore, it is unlikely that any drugs are required to assist in the intubation process. Preparation for intubation should involve these steps:

- Confirm that the ventilation bag being used is of an appropriate size for ventilation of the child post-intubation.
- Confirm that the oxygen source is available and turned on, with the reservoir bag appropriately inflated.
- Confirm the roles of various assistants, including those responsible for cricoid pressure (see below) and airway equipment.
- Check that suction equipment is available and functioning.
- Check that an appropriately sized laryngoscope, blade and introducer stylet are available and assembled and that the light on the laryngoscope blade shines brightly.
- Select an appropriately sized ETT for the child's age (see Table 1).
- Anticipate any additional equipment items which may be required (for example, Magill's forceps for removing foreign bodies, oropharyngeal airways, lubricant and so on).
- Prepare end tidal CO_2 ($ETCO_2$) monitoring equipment.

Table 1: Endotracheal tube size and depth of insertion for paediatric resuscitation

Age	0	2 mths	5 mths	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	11 years	12 years	13 years	14 years
Approximate body weight (kg)	3.5	5	7	10	12	14	16	18	20	22	25	28	32	36	40	46	50
Uncuffed endotracheal tube size (mm)	3.5	3.5	3.5	4	4.5	4.5	5	5	5.5	5.5	6	6	6.5	6.5	7	7	7.5
Oral length (cm) (depth of ETT insertion)	9.5	11	11.5	12	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19

A handy formula for calculating the size of the uncuffed tube appropriate for a child's age is:

Age/4 + 4 mm = uncuffed tube size

To calculate the oral length (depth of insertion of the endotracheal tube) so that the ETT is optimally positioned above the carina, use this formula:

Age/2 + 12 cm = depth of insertion

Generally, endotracheal tubes smaller than 6.0 are uncuffed. It is preferable in most situations in paediatric resuscitation to use uncuffed tubes, because of the anatomy of the paediatric airway and potential for tracheal damage.

Cricoid pressure (the Sellick manoeuvre) is a common airway manoeuvre used in anaesthetic practice. Based on theory, it was introduced as a means of compressing the oesophagus and reducing the risk of pulmonary aspiration in patients undergoing urgent or semi-urgent endotracheal intubation when not properly fasted. The technique of cricoid pressure involves these steps:

- Allocate the role to a dedicated assistant.
- Locate the cricoid cartilage on the anterior aspect of the neck immediately below the inferior border of the thyroid cartilage.
- Grasp the cricoid cartilage with thumb and index finger.
- Firmly push the cricoid cartilage directly backwards to occlude the oesophagus located immediately behind the upper airway.
- Maintain this pressure until instructed otherwise by the clinician performing endotracheal intubation.

Recently, the use of cricoid pressure has been challenged[5]. Incorrect application may make direct laryngoscopy more difficult, and the theoretical benefit of oesophageal occlusion and reduction in aspiration has not been proven. While debate persists, current best practice still recommends using this manoeuvre.

After the preparation procedure, ETT placement is then performed thus:

- Instruct an assistant to provide cricoid pressure.
- Open the mouth and remove any OP airway or foreign bodies if not already done.
- Position the head in the 'sniffing position' with the neck flexed and the head extended. This is more easily achieved with the patient's head on a pillow. In infants who have large occiputs, some clinicians find it helpful to use a small towel or cloth rolled up and placed under the shoulders in order to facilitate the view of the airway. Infant 'sniffing position' aided by a small towel under the shoulders

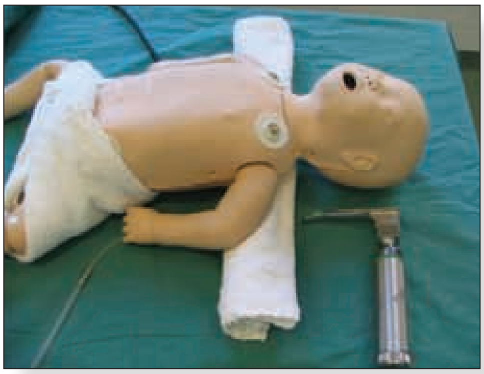


Figure 6: Infant 'sniffing position' aided by a small towel under the shoulders

- Some clinicians use an intubating stylet inserted into the endotracheal tube to facilitate intubation. If a stylet is used, care should be taken during preparation that the stylet does not extend past the end of the endotracheal tube. This can damage the trachea.
- Hold the laryngoscope in the left hand and introduce the tip of the blade into the right side of the patient's mouth—the patient's tongue is thus deflected to the left.
- The technique of viewing the vocal cords depends on the type of laryngoscope blade used. When using a curved laryngoscope (Macintosh), direct the tip of the blade to lie in the vallecula (space between base of tongue and front of epiglottis)—the epiglottis should be visible posterior to the laryngoscope blade (Figure 7).
- Apply pressure to the vallecula to lift the epiglottis in order to view the vocal cords. Using a straight blade (Miller) in an infant, direct the blade underneath the epiglottis to directly lift the epiglottal structure for a view of the laryngeal inlet and vocal cords (Figure 8).

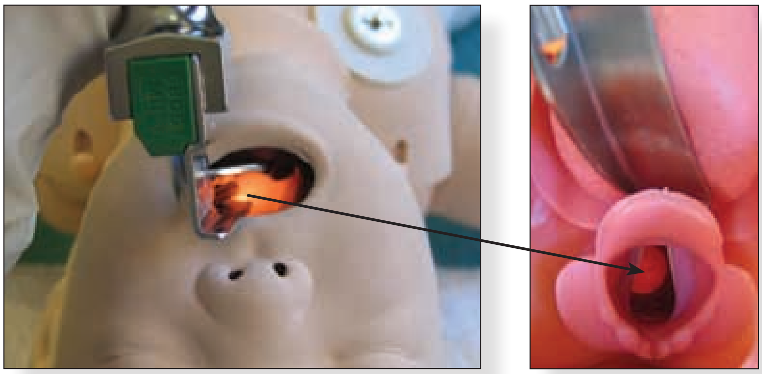


Figure 7: Macintosh blade position in the vallecula space

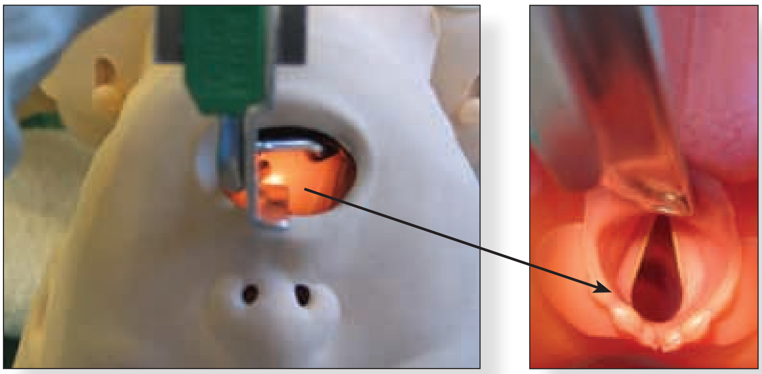


Figure 8: Miller blade position underneath the epiglottis

- Use suction to remove secretions or blood if viewing anatomy is difficult.
- Lift the laryngoscope, tongue and jaw forwards in the line of the handle of the laryngoscope to allow direct viewing of the larynx and vocal cords. Do not rotate the laryngoscope backwards or use the teeth as a fulcrum. This does not improve the view of the larynx and may lead to dental trauma.
- Introduce the ETT into the right corner of the mouth (avoiding obstruction of view of vocal cord structures) and advance the tube through the vocal cords.
- If a cuffed ETT is used in an adolescent or older child, position and inflate the cuff of the ETT just beyond the vocal cords. Otherwise, the depth of ETT insertion should be calculated according to Table 1, above, or approximately three times the diameter of the ETT. Advancing the ETT too far may result in selective intubation of the right main stem bronchus and subsequent ventilation of the right lung only.
- Attach $ETCO_2$ monitor and ventilation bag.
- Ventilate with 15 litres per minute oxygen.
- Confirm correct endotracheal placement of ETT.
- Firmly secure ETT.

Figure 9: Correct laryngoscope position and introduction of ETT via the right corner of the mouth

Correct placement of the ETT should be confirmed. No method of confirmation is infallible, and it is recommended that operators use a variety of techniques. These include:

- direct visualisation of ETT passage through the vocal cords
- observation of bilateral chest movement with ventilation
- bilateral chest auscultation for equal air entry
- auscultation of the epigastrium to exclude 'ventilation' of the stomach
- fogging of the tube due to expired humidified air from the lungs
- $ETCO_2$ detection: correct placement of the ETT in the trachea should lead to the detection of CO_2 with each expiration; however, the $ETCO_2$ level may be low or non-detectable in patients suffering cardiac arrest due to low or absent pulmonary blood flow
- chest X-ray.

After placement of an advanced airway, it is acceptable to continue ventilations at a rate of 8–10 per minute without pausing chest compressions[6].

The procedure for intubation should be modified for children who have, or are suspected of having a cervical spine injury:

- Minimise head and neck movement.
- Use the jaw thrust to maintain the airway, rather than the head tilt/chin lift method.
- Employ a dedicated assistant to provide in-line stabilisation of the cervical spine (see below).
- Once in-line stabilisation is in place, release the cervical collar to allow greater movement of the jaw during laryngoscopy.
- Perform intubation with minimal movement of the patient's head and neck.
- After successful intubation, re-fit the cervical collar.
- An appropriately sized cervical collar for age is critical to ensure immobilisation of the cervical spine. If an appropriately sized paediatric or infant collar is unavailable, use towel rolls or pillows for stabilisation until a collar is available.

Figure 10: Towel roll method of cervical stabilisation until cervical collar is available

In-line stabilisation of the cervical spine is performed by a dedicated assistant whose sole responsibility is to care for the patient's cervical spine:

- The assistant stabilises the patient's head and neck to prevent any movement during the intubation process.
- The assistant should only provide stabilisation, and should not impart any traction to the cervical spine.
- The assistant may crouch at the head of the patient's bed with one hand placed on either side of the patient's head, and fingers pointing towards the patient's chest; however, in this position, the assistant may be a hindrance to the intubator. This position was initially described when the assistant was required to provide cervical spine traction in addition to stabilisation. Traction is no longer recommended in this situation.
- Alternatively, the assistant may lean over the patient's chest, placing one hand on either side of the patient's head with the fingers pointing towards the intubator. In this position, the person intubating has more room to move. For small children and infants, this may be the superior method of positioning.
- The assistant should maintain their position until the patient is successfully intubated and the cervical collar is re-applied.

Laryngeal mask insertion

The laryngeal mask airway (LMA) provides a more secure and reliable means of ventilation than the face mask[6]. The LMA may be considered in the paediatric ALS setting to help maintain an airway and provide ventilation, but is regarded as inferior to the ETT[7]. The LMA does not protect the airway and lungs from aspiration. However, it may allow the responder to deliver adequate ventilations temporarily if bag-mask ventilation is difficult, if insertion of an ETT is not possible or fails, or if the operator is not confident in attempting endotracheal intubation. The LMA should be replaced by an ETT when appropriately skilled personnel are available.

The following technique should be followed for inserting an LMA:

- Select the appropriate LMA size for patient weight (see Table 2).
- Apply adequate lubrication to the cuffed area of the device.
- Some operators prefer to inflate the cuff partially before insertion, although the device was initially designed to be inserted with the cuff deflated.
- The patient's head should be in the 'sniffing position' with the neck flexed and head extended.
- The LMA is inserted into the mouth in a horizontal position initially, staying close to the patient's hard palate and avoiding the tongue.

- Further pressure on the tube (when held like a pen) or mask (if introduced with index finger) results in the LMA advancing further until the tip of the mask lies in the hypopharynx posterior to the opening of the larynx.
- The cuff should then be inflated and the LMA observed to rise slightly and centre itself in the patient's mouth. Failure to sit centrally indicates misplacement of the LMA. Approximate cuff inflation volumes for LMA size and patient weight are shown in Table 2.
- A ventilation bag should then be applied and the patient ventilated with 15 litres per minute of oxygen.
- Adequate ventilation should be confirmed by observing equal and adequate chest movements and auscultating both lungs for air movement.

Table 2: Laryngeal mask airway (LMA) sizes and cuff inflation volumes appropriate for patient weight

Patient weight (kg)	LMA size	Cuff volume (mL)
< 6.5	1	2–5
5–10	1.5	2–8
10–20	2	2–10
20–30	2.5	2–15
> 30	3	10–25
> 70	4	20–30
> 80	5	20–40

Learning activities

Suggested learning activities and timetable are outlined below.

Timing	Activity	Objective
40 minutes	Facilitated discussion	All
60 minutes	Skills stations (three rotations): ■ bag-mask ventilation ■ ETT placement ■ LMA placement	 1, 2 4 5
10 minutes	Summary	All
10 minutes	Evaluation	

Total time = 2 hours

Facilitated discussion

The facilitator should lead a discussion amongst participants about the issues covered in the background information, aware that many clinicians have limited exposure to paediatric patients and the special issues which can arise when caring for children. The facilitator should not give a didactic lecture, but instead promote open discussion and knowledge sharing amongst participants. Participants should be encouraged to describe any real-life experiences with children they may have encountered.

Major issues which the facilitator should cover include:

- techniques for obtaining an adequate airway
- bag-mask ventilation technique
- indications for advanced airway intervention
- technique for ETT placement
- technique for LMA placement.

PowerPoint slides are available for the facilitator to use to summarise these main point at the end of the discussion, or as triggers during the discussion.

Skills stations

The skills stations allow participants to practise basic paediatric airway manoeuvres, bag-mask ventilation, ETT and LMA insertion on a paediatric training manikin while receiving feedback in a structured format from peers and/or facilitators. Participants should be guided through each of the three skills using Peyton's four-step model[8]. Feedback should be provided at the completion of the skill.

The activity and resources outlined assume three facilitators for every 12 participants, a ratio of 1:4. Each group of participants should rotate through three 20-minute skills stations. Each participant should have five minutes of hands-on experience at each station while observing three colleagues for 15 minutes.

Depending on the professional mix of the group (that is, medical and nursing), appropriate emphasis should be placed on those 'assisting' and 'doing' as deemed appropriate for individual institutions.

Summary

The summary session reinforces content covered in the learning activities, and is an opportunity for participants to reflect on what they have learned. No new material should be introduced.

Major points to recap in the summary include:

1. bag-mask ventilation technique
2. indications for and timing of advanced airway techniques
3. technique of endotracheal intubation
4. technique of LMA insertion.

Participants should be offered access to equipment and educators in the future to allow them to practise these skills if they need to improve their skill level or confidence. Participants may be encouraged to observe or assist experienced colleagues performing these skills in controlled settings (for example, anaesthetics departments) to put these skills into a clinical context.

Resource list

The following resource list assumes three facilitators for every 12 participants, a ratio of 1:4. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
Facilitators	3	Allows 1:4 ratio with 12 participants
PowerPoint presentation	1	Provided with module
Infant and child manikins	3 each	Should be suitable for bag-mask ventilation, endotracheal intubation and LMA insertion
Oxygen supply	3	Three wall outlets or oxygen cylinders
Oropharyngeal airways	3 sets	Include at least 2–3 different sizes
Bag-mask ventilation device	3	Including oxygen tubing
Ventilation mask	3 sets	Include at least 2–3 different sizes
Endotracheal tubes and introducer stylets	3 sets	Include at least 2–3 different sizes for demonstration and cuffed/uncuffed ETT for comparison
Laryngoscope blades	3 sets	Include straight (Miller) and curved (Macintosh) blades for comparison
LMA	3 each	Appropriate sizes for infant and child manikins
10 mL syringe	3	For inflation of ETT/LMA cuffs
Feedback sheets	3	As a prompt for each facilitator
Evaluation Forms	12	One for each participant

Evaluation

A formal evaluation was specifically developed for this module. It incorporates the objectives of the module and the perceptions of the participants about whether they have increased their understanding by working through the module. It is highly recommended that this formal evaluation be copied and completed by all participants at the completion of the module.

A range of informal evaluation tools may also be used in conjunction with this evaluation throughout the module, including those available in the Department of Human Services' *Clinical Skills Facilitators Manual* from the basic course conducted in 2007.

References

1. Australian Resuscitation Council, Guideline 12.1: Introduction to Paediatric Advanced Life Support. February 2006
2. Gausche M., Lewis R.J., Stratton S.J. et al. 2000 Effect of Out-of-Hospital Pediatric Endotracheal Intubation on Survival and Neurologic Outcome: a Controlled Clinical Trial. *Jama* 283: 783–90
3. Pitetti R., Glustein J.Z. and Behende M.S. 2002 Prehospital Care and Outcome of Pediatric Out-of-Hospital Cardiac Arrest. *Prehospital Emergency Care* 6: 283–90
4. Eckstein M., Chan L., Schneir A. and Palmer R. 2000 Effect of Prehospital Advanced Life Support on Outcomes of Major Trauma Patients. *Journal of Trauma* 48: 643–8
5. Bulter J. 2005 Cricoid Pressure in Emergency Rapid Sequence Induction. *Emerg Med J*. 22: 815–816
6. Australian Resuscitation Council, Guideline 12.2: Advanced Life Support for Infants and Children, Diagnosis and Management. February 2006
7. International Liaison Committee on Resuscitation 2006 Consensus on Science with Treatment Recommendations for Pediatric and Neonatal Patients: Pediatric Basic and Advanced Life Support. *Pediatrics* 117: E955–E977
8. Peyton J. 1998 *Teaching and Learning in Medical Practice*. Manticore Europe Ltd. Great Britain

Resources

Facilitator feedback form

The following form should be used to assist you in giving feedback after each participant has practised their ALS skills at the skill station.

Feedback using the Pendleton model

Pendleton's model of feedback assists learners to maximize their potential at different stages of training, raise their awareness of strengths and areas for improvement, and identify actions to be taken to improve performance. Pendleton's rules are structured in such a way that the learner identifies the positives first, in order to create a safe environment. This is followed by the facilitator or group reinforcing these positives and discussing skills to achieve them. Different techniques are then suggested. The advantage of this method is that the learner's strengths are discussed first. Avoiding a discussion of weaknesses right at the beginning prevents defensiveness and allows reflective behaviour in the learner.

Below is a series of questions to assist you in this technique:

1. Ask the learner how they feel.
2. Ask the learner what went well and why (this can be combined with question 1 and 3).
3. Tell the learner what went well and why.
4. Ask the learner what could have been done better and why.
5. Tell the learner what could have been done better and why.
6. Summarise the learner's strengths and identify up to three things to concentrate on.

Note: This form does not need to be given to the participant — it is a guide for you, the group facilitator.

Module 1: Paediatric airway—evaluation

Thank you for participating in this module. As part of our commitment to quality improvement the following questionnaire will be used to plan future implementation of this module. We appreciate your time completing this evaluation.

1. Overall

How would you rate this module?

☐ poor ☐ fair ☐ good ☐ very good ☐ outstanding

2. Learning objectives

Please consider whether this module was successful in meeting the following learning objectives:

ALS paedriatic Learning objectives of Module 1: Airway	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Practised basic airway manoeuvre techniques on child and infant manikins, including use of an oropharyngeal (OP) airway	☐	☐	☐	☐	☐
Practised bag-mask ventilation on child and infant manikins, choosing appropriately sized equipment	☐	☐	☐	☐	☐
Identified the indications for escalation to advanced airway management in the setting of cardiac arrest and paediatric ALS	☐	☐	☐	☐	☐
Practised endotracheal intubation on child and infant manikins	☐	☐	☐	☐	☐
Practised laryngeal mask (LMA) insertion on child and infant manikins	☐	☐	☐	☐	☐

3. Important learning outcomes

What are the three most important things you have learned from this module?

4. Module implementation

Please indicate to what extent you agree or disagree with each of the following statements in relation to the implementation of the module.

	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
The facilitator respected my experience	☐	☐	☐	☐	☐
The facilitator encouraged my participation	☐	☐	☐	☐	☐
I was able to ask the facilitator questions	☐	☐	☐	☐	☐
The facilitator was able to answer my questions	☐	☐	☐	☐	☐
The feedback I received was clear	☐	☐	☐	☐	☐
The feedback I received will assist me in my future performance	☐	☐	☐	☐	☐
There was adequate time for the skills stations	☐	☐	☐	☐	☐
There was adequate time for the facilitated discussions	☐	☐	☐	☐	☐
There was adequate time for the simulations	☐	☐	☐	☐	☐
I have increased my confidence in performing paediatric ALS	☐	☐	☐	☐	☐
I have identified future learning needs in this topic area	☐	☐	☐	☐	☐

5. Future module implementation

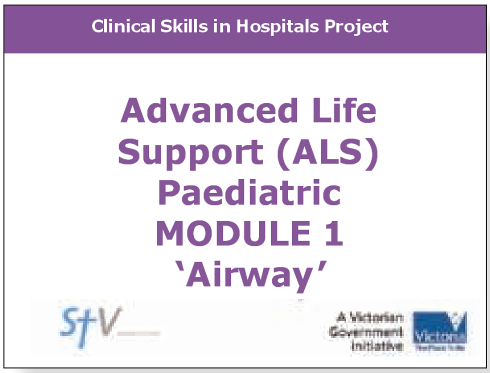
Do you think the module should be altered in any way? ☐ yes ☐ no

If yes, what recommendations do you have?

Thank you

PowerPoint presentation

1.



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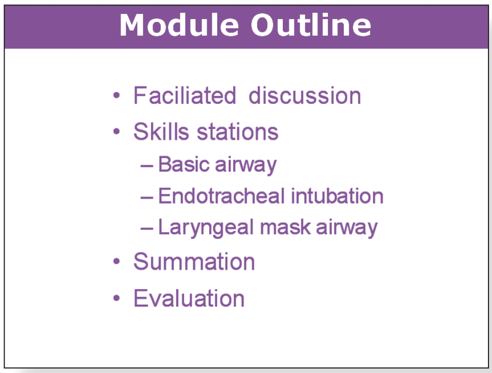

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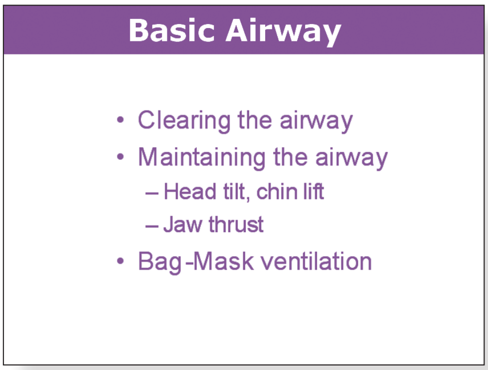

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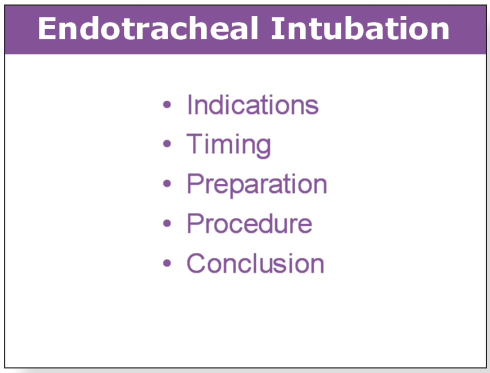


Module 2: Paediatric defibrillation/ external pacing and ALS pharmacology

Introduction

ALS paediatric (advanced life support) was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *ALS paediatric* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course, as described in the Module Outline.

ALS paediatric covers paediatric advanced life support and does not address issues specific to the newly born nor neonatal advanced life support.

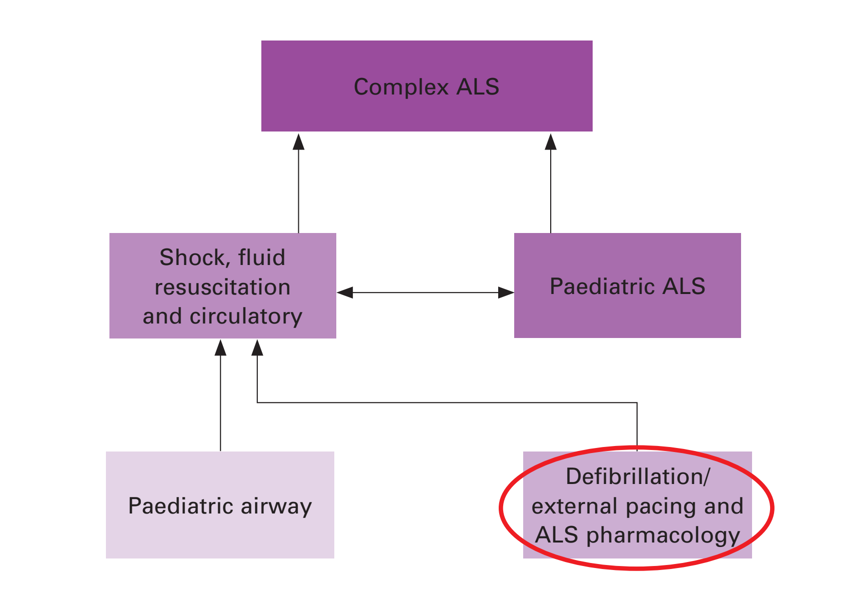
ALS paediatric should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

Aims

ALS paediatric aims to make participants confident in their application of advanced life support (ALS) knowledge and skills on children in different environments and settings. *ALS paediatric* is intended for use with medical and nursing participants.

Package structure

ALS paediatric contains five modules which provide learning opportunities for health professionals at all levels of experience and from medical and nursing disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate. Module 5 is more advanced and regarded as complex.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	

Paediatric ALS skills include advanced airway management (including endotracheal intubation), the recognition and management of common cardiac arrest arrhythmias, manual defibrillation, external cardiac pacing, and fluid resuscitation in shock states (including intraosseous needle placement).

As a clinical skills course, *ALS paediatric* does not cover issues relating to post-resuscitation therapy, such as therapeutic hypothermia, glycaemic control, cerebral perfusion and respiratory support. Educators and participants are referred to the Australian Resuscitation Council's Guideline 12.7: Management after resuscitation in paediatric advanced life support, February 2006 for this information.

ALS paediatric was designed to develop participants' knowledge, skills and behaviours in paediatric ALS, and to expose them to increasingly complex scenarios aimed at testing their ability to combine these individual skills, work as a team and problem solve in more difficult situations.

Educators delivering these modules should be aware of participants' level of experience and choose appropriate modules. Modules presume an increasing level of knowledge as they progress, ranging from a fundamental knowledge of anatomy and physiology for the fundamental modules, up to detailed knowledge of ALS and resuscitation for the complex modules. Novice participants (such as first-year graduates) are expected to start with the fundamental modules, and only move onto intermediate and more complex modules as they demonstrate proficiency. More experienced participants may start at the intermediate level if the educator is satisfied that they have the prior knowledge and skills. Individual educators are responsible for assessing each participant's baseline knowledge and determining which modules they need to complete. More specific descriptions of presumed knowledge are outlined in each module.

The design of these packages presumes that the clinical educators using them have knowledge and expertise in current best practice regarding the teaching of clinical skills and conducting facilitated discussions. Knowledge and expertise are presumed commensurate with the Department of Human Services' basic and advanced Train-the-Trainer programs. Clinical educators are encouraged to refer to the Department of Human Services' *Clinical Skills Facilitators Manual* for theory on:

1. Peyton's model for teaching clinical skills
2. leading small group discussions
3. giving feedback
4. crisis resource management skills.

Module 2: Paediatric defibrillation/ external pacing and ALS pharmacology

Authors: Dr Nicole Shilkofski, Dr Robert O'Brien, Mr Julian Van Dijk

Definition

For the purposes of these modules, a 'child' is defined as approximately 1–8 years of age and an infant is less than approximately 1 year of age. These modules do not deal with newborn infants or neonates (under 28 days old).

Aims

The purpose of *ALS paediatric—Module 2: Defibrillation/external pacing* and *pharmacology* is for participants to learn and become comfortable with recognising and managing the common arrhythmias encountered in paediatric advanced life support (ALS), including the use of the manual defibrillator with paediatric pads and paddles.

Presumed knowledge

This module is targeted to health professionals with little or no experience in ALS management, manual defibrillation or cardiac pharmacology. However, they are expected to have a basic knowledge of:

1. paediatric cardiovascular anatomy: heart, peripheral pulses
2. paediatric cardiovascular physiology: blood pressure (BP), circulation, cardiac electrophysiology and conduction
3. paediatric basic life support (BLS) skills (basic airway management, bag-mask ventilation, chest compressions, use of automatic external defibrillator)
4. drugs commonly used in the paediatric ALS setting (adrenaline, amiodarone, lignocaine and atropine)
5. normal electrocardiograph (ECG) appearances in children.

Objectives

By the end of this module, participants should have:

1. recognised ventricular fibrillation (VF), ventricular tachycardia (VT), asystole and pulseless electrical activity/electromechanical dissociation (PEA/EMD) in children, using sample rhythm strips
2. discussed the roles of defibrillation, electrical cardioversion and common pharmacological interventions in paediatric ALS
3. discussed the functionality and demonstrated the use of the manual defibrillator in children
4. recognised the indications for, and the doses of, pharmacological agents recommended in paediatric ALS according to the Australian Resuscitation Council (ARC) ALS Guidelines[1]
5. recognised the indications for intraosseous (IO) access in children.

Background information for educators

Paediatric ALS arrhythmias

A wide variety of arrhythmias exist (before, during or after a cardiac arrest), but the most important arrhythmias in the setting of paediatric ALS are sinus bradycardia, supraventricular tachycardia (SVT), VF, VT, asystole and PEA/EMD. The current paediatric ARC Guidelines[2] conveniently divide these into those that are 'shockable' (VF/pulseless VT) and those that are 'non-shockable' (PEA/EMD, asystole).

Ventricular fibrillation/ventricular tachycardia

VF is an asynchronous chaotic ventricular rhythm which follows no regular pattern and produces no cardiac output.

VT is a wide, complex regular tachycardia (rapid heart rate) which may or may not produce a detectable cardiac output (pulse, BP). Torsade de pointes, or polymorphic VT, is a variation of VT where the amplitude of the waveform varies quickly over time, resulting in a twisted ('torsade') appearance of the rhythm strip.

The rate of VT is often faster in children than in adults. The only effective treatment is DC shock, in order to depolarise all contractile tissue to allow resumption of sinus rhythm. The ideal energy dose for paediatric defibrillation is unknown, but the recommended doses based on available studies are given below. Biphasic defibrillation is more efficacious and less harmful than monophasic defibrillation, and may be achieved with less energy than monophasic shocks[3].

In contrast to adults, where ischaemic heart disease is a common cause of arrest, the spontaneous onset of VF is less common in children—but not rare. VF may occur initially with congenital heart conditions or secondary to poisoning with cardioactive drugs.

VF and pulseless VT (unwitnessed) should be managed by:

- confirmation of unresponsiveness/unconsciousness and correct lead placement (because electrical interference (artefact) may mimic VF on the monitor)
- institution of immediate cardiopulmonary resuscitation (CPR)
- rapid defibrillation as soon as available:
  - initial shock of 2 j per kilogram
  - followed by 2 minutes of CPR
  - then a shock of 4 j per kilogram
  - all subsequent shocks should be 4 j per kilogram
- adrenaline and an anti-arrhythmic drug (amiodarone or lignocaine) as per paediatric ALS guidelines

- repeat defibrillation and adrenaline as necessary
- refractory VF or VT may be treated with sodium bicarbonate, magnesium sulphate, potassium chloride or all three in combination with adrenaline every 3 minutes.

Asystole or severe bradycardia

Asystole is characterised by the absence of any cardiac electrical activity, and is associated with a very poor prognosis[2]. Pulseless severe bradycardia is defined as less than 60 BPM in infants and less than 40 BPM in children which is unresponsive to oxygen and mechanical ventilation. Defibrillation does not 'revert' asystole or bradycardia, and is not indicated. The patient may appear to be in asystole if the ECG monitoring leads are not applied correctly. In contrast to adults, the initial cardiac rhythm for children who experience trauma, drowning, septicaemia, sudden infant death syndrome, asthma or upper airway obstruction is often severe bradycardia or asystole (rather than the VF seen commonly in adults)[4]. Asystole and pulseless severe bradycardia should be managed by these steps:

- Confirm correct ECG lead placement.
- Confirm unresponsiveness/unconsciousness.
- Institute immediate CPR.
- Administer adrenaline as per paediatric ALS guidelines.
- Consider atropine and sodium bicarbonate.
- If available, transcutaneous, transvenous or epicardial pacing may be effective.

Pulseless electrical activity

PEA or EMD is the presence of a coordinated electrical rhythm with no detectable cardiac output (absent pulses). Defibrillation is not indicated, because fibrillation is not present. It may be due to poor intrinsic myocardial contractility, or it may be secondary to several remediable causes (see below). PEA or EMD should be managed by these steps:

- Institute immediate CPR.
- Administer adrenaline as per paediatric ALS guidelines.
- Assess for and manage 'reversible causes' (see below).
- Treat persistent PEA/EMD with a bolus of colloid or crystalline fluid 20 mL/kg and/or sodium bicarbonate.

'Reversible causes' refers to several clinical conditions which might be responsible for persistent VF/VT, asystole or PEA and if treated expeditiously, may result in return of spontaneous circulation or successful defibrillation. Reversible causes include:

- hypoxaemia

- hypovolaemia
- hypo/hyperthermia
- hypo/hyperkalaemia
- hypocalcaemia
- severe acidosis
- tamponade (pericardial)
- tension pneumothorax
- toxins, poisons, drugs
- pulmonary embolism.

Tachyarrythmias

Any heart rate above normal for age should be considered a tachyarrhythmia, particularly if:

- there is associated circulatory compromise and/or hypotension
- the child has a history of cardiac disease or cardiac surgery
- the child may have been poisoned by cardio-active drugs.

It is important to determine the type and aetiology of the tachycardia by history and analysis of a 12-lead ECG. The rate and duration of the QRS complex are starting points to differentiate sinus tachycardia (ST), ventricular tachycardia (VT), supraventricular tachycardia (SVT) and wide QRS complex SVT. Other tachycardias, such as junctional ectopic tachycardia, are also possible. We focus here on SVT, because it is the most common spontaneous arrhythmia in childhood and infancy.

SVT may cause life-threatening hypotension. It is usually re-entrant with a rate of 220–300 per minute in infants, and can be 180 per minute or above in children. The QRS complex is usually narrow (< 0.08 seconds). This can make it difficult to distinguish from ST. However, the rate in ST varies with activity or stimulation, but is *uniform without variability* in SVT. The onset and offset are often sudden in SVT, and a P wave is often undiscernible in SVT.

Haemo-dynamically stable SVT (adequate perfusion, blood pressure and normal mental status) should be managed by:

- initial vagal stimulation via application of ice to the face or carotid sinus massage—vagal stimulation can also be effected by pharyngeal/tracheal suctioning or asking a cooperative child to Valsalva (for example, blow through a straw)
- if refractory to vagal manoeuvres, adenosine is the drug of choice, but it must be given rapidly as a bolus with rapid flush into the circulation, due to its very short half-life

- amiodarone should also be considered as per paediatric ALS guidelines[2]
- digoxin, beta blockers and calcium channel blockers can also be considered (although calcium channel blockers should be avoided in infants and used with caution due to associated hypotension and cardiac depression).

Any haemo-dynamically unstable SVT (severe hypotension, compromised perfusion or mental status, pulselessness) should be managed by:

- synchronised DC shock (cardioversion) given immediately in a dose of 0.5–1 j/kg (monophasic or biphasic shock)
- if available, overdrive pacing (oesophageal, transcutaneous, transvenous, epicardial) may be effective.

Manual defibrillation

Defibrillation is the only intervention of proven benefit for patients in cardiac arrest. It is most effective if delivered within the first minute of a cardiac arrest. The probability of successful defibrillation diminishes rapidly over time. VF can deteriorate to asystole.

Defibrillation is the delivery of an electrical charge to the heart. This charge stops all electrical activity in the heart, allowing the normal pacemaker of the heart (the sino-atrial (SA) node) or another part of the heart to 'reset' and initiate a more normal rhythm.

Defibrillation in children is indicated in cases of:

1. ventricular fibrillation (VF)
2. pulseless ventricular tachycardia (VT).

These patients will be unconscious, not breathing normally and have no detectable pulse or signs of life. Some children in VT may still be conscious and have a pulse—these patients should not be defibrillated unless they become unconscious, but synchronised cardioversion may be a therapeutic option (see dosing criteria below).

The defibrillator also serves as a monitor to enable assessment of cardiac rhythm if the patient is not already on a cardiac monitor. Cardiac rhythm may be observed by either:

1. applying the defibrillator paediatric pads/paddles directly to the patient's chest and selecting the 'paddles' option for the ECG display or,
2. connecting the defibrillator ECG leads to the child's chest and selecting a lead (i, ii or iii) for the ECG display.

The 2006 ARC and ILCOR guidelines indicate that biphasic shocks with an AED are acceptable for children 1 year and older. Attenuated shocks using paediatric pads and cables in an AED system are recommended in children under 8 years.[5] Evidence is insufficient to support a recommendation for or against the use of AEDs in children under 1 year.[5] If a paediatric energy dose is set at 50 j (or attenuated to 50 j via use of paediatric pads/cables), it is suitable for use in children 1–8 years (up to approximately 25 kg). 50 joules provides sufficient energy to ensure that children up to 8 years (or 55 kg) receive at least 2 j/kg.[5] Preset adult energy levels may be used for AED defibrillation of children over 8 years. However, if using manual defibrillation, the recommended DC energy dose for infants and children of any age (using a biphasic or monophasic defibrillator) is 2 j/kg for the first shock and 4 j/kg for subsequent shocks. The energy dose for supraventricular tachycardia (SVT) using monophasic or biphasic shock is synchronised cardioversion with 0.5–1 j/kg. The energy dose for pulsatile VT is synchronised cardioversion with 0.5–2 j/kg.[6] if the exact energy dose for weight is not possible on the defibrillator, the operator can dial up to the next-closest joule dose.

Many defibrillator models have smaller paddles underneath the adult paddles which often slide off to reveal the smaller paddles. If available, small paddles (with cross-sectional areas of 12–20 cm2) should be used for infants and small children (less than 10 kg) to allow full skin contact and to prevent physical contact between paddles on the chest (adult paddles are 50–80 cm^2).

Once the presence of VF or pulseless VT is confirmed, the defibrillator should be deployed. The exact methods of doing this will vary slightly, depending on whether adhesive paediatric pads or manual paddles are used. For defibrillators with adhesive pads:

1. Turn on the defibrillator.
2. Apply the electrode pads to the child's chest. In older children, the pads can be positioned as for an adult patient: one below the right clavicle near the right sternal border (to the right of the upper sternum); the other over the cardiac apex or in the left mid-axilla opposite the xiphoid. In infants and small toddlers with less body surface area, the pads can be positioned in an anterior/posterior fashion.

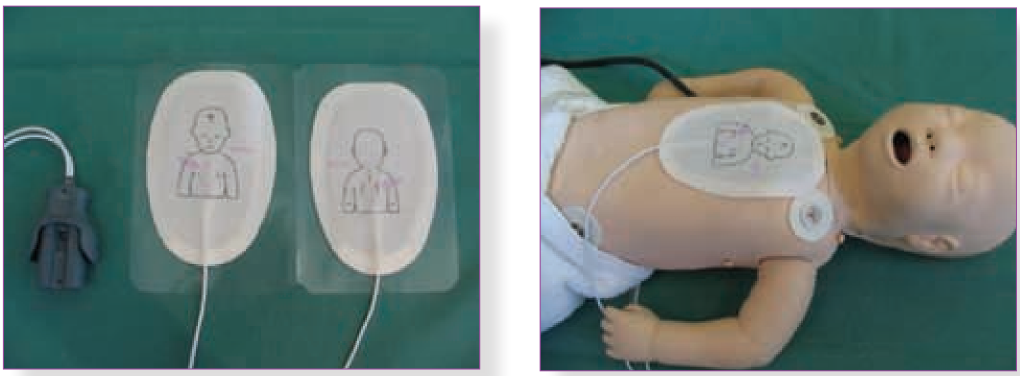


Figure 1: Correct position of AED pads for both infants and children

3. Confirm the presence of VF or pulseless VT on the monitor.
4. Dial up the appropriate charge as above (2 j/kg for initial shock, 4 j/kg for subsequent shocks).

5. Press the ‘charge’ button to load the pads with the appropriate charge.
6. Do not touch the patient.
7. Advise everyone to stand clear and check for clearance visually.
8. Discharge the pads by pressing the ‘shock’ button.
9. Continue CPR while assessing for success of defibrillation.

For defibrillators with manual paddles:

1. Turn on the defibrillator.
2. Confirm the presence of VF or pulseless VT on the monitor.
3. Place conductive gel pads on the child’s chest, either in anterior/anterior position (one below the right clavicle near the right sternal border, the other over the cardiac apex or in the left mid-axilla opposite the xiphoid) or anterior/posterior position in an infant or small child. The pads or conductive gel must be confined to the area beneath the paddles and not permitted to touch, to avoid bridging and ineffective delivery.
4. Dial up the appropriate charge (2 j/kg for initial shock, 4 j/kg for subsequent shocks).
5. Firmly press the defibrillation paddles onto the patient’s chest over the conductive gel pads.
6. Press the ‘charge’ button (front of defibrillator console or on side of apex paddle) to load the paddles with the appropriate charge.
7. Do not touch the patient anywhere else.
8. Advise everyone to stand clear and check for clearance visually.
9. Discharge the paddles simultaneously pressing the ‘shock’ buttons on the end of each paddle.
10. Continue CPR while assessing for success of defibrillation.

Figure 2: Defibrillators with manual paddles can be adapted for paediatric use

Debate surrounds the merits of using a single shock compared to the traditional 'stack of three'. The general consensus is that if there is a delay to defibrillation, then a single shock at maximum energy levels (200 j biphasic, 360 j monophasic) is advised. For patients where the onset of VF or pulseless VT is witnessed, and there is a defibrillator immediately available, then a 'stack of three' shocks is still appropriate (200 j, 200 j, 200 j biphasic or 200 j, 200 j, 360 j monophasic). Any subsequent shocks should be single shocks of 4 j/kg[2].

External cardiac pacing in children

Complete heart block (CHB) occurs when there is interruption to normal cardiac conduction through the atrioventricular (AV) node. This disrupts the relationship between atrial and ventricular contractions which is reflected in a lack of relationship between P waves and QRS complexes on the electrocardiograph (ECG). The resultant QRS complexes are usually wide, due to the electrical activity responsible for ventricular contraction arising from the ventricular muscle, rather than being conducted through the atrioventricular node.

Some children can compensate effectively and produce an adequate cardiac output and blood pressure (BP) for a short period despite being in CHB. These patients do not need immediate external pacing, but generally need a permanent pacemaker inserted acutely unless their heart block is due to a reversible cause (for example, drug toxicity).

CHB can be congenital in children (seen in infants of mothers born with systemic lupus erythematosus), related to congenital heart disease (particularly post-surgically), or acquired from toxins/poisons or myocarditis. It is seen less frequently in the paediatric population as compared to adults.

Children in any form of heart block whose cardiovascular state is compromised (low BP, cold, sweaty, poorly perfused, confused or altered mental status), or who have no detectable output, should be considered for external cardiac pacing[2]. Atropine or an adrenaline infusion may be considered while awaiting cardiac pacing.

Attempts to pace should not interfere with good CPR. External cardiac pacing is rarely indicated in asystole[2].

The external cardiac pacer should be applied to the patient once it is determined that cardiac pacing is required.

1. Ensure adequate sedation/analgesia is provided to the child if they are alert.
2. Apply adhesive paediatric electrode pads to the patient's chest. Electrodes may be placed in the traditional positions for defibrillation (anterior/anterior or anterior/posterior). However, placing electrodes in anterior and posterior positions on the left side of the child's chest may be more effective.

3. Connect the paediatric pads to the patient cable.
4. Apply cardiac monitoring electrodes.
5. Turn on the defibrillator/external cardiac pacer and select the 'pacing' option.
6. Select 'demand mode pacing'. Verify that the dot markers appear near the middle of the QRS complexes of the ECG. Demand (synchronous) pacing will only fire when no QRS complex is sensed. Fixed (asynchronous) pacing may fire during a vulnerable period of the cardiac cycle and could precipitate arrhythmias.
7. Select desired pacing rate, usually 100 BPM (infants may need a higher rate to maintain adequate perfusion).
8. Select initial current to deliver, usually around 50 mA.
9. Press 'start' to initiate pulse delivery.
10. Gradually increase current output until electrical capture occurs (every pacemaker spike is followed by QRS of ventricular depolarisation). Capture is often achieved with a current 65–100 mA.
11. Confirm that mechanical capture has also occurred by noting the correlation of peripheral pulses/cardiac output with electrical capture. Accurate palpation of the carotid pulse may be impeded by electrical pulsations from the pacer, so femoral pulses may be more accurately palpated.

Children with congenital cardiac disease or myocardial depression may still require inotropic support despite being adequately paced, so continuous monitoring of blood pressure and haemo-dynamic status is vital.

Access to circulation during paediatric resuscitation

All resuscitative fluids and drugs discussed below can be given via the intravenous or intraosseous route (see below). However, adrenaline, lignocaine and atropine are absorbed when given via the endotracheal tube (ETT) route if IV access is unavailable. Plasma concentration of the drug is considerably lower when given via ETT, and higher doses than that given via IV may be required. Other cardiac arrest drugs should not be given via the ET route, because they may damage the respiratory mucosa. Endotracheal drugs cannot be delivered via a laryngeal mask. Refer to *ALS paediatric—Module 3: Shock, fluid resuscitation and circulatory access* for more information regarding intraosseous needles and access to the circulation during resuscitation.

Paediatric ALS pharmacology

All IV and IO drugs should be flushed with small boluses of fluid to ensure that they enter the circulation and prevent precipitation or inactivation. The paediatric ALS drugs to be discussed include:

- adrenaline
- amiodarone
- lignocaine
- atropine
- adenosine
- magnesium, potassium, sodium bicarbonate and calcium
- glucose.

All recommended paediatric drug doses are given as IV, IO and ETT (where applicable) routes. In many settings, clinicians may find Breslow tapes helpful for dosing by weight. In a paediatric resuscitation situation, these references estimate weight for length (height) of the child and dictate appropriate doses of common resuscitation medications and equipment based on weight.

Adrenaline

Adrenaline is thought to be beneficial in cardiac arrest by causing peripheral vasoconstriction. The aim is to direct what cardiac output is present to the myocardium and brain. It may facilitate defibrillation by improving myocardial blood flow during CPR. Adrenaline is indicated in the paediatric ALS setting for:

- VF or pulseless VT after initial defibrillation attempts fail
- asystole or severe bradycardia
- PEA/EMD.

The initial and any subsequent paediatric dose of adrenaline is:

- dose by **IV or IO** route of **10 μg/kg**
- dose by **ETT** route of **100 μg/kg**.

In special circumstances (such as beta-blocker poisoning) larger doses may be used, but are otherwise not recommended. High doses of adrenaline may have significant complications and have been associated with lower short-term survival7. Adrenaline should be administered at regular intervals (every 3 minutes) during CPR until return of circulation or cessation of resuscitation efforts. Small does of adrenaline or an adrenaline infusion may be needed after return of spontaneous circulation to augment blood pressure and cardiac output.

Amiodarone

Amiodarone has a complex mechanism of action acting on sodium, potassium and calcium channels in the myocardium, as well as alpha and beta receptors. It can stabilise the myocardial cell membrane in an attempt to halt or prevent arrhythmias. In children, amiodarone is most commonly used to treat:

- shock-resistant VF
- pulseless VT
- prevention of recurrent VF/VT after successful defibrillation.

Amiodarone is also used successfully to treat a wide range of other tachyarrhythmias, including atrial tachycardias, SVT, pulsatile VT and wide QRS complex tachycardia. The initial paediatric dose for shock-resistant VF and pulseless VT is a bolus of **5 mg/kg**, which may be repeated.

Acute adverse events in children may be related to the rapidity of infusion, and include hypotension, bradycardia and heart block.

Lignocaine

Although lignocaine has a membrane stabilising effect and is a potential to aid defibrillation, a benefit in the treatment of paediatric VF has never been demonstrated. Lignocaine is considered inferior to amiodarone1 for shock-resistant VF and VT. If used, the paediatric dose is **1 mg/kg IV or IO.**

Atropine

Atropine is an anti-cholinergic agent that blocks the effect of the vagus nerve on the heart. The resultant effect is to increase heart rate. In children, parasympathetic cardiac blockade with atropine may be indicated if bradycardia is initiated by vagal stimulation. Bradycardia caused by hypoxemia should be managed with ventilation and oxygen. Severe bradycardia with hypotension should be treated with oxygen and adrenaline.

In the paediatric ALS setting, atropine should be administered as:

- an **IV or IO** dose of **20 µg/kg**
- an **ETT** dose of **30 µg/kg**.

Adenosine

Adenosine is an antiarrhythmic agent which slows conduction at the atrioventricular node and can interrupt re-entry pathways though the atrioventricular node. It is used in paediatric ALS to convert some forms of re-entry or paroxysmal supraventricular tachycardia (SVT) to sinus rhythm. It has a very short half-life, so must be given as a rapid bolus followed by rapid flush of at least 5–10 mL of saline. It is advisable to use a three-way tap to administer the drug, followed by rapid flush to maximise the potential success of drug use in SVT. When adenosine is used to chemically cardiovert an abnormal rhythm, it is normal for the heart to enter ventricular asystole for a few seconds. This can be disconcerting to a normally conscious patient, and is associated with angina-like sensations in the chest, so patients should be warned about this potential effect, and resuscitation equipment/personnel should be readily available when the drug is administered.

Magnesium, potassium, sodium bicarbonate and calcium

Magnesium (Mg), potassium (K), sodium bicarbonate (NaHCO3) and calcium (Ca) are electrolytes with specific indications for use in the setting of ALS. These agents are not used routinely in most cardiac arrests, due to their lack of proven efficacy and, in some instances, adverse effect, but should be considered in certain clinical situations.

Magnesium (Mg) is a membrane stabiliser. It is the preferred treatment for polymorphic VT (torsade de pointes)—whether acquired or arising from congenital prolonged QT interval syndromes. It should also be considered in known or suspected hypomagnesaemia causing ventricular tachyarrhythmias, particularly when associated with hypokalaemia. The initial IV or IO bolus dose of magnesium sulphate is **0.1–0.2 mmol/kg**, followed by an infusion of 0.3 mmol/kg over 4 hours.

Potassium (K) should be used in paediatric patients with extreme caution and with close monitoring (continuous ECG display, slow infusion, preferably in an ICU setting with frequent monitoring of serum levels). Hypokalaemia can cause life-threatening tachyarrhythmia. Emergency treatment is IV or IO administration of **0.03–0.07 mmol/kg** by slow injection. If the situation is critical, but not immediately life-threatening, severe hypokalaemia may be treated with an infusion of 0.2–0.5 mmol/kg per hour to a maximum of 1 mmol/kg. Therapies that rapidly decrease serum potassium level are IV glucose plus insulin, inhaled, or IV salbutamol plus IV glucose, or a combination of these agents with or without sodium bicarbonate.

Sodium bicarbonate ($NaHCO_3$) has a limited and unproven place in the management of cardiorespiratory arrest, and can exacerbate intracellular acidosis. It can also cause hypernatraemia and hyperosmolarity, which can depress cardiac function. The paediatric dose IV or IO is **1 mmol/kg** after adequate ventilation with oxygen and chest compressions are established. It may be useful and can be considered in cases of:

- documented hyperkalaemia after initial treatment with calcium
- cardiac arrest associated with tricyclic antidepressant toxicity
- severe metabolic acidosis (pH < 7.1)
- prolonged arrest.

Calcium (Ca) has inotropic and vasopressor properties, but has no place in the management of arrhythmias except in the indications listed below. The IV or IO dose is **0.2 mL/kg of 10% calcium chloride or 0.7 mL/kg of 10% calcium gluconate (20 mg/kg**). It should not be given routinely at cardiac arrest, but can be considered in cases of:

- documented hyperkalaemia, hypocalcaemia or hypermagnesaemia causing arrhythmia
- cardiac arrest associated with calcium channel blocker toxicity.

Glucose

Glucose is mentioned here because hypoglycaemia may be present in critical illness in children, particularly in infants. However, hyperglycaemia also occurs and is associated with mortality. The normal level in children is 3–8 mmol/L. The blood sugar should be checked at and after cardiac arrest, with the aim of restoring normoglycaemia. Hypoglycaemia may be treated IV or IO with **0.5 g/kg glucose**. The maintenance requirement to avoid hypoglycaemia in infancy is approximately 5–8 mg/kg per minute.[1]

Learning activities

Suggested learning activities and timetable are printed below.

Timing	Activity	Objective
40 minutes	Facilitated discussion	All
60 minutes	Skill 1: Rhythm recognition	1, 2, 4
10 minutes	Summary	All
10 minutes	Evaluation	

Total time = 2 hours

Facilitated discussion

The facilitator should lead a discussion amongst participants about the issues covered in the background information, for example, arrhythmia recognition, indications for defibrillation and pharmacological intervention in paediatric ALS. The facilitator should not give a didactic lecture, but instead promote open discussion and knowledge sharing amongst participants. Participants should be encouraged to describe any real-life experiences they have encountered.

Major issues which the facilitator should cover include:

- recognition of paediatric VF, VT, asystole/severe bradycardia and PEA/EMD
- indications for the use of the defibrillator
- indications for use of intraosseous access to the circulatory system for drug delivery in paediatric ALS
- indications for and doses of common paediatric ALS drugs (adrenaline, amiodarone and atropine)
- indications for the use of uncommon paediatric ALS drugs (magnesium, potassium, sodium bicarbonate, calcium, glucose)
- institution-specific policies regarding paediatric ALS drugs and defibrillator use.

PowerPoint slides are available for the facilitator to summarise these main points at the end of the discussion, or as triggers for discussion if the participants have not identified the major issues.

Skills station 1: Rhythm recognition

This station allows participants to practise recognising common arrhythmias encountered in the paediatric ALS setting. The facilitator should use the case scenarios provided below. Participants should be asked to interpret the common paediatric ALS arrhythmias (VF, VT, asystole/severe bradycardia and PEA/EMD) as they are presented to them, either via cardiac rhythm generators/rhythm-capable manikins or hard copy rhythm strips. Participants should also be asked to recommend appropriate treatments for each case.

Case 1: VF
A six-year-old boy with history of congenital heart disease collapses in the waiting room of the hospital's outpatient department. The cardiac arrest team arrives and has attached a cardiac monitor. You are asked to interpret the cardiac rhythm and recommend treatment. His weight is approximately 20 kg.

Teaching points:

- recognition of paediatric VF
- recommendation of appropriate treatment
  - initiation of and ongoing CPR as necessary
  - defibrillation, 2 j/kg initial shock (monophasic or biphasic) followed by 2 minutes of CPR and then 4 j/kg for subsequent shocks
  - adrenaline 10 μg/kg IV or IO, every 3 minutes
  - anti-arrhythmic therapy if refractory to above (amiodarone 5 mg/kg IV or IO).

Facilitator notes:

- initially show an obvious VF rhythm
- show variations of VF to demonstrate subtle differences, that is, fine VF compared to coarse VF
- include alternative therapies for variations in scenarios in the discussion, for example:
    - potassium if hypokalaemia suspected
    - magnesium if persistent VF
    - sodium bicarbonate in the setting of tricyclic antidepressant toxicity, prolonged arrest or severe metabolic acidosis.

Case 2: VT
A five-year-old boy with history of chronic renal failure presents to the emergency department with chest pain and suddenly becomes unresponsive. He has cardiac monitoring attached. You are asked to interpret the current cardiac rhythm and recommend treatment.

Teaching points:

- recognition of paediatric VT
- confirmation of 'unresponsiveness/unconsciousness'
- recommendation of appropriate treatment
    - initiation of and ongoing CPR as necessary
    - defibrillation, 2 j/kg initial shock (monophasic or biphasic) followed by 2 minutes of CPR and then 4 j/kg for subsequent shocks
    - adrenaline 10 µg/kg IV or IO, every 3 minutes
    - anti-arrhythmic therapy if refractory to above (amiodarone 5 mg/kg)
- consideration of underlying aetiology of VT in a child.

Facilitator notes:

- initially show an obvious VT rhythm
- show variations of VT to demonstrate different VT morphology, including torsade de pointes, with discussion of differences in therapeutic options
- include alternative therapies for variations in scenarios in the discussion, for example:
    - magnesium—if consistent with torsade de pointes or persistent VT
    - sodium bicarbonate—in the setting of tricyclic antidepressant toxicity
    - calcium, insulin, glucose, sodium bicarbonate therapy—in the setting of suspected hyperkalaemia (particularly in setting of child with history of renal failure).

Case 3: Bradycardia progressing to asystole

A four-month-old girl is rushed to the emergency department by her mother who found her 'gasping' in her crib at home. She was a full-term infant and has otherwise been healthy. She is attached to cardiac monitoring. You are asked to interpret the cardiac rhythm and recommend appropriate treatment.

Teaching points:

- recognition of severe bradycardia in an infant which progresses to asystole
- checking of lead placement
- confirmation of 'unresponsiveness/unconsciousness'
- recommendation of appropriate treatment:
  - ensure adequate airway and ventilation
  - initiation of and ongoing CPR as necessary
  - adrenaline 10 μg/kg IV or IO, every 3 minutes
  - consideration of atropine, 20 μg/kg IV or IO
  - consideration of hypoglycaemia and glucose administration in an infant with bradycardia
  - ongoing management according to subsequent rhythms.

Facilitator notes:

- initially show a bradycardic rhythm (heart rate < 40), which can progress to asystole
- discussion should also cover differential diagnoses of aetiology of rhythm in an infant, including:
  - inadequate ventilation
  - possible head trauma
  - electrolyte disturbances, particularly hypoglycaemia
  - hypothermia
  - very fine VF when rhythm progresses to asystole (check rhythm in other leads).

Case 4: PEA/MD

A 12-month-old girl is brought to the emergency department by her parents for 'lethargy' after several days of profuse vomiting and diarrhoea. She has now become unresponsive. It is discovered that she is not breathing and has no palpable pulse. She is connected to an ECG monitor. You are asked to interpret the initial ECG rhythm and recommend management.

Teaching points:

- recognition of PEA/EMD in a child
- confirmation of 'unresponsiveness/unconsciousness'
- confirmation of lack of cardiac output
- recommendation of appropriate treatment
  - initiation of and ongoing CPR as necessary
  - adrenaline 10 µg/kg, every 3 minutes
  - search for and management of 'reversible causes'
  - common aetiology in children of hypovolaemia causing PEA/EMD
  - ongoing management according to subsequent rhythms.

Facilitator notes:

- initially show an ECG with a slow idioventricular rhythm (HR 30)
- discussion should cover possible reversible causes and appropriate management—in this case, likely hypovolaemia requiring aggressive fluid resuscitation with boluses of crystalloid or colloid fluid 20 mL/kg given via IO or IV route
- suggest variations in the scenario (for example, asthmatic patient and the possibility of tension pneumothorax) to raise other reversible causes.

Skills station 2: Paediatric defibrillation

This station allows participants to practise using the defibrillator on a training paediatric manikin while receiving feedback in a structured format from peers and/or facilitators. VF or VT should be simulated on the child and infant manikins to consolidate learning about rhythm interpretation gained in the previous skills station. Participants should be guided through the use of the defibrillator using Peyton's four-step model[8]. Feedback should be provided at the completion of the skill.

Key issues to cover include:

- placement of ECG leads/paddles—two different positions in different-aged children
- use of paediatric pads and paddles
- confirmation of shockable rhythm
- selection of appropriate charge for weight
- safe delivery of shock.

Summary

The summary session reinforces content covered in the learning activities, and is an opportunity for participants to reflect on what they have learned. No new material should be introduced.

Major points to recap in the summary include:

1. identification of 'shockable' paediatric heart rhythms, that is, VF and pulseless VT
2. defibrillator functionality and use in children
3. commonly used drugs in paediatric ALS (adrenaline, amiodarone and atropine)
4. institution-specific policies regarding paediatric ALS drugs and defibrillation in children.

Participants should be encouraged to review the appropriate ARC Guidelines in their own time to reinforce the skills acquired in this module. They should be offered access to equipment and educators in the future to allow them to practise these skills if they need to improve their skill level or confidence. Participants might also be encouraged to attend and observe a real-life paediatric cardiac arrest in order to put these skills into a clinical context.

Resource list

The following resource list assumes two facilitators for every eight participants, a ratio of 1:4. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
Facilitators	2	Ratio of 1:4
ARC paediatric ALS flowchart	1	For display in tutorial area
PowerPoint presentation	1	Provided with module
Example rhythms	12	VF, VT and asystole handout for each participant
Case scenarios	4	Provided in module for facilitator to use
Paediatric and infant manikins/ rhythm generator	2	Capable of simulating VF/VT/asystole/ bradycardic rhythms and be receptive to defibrillation
Defibrillator with paediatric pads and paddles	1	Should have paediatric paddles underneath adult paddles
Drug ampoule props	1 set	Adrenaline, amiodarone, atropine, lignocaine, magnesium, potassium and sodium bicarbonate Selection of ampoules and saline/syringes for dilution to appроptiate doses.
Breslow tape	1	Optional, if available and used by institution/hospital Use to demonstrate estimation of weight for length (height) and appropriate medication dosing in children.
Feedback sheets	2	As prompt for each facilitator
Evaluation forms	12	One for each participant

Evaluation

A formal evaluation has been specifically developed for this module. It incorporates the objectives of the module and the perceptions of the participants about whether they have increased their understanding by working through the module. It is highly recommended that this formal evaluation be copied and completed by all participants at the completion of the module.

A range of informal evaluation tools may also be used in conjunction with this evaluation throughout the module, including those available in the Department of Human Services' *Clinical Skills Facilitators Manual* from the basic course conducted in 2007.

References

1. Australian Resuscitation Council Guideline 12.4: Medications and Fluids in Paediatric Advanced Life Support. February 2006
2. Australian Resuscitation Council Guideline 12.5: Management of Specific Arrhythmias in Paediatric Advanced Life Support. February 2006
3. Consensus on Science and Treatment Recommendations 2005 Part 6: Paediatric Basic and Advanced Life Support. *Circulation* 67: 271–91
4. Nadkarni V.M., Larkin G.L., Peberdy M.A. et al. 2006 First Documented Rhythm and Clinical Outcome from in-Hospital Cardiac Arrest Among Children and Adults. *JAMA* 295: 50–57
5. International Liaison Committee on Resuscitation 2006 Consensus on Science with Treatment Recommendations for Pediatric and Neonatal Patients: Pediatric Basic and Advanced Life Support. *Pediatrics* 117: E955–E977
6. Australian Resuscitation Council Guideline 12.6: Techniques in Paediatric Advanced Life Support. February 2006
7. Perondi M.B., Reis A.G., Paiva E.F., Nadkarni V.M. and Berg R.A. 2004 A Comparison of High-Dose and Standard-Dose Epinephrine in Children with Cardiac Arrest. *New England Journal of Medicine* 350: 1722–30
8. Peyton J. 1998 *Teaching and Learning in Medical Practice*. Manticore Europe Ltd. Great Britain

Resources

Facilitator feedback form

The following form should be used to assist you in giving feedback after each participant has practised their ALS skills at the skill station.

Feedback using the Pendleton model

Pendleton's model of feedback assists learners to maximize their potential at different stages of training, raise their awareness of strengths and areas for improvement, and identify actions to be taken to improve performance. Pendleton's rules are structured in such a way that the learner identifies the positives first, in order to create a safe environment. This is followed by the facilitator or group reinforcing these positives and discussing skills to achieve them. Different techniques are then suggested. The advantage of this method is that the learner's strengths are discussed first. Avoiding a discussion of weaknesses right at the beginning prevents defensiveness and allows reflective behaviour in the learner.

Below is a series of questions to assist you in this technique:

1. Ask the learner how they feel.
2. Ask the learner what went well and why (this can be combined with question 1 and 3).
3. Tell the learner what went well and why.
4. Ask the learner what could have been done better and why.
5. Tell the learner what could have been done better and why.
6. Summarise the learner's strengths and identify up to three things to concentrate on.

Note: This form does not need to be given to the participant — it is a guide for you, the group facilitator.

Module 2: Paediatric defibrillation/external pacing and pharmacology—evaluation

Thank you for participating in this module. As part of our commitment to quality improvement the following questionnaire will be used to plan future implementation of this module. We appreciate your time completing this evaluation.

1. Overall

How would you rate this module?

☐ poor ☐ fair ☐ good ☐ very good ☐ outstanding

2. Learning objectives

ALS paedriatric Learning objectives of Module 2: Defibrillation/external pacing and pharmacology	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Recognised ventricular fibrillation (VF), ventricular tachycardia (VT), asystole and pulseless electrical activity/electromechanical dissociation (PEA/EMD) in children using sample rhythm strips	☐	☐	☐	☐	☐
Discussed the roles of defibrillation, electrical cardioversion and common pharmacological interventions in paediatric ALS	☐	☐	☐	☐	☐
Discussed the functionality and demonstrated the use of the manual defibrillator in children	☐	☐	☐	☐	☐
Recognised the indications for and the doses of pharmacological agents recommended in paediatric ALS according to the Australian Resuscitation Council (ARC) ALS guidelines[1]	☐	☐	☐	☐	☐
Recognised the indications for intraosseous (IO) access in children	☐	☐	☐	☐	☐

Please consider whether this module was successful in meeting the following learning objectives:

3. Important learning outcomes

What are the three most important things you have learned from this module?

4. Module implementation

Please indicate to what extent you agree or disagree with each of the following statements in relation to the implementation of the module.

	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
The facilitator respected my experience	☐	☐	☐	☐	☐
The facilitator encouraged my participation	☐	☐	☐	☐	☐
I was able to ask the facilitator questions	☐	☐	☐	☐	☐
The facilitator was able to answer my questions	☐	☐	☐	☐	☐
The feedback I received was clear	☐	☐	☐	☐	☐
The feedback I received will assist me in my future performance	☐	☐	☐	☐	☐
There was adequate time for the skills stations	☐	☐	☐	☐	☐
There was adequate time for the facilitated discussions	☐	☐	☐	☐	☐
There was adequate time for the simulations	☐	☐	☐	☐	☐
I have increased my confidence in performing paediatric ALS	☐	☐	☐	☐	☐
I have identified future learning needs in this topic area	☐	☐	☐	☐	☐

5. Future module implementation

Do you think the module should be altered in any way? ☐ yes ☐ no

If yes, what recommendations do you have?

Thank you

PowerPoint presentation

1.

Clinical Skills in Hospitals Project

Advanced Life Support (ALS) Paediatric MODULE 2
'Defibrillation and ALS Pharmacology'

A Victorian Government Initiative

2.

Module Outline

- Facilitated discussion
- Skills stations
  - Rhythm recognition
  - Rhythm management
  - Manual defibrillation
- Summation
- Evaluation

3.

ALS Arrhythmias

- ALS flowchart
- Shockable
  - VF, VT
- Non-shockable
  - Asystole
    - EMD / PEA

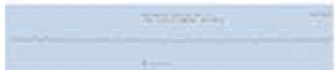
4.

ALS Arrhythmias

•Slow VT

•Rapid VT

•VF



5.

ALS Arrhythmias

•SVT

•Bradycardia

•Asystole

6.

Manual Defibrillation

- Indications
- Procedure
- Safety

7.

ALS Pharmacology

- Adrenaline
- Anti-arrhythmics
  - Lignocaine
  - Amiodarone
- Atropine
- Others

Module 3: Shock, fluid resuscitation and circulatory access

Introduction

ALS paediatric (advanced life support) was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *ALS paediatric* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course, as described in the Module Outline.

ALS paediatric covers paediatric advanced life support and does not address issues that are specific to the newly born nor neonatal advanced life support.

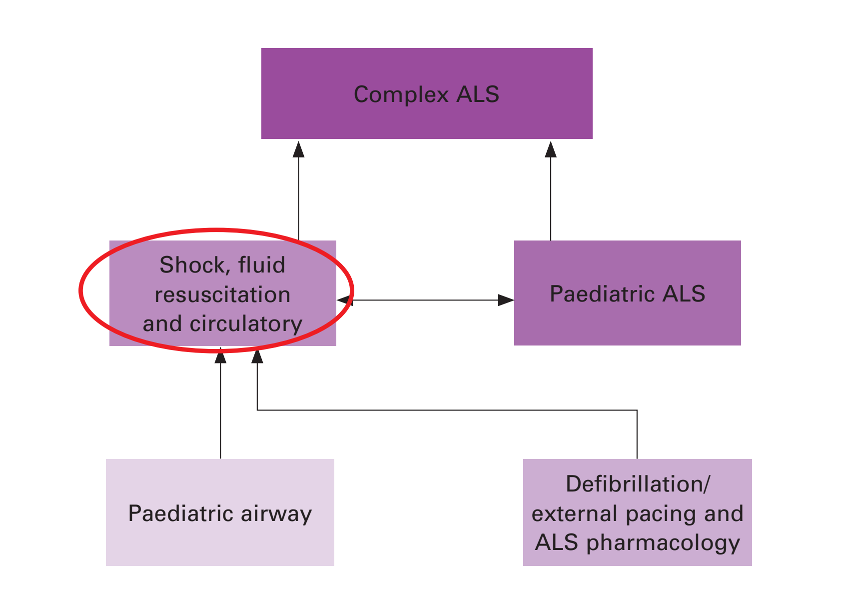
ALS paediatric should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

Aims

ALS paediatric aims to make participants confident in their application of advanced life support (ALS) knowledge and skills on children in different environments and settings. *ALS paediatric* is intended for use with medical and nursing participants.

Package structure

ALS paediatric contains five modules which provide learning opportunities for health professionals at all levels of experience and from medical and nursing disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate. Module 5 is more advanced and regarded as complex.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	

Paediatric ALS skills include advanced airway management (including endotracheal intubation), the recognition and management of common cardiac arrest arrhythmias, manual defibrillation, external cardiac pacing, and fluid resuscitation in shock states (including intraosseous needle placement).

As a clinical skills course, *ALS paediatric* does not cover issues relating to post-resuscitation therapy, such as therapeutic hypothermia, glycaemic control, cerebral perfusion and respiratory support. Educators and participants are referred to the Australian Resuscitation Council's Guideline 12.7: Management after resuscitation in paediatric advanced life support, February 2006 for this information.

ALS paediatric was designed to develop participants' knowledge, skills and behaviours in paediatric ALS, and to expose them to increasingly complex scenarios aimed at testing their ability to combine these individual skills, work as a team and problem solve in more difficult situations.

Educators delivering these modules should be aware of participants' level of experience and choose appropriate modules. Modules presume an increasing level of knowledge as they progress, ranging from a fundamental knowledge of anatomy and physiology for the fundamental modules, up to detailed knowledge of ALS and resuscitation for the complex modules. Novice participants (such as first-year graduates) are expected to start with the fundamental modules, and only move onto intermediate and more complex modules as they demonstrate proficiency. More experienced participants may start at the intermediate level if the educator is satisfied that they have the prior knowledge and skills. Individual educators are responsible for assessing each participant's baseline knowledge and determining which modules they need to complete. More specific descriptions of presumed knowledge are outlined in each module.

The design of these packages presumes that the clinical educators using them have knowledge and expertise in current best practice regarding the teaching of clinical skills and conducting facilitated discussions. Knowledge and expertise are presumed commensurate with the Department of Human Services' basic and advanced Train-the-Trainer programs. Clinical educators are encouraged to refer to the Department of Human Services' *Clinical Skills Facilitators Manual* for theory on:

1. Peyton's model for teaching clinical skills
2. leading small group discussions
3. giving feedback
4. crisis resource management skills.

Module 3: Shock, fluid resuscitation and circulatory access

Authors: Dr Nicole Shilkofski, Dr Robert O'Brien, Mr Julian Van Dijk

Definition

For the purposes of these modules, a 'child' is defined as approximately 1–8 years of age and an infant is less than approximately 1 year of age. These modules do not deal with newborn infants or neonates (under 28 days old).

Aims

The purpose of *ALS paediatric—Module 3: Shock, fluid resuscitation and circulatory access* is for participants to learn how to perform safely, or assist others in performing, emergency circulatory access to treat shock, cardiac arrest, administer fluids or drugs rapidly in the setting of shock states or cardiorespiratory arrest in children. It specifically discusses indications and techniques for intraosseous (IO) access in the paediatric ALS setting in addition to appropriate fluid resuscitation in hypoperfused states of shock.

Presumed knowledge

This module is targeted to medical and nursing health professionals who are competent in the component skills of paediatric ALS (advanced paediatric airway management, manual defibrillation in children and paediatric ALS drug therapy). However, they are expected to have good knowledge and skills relevant to:

1. routine peripheral intravenous (IV) access in children
2. indications for placement of IV access in children
3. cardiovascular physiology in children as it pertains to shock states.

Objectives

By the end of this module, participants should have:

1. identified and reviewed the types of shock states seen in the setting of paediatric ALS
2. reviewed methods of circulatory assessment in paediatric patients
3. practised routine peripheral venous cannulation in a paediatric patient in a simulated setting
4. practised emergency intraosseous access for a paediatric patient in a simulated setting.

Background information for educators

Circulatory assessment in paediatric ALS

Circulatory compromise is detected by evaluation of heart rate, presence and volume (strength) of peripheral pulses and adequacy of end-organ perfusion. The latter includes assessment of mental status, capillary refill, skin temperature and, when available, monitoring urine output. All these parameters must be considered when assessing circulation in children. Peripheral perfusion, capillary refill time and heart rate should be emphasised as the early clinical parameters for assessment of compromise in children.

Cardiac output is the product of heart rate and stroke volume. If stroke volume is compromised for any reason, tachycardia is a common physiological response in an attempt to maintain cardiac output, particularly in children. Therefore, sustained sinus tachycardia in the absence of known causes (such as fever or pain) may be an early sign of cardiovascular compromise. Bradycardia, on the other hand, may be a pre-terminal cardiac rhythm indicative of advanced shock, and is often associated with hypotension. When cardiac output and systemic perfusion are compromised, the volume (strength or quality) of peripheral pulses decreases, capillary refill time may be prolonged, and skin temperature is often cool despite a warm ambient temperature. However, in some children with shock, the pulses may be readily palpable and the skin temperature may be warm (see discussion of shock below).

Types of shock encountered in paediatric patients

Shock is defined physiologically as the inadequate delivery of substrates and oxygen to meet the metabolic needs of the tissues. If left untreated, it results in a state of multisystem organ hypoperfusion, deranged homeostasis and ultimately, anaerobic metabolism with resulting cellular damage and death.

Shock in children is globally classified as compensated, uncompensated or irreversible. In compensated shock, the patient's vital organ function is maintained and blood pressure is usually normal. Tachycardia may be the only deranged vital sign of note, and is an important and sensitive early clinical indication of shock in paediatric patients. If left untreated, compensated shock will progress to uncompensated (or decompensated) shock, where organ and cellar function deteriorates, microvascular perfusion is compromised and hypotension can develop. Irreversible shock occurs when end organ damage has occurred. *Hypotension is a late finding in children suffering from shock*. Several types of shock exist in children. The features of the more commonly seen types are outlined below.

Hypovolaemic shock is the most common form of shock seen in children worldwide. Hemorrhagic shock (for example, from trauma) is a form of hypovolaemic shock. A clinical history of volume loss exists (vomiting, diarrhoea, or blood loss) and the child may demonstrate signs of dehydration (oliguria, poor skin turgor, dry mucous membranes). Treatment includes monitoring of ABCs according to paediatric ALS guidelines[1] and aggressive fluid replacement with isotonic crystalloid (Hartmann's solution or 0.9% normal saline) fluid given in 20 mL/kg increments (up to 60 mL/kg given in the first 15–20 minutes). After 60–80 ml/kg of isotonic fluid is administered, colloid fluids should be considered (particularly blood products if hypovolaemia is secondary to haemorrhage)[2]. Hypoglycaemia can be present in children in this and other forms of shock, and it is important to check glucose level, especially in infants.

Septic shock also occurs in the paediatric population with some frequency. It may initially present as compensated shock with a hyperdynamic/vasodilated state resulting in warm extremities, bounding pulses, tachypnea, tachycardia and a widened pulse pressure. If untreated, this state can progress to an uncompensated stage with progression to cool extremities from hypoperfusion. Children may be hyperthermic or hypothermic due to infection. Septic shock should be treated with monitoring of ABCs according to paediatric ALS guidelines and aggressive fluid replacement with isotonic crystalloid fluid given in 20 mL/kg increments (up to 60 mL/kg given in the first 15–20 minutes)[3, 4]. Hypoglycaemia can be present in children in this and other forms of shock, and it is important to check glucose level, especially in infants.

Cardiogenic shock can result from several aetiologies: congenital heart disease, dysrhythmia, infection, metabolic causes, obstructive lesions (congenital or acquired), trauma or drug poisoning. It is characterised by low cardiac output, cardiomegaly with pulmonary venous congestion and often hepatomegaly. The use of vasopressor support should be considered early in this form of shock, because fluid administration must proceed with caution. It is recommended that isotonic fluids be given in increments of 10 mL/kg in cardiogenic shock, with continuous reassessment of perfusion, liver size and lung sounds after each intervention[1]. Treatment must also consider the underlying cause of the shock. Infants with some forms of congenital heart disease can be previously asymptomatic, but then present acutely in cardiogenic shock due to closure of the ductus arteriosus in the first few weeks of life.

Distributive shock is characterised by low systemic vascular resistance, accompanied by increased cardiac output and a redistribution of blood flow, resulting in abnormal peripheral vasodilatation. This category of shock includes *anaphylactic shock* and *neurogenic shock*.

Anaphylactic shock is characterised by increased vascular permeability due to systemic release of histamine. This can produce cutaneous manifestations (rash), potential upper airway obstruction, bronchiolar constriction and often profound hypotension. Anaphylactic shock should be treated with support of airway, breathing and circulation, including administration of adrenaline and fluids to counteract histamine release and hypotension[5].

Neurogenic shock can occur from brainstem injury or compression or transection of the spinal cord with loss of sympathetic cardiovascular tone. This is characterised by hypotension associated with bradycardia. Drug poisonings can also result in peripheral vasodilatation and forms of distributive shock.

Access to circulation during paediatric resuscitation

Peripheral venous access can sometimes be achieved in children by locating veins on the dorsum of the hand, wrist, forearm, cubital fossa, foot and ankle (long saphenous vein). In young infants, scalp veins are accessible and the umbilical vein can be used up to approximately one week after birth. The external jugular vein is often distended during cardiopulmonary resuscitation, but cannulation is impeded by performance of endotracheal intubation.

All resuscitative fluids and drugs used in paediatric ALS can be given via the intravenous or intraosseous route. As previously mentioned, adrenaline, lignocaine and atropine are absorbed when given via the endotracheal tube (ETT) route if IV access is unavailable. Plasma concentration of the drug is considerably lower when given via ETT, and higher doses than that given via IV may be required. Other cardiac arrest drugs should not be given via the ET route because they may damage the respiratory mucosa.

In children, intraosseous (IO) access can be used if peripheral IV access cannot be obtained quickly in shock states or during arrest. Do not waste time (more than 90 seconds) with repeated unsuccessful attempts at peripheral or central venous cannulation, because alternative safe and ready access to the circulation can be provided by the IO route (or less effectively via the respiratory tract and ETT)[6].

The bone marrow has a rich blood supply and forms part of the peripheral circulation. Drugs are distributed quickly and have been shown to attain the same serum concentrations as drugs given via IV routes. IO needles can be used in patients of any age, including premature newborns and adults[7, 8, 9].

Any IV fluid or drug may be administered via the IO route at the same dose. These must be infused under pressure or injected from a syringe into the IO needle. The preferred sites are the antero-medial surfaces of the proximal or distal tibia, although many sites can be used, including the malleoli and distal femur. IO needles are manufactured for this purpose, but if unavailable, a short lumbar puncture (hollow bore) needle may suffice.

The procedure for inserting an intraosseous (IO) needle follows:

1. Select appropriate sized IO needle (size will vary depending on hospital brand used, but the package may indicate appropriate age/weight).
2. Identify landmark/site for insertion (two finger widths below the tibial tuberosity is the preferred site).
3. If the situation allows, sterilise the insertion site with antiseptic.
4. Using firm downward pressure and a back-and-forth rotary motion to traverse the cortex, insert the needle into the marrow, perpendicularly to the bone surface and away from the growth plate.
5. A loss of resistance signals entry into the bone marrow.
6. Remove stylet/inner cannulae from needle and attach syringe or connector piece with syringe.
7. Correct positioning is confirmed by aspiration of marrow or injection of saline into the needle while monitoring for extravasation into the soft tissue.
8. Secure the needle carefully and attach a connector piece for the injection of drugs to avoid direct attachment to the needle hub and inadvertent displacement of the needle from the marrow.
9. Marrow may be used reliably for venous biochemical and haematological analysis.

Figure 1: Intraosseous (IO) needle

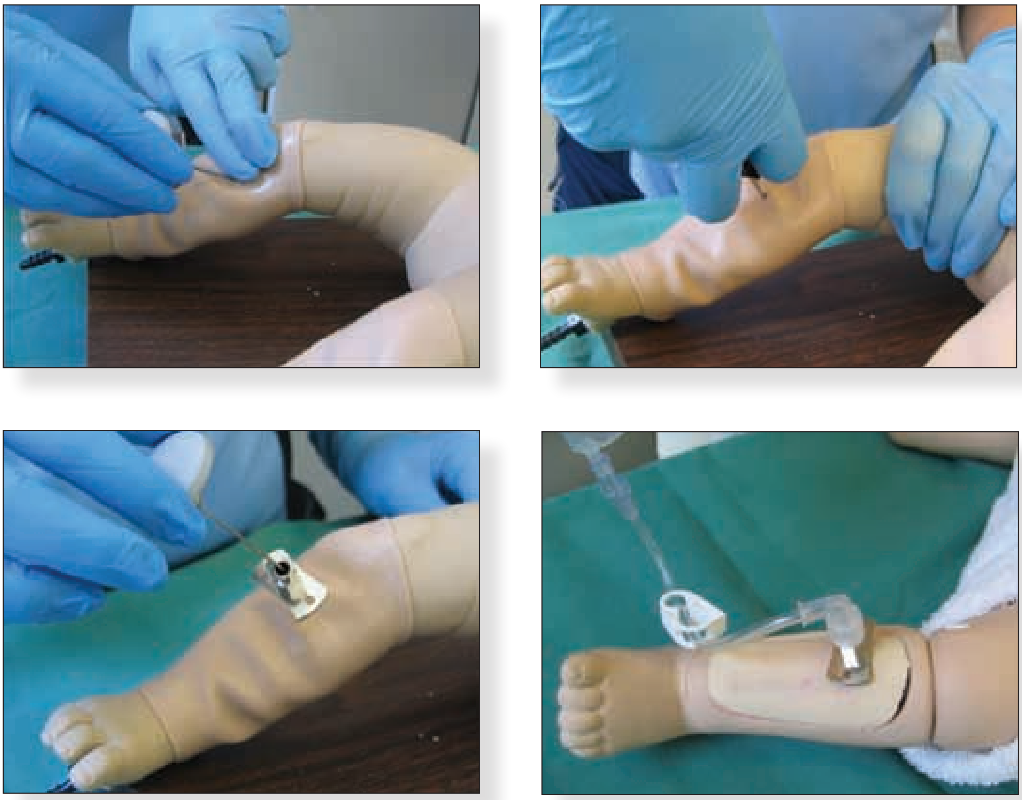


Figure 2: Sequence for correct intraosseous needle insertion

IO needles are safe, fast and effective and have a very low complication rate. The most frequent complication seen is extravasation of fluid into the soft tissue, but fracture, infection and compartment syndrome are rare[9]. Contraindications to the use of IO needles include local trauma, infection and bone disorders. Once a bone is punctured, it cannot be reused for IO access during the same resuscitation, because fluid which is infused will extravasate from the puncture site already created.

Learning activities

Suggested learning activities and timetable are outlined below.

Timing	Activity	Objective
40 minutes	Facilitated discussion	All
45 minutes	Skills station: Practice of venous cannulation and intraosseous needle placement in simulated paediatric patient	All
10 minutes	Summary	All
10 minutes	Evaluation	

Total time = 1 hours 45 minutes

Facilitated discussion

The facilitator should lead a discussion amongst participants about the issues covered in the background information, for example, the recognition and aetiologies of paediatric shock, circulatory assessment and fluid resuscitation and the clinical indications and technique for insertion of intraosseous needles. The facilitator should not give a didactic lecture, but instead promote open discussion and knowledge sharing amongst participants. Participants should be encouraged to describe any real-life experiences they have encountered.

Major issues which the facilitator should cover include:

- types of shock seen in children and the clinical manifestations that differentiate each type
- assessment of circulation in children and recognition of circulatory compromise
- routine venous cannulation in paediatric patients
- emergency access to the circulation in paediatric ALS, including indications for intraosseous needle placement in children
- technique and method of IO placement in children.

PowerPoint slides are available for the facilitator to summarise these main points at the end of the discussion or as triggers for discussion if the participants have not identified the major issues.

Skills station

This station allows participants to practise two skills: the first involves placement of peripheral venous cannulae in a simulated paediatric patient using 24 and 22 gauge intravenous catheters; the second skill is the placement of an intraosseous (IO) needle in a paediatric training manikin and a simulated animal model (chicken bones), while receiving feedback in a structured format from peers and/or facilitators. Participants should be guided through the placement of an IO needle using Peyton's four-step model[10]. Feedback should be provided at the completion of the skill.

The activity and resources outlined assume three facilitators for every 12 participants, a ratio of 1:4. Each facilitator should have access to one paediatric manikin (suitable for insertion of IO needles) and each participant should have their own chicken bone for hands-on skill practice. Depending on the professional mix of the group (that is, medical and nursing), appropriate emphasis should be placed on those 'assisting' and 'doing' as deemed appropriate for individual institutions.

Summary

The summary session reinforces content covered in the learning activities, and is an opportunity for participants to reflect on what they have learned. No new material should be introduced.

Major points to recap in the summary include:

1. types of shock seen in paediatric patients, and clinical findings seen in each type
2. assessment of circulatory compromise in the paediatric population
3. indications for placement of intraosseous needles in clinical practice.

Participants should be encouraged to review the appropriate guidelines in their own time to reinforce the knowledge and skills acquired in this module. They should be offered access to equipment and educators in the future to allow them to practise these skills if they need to improve their skill level or confidence.

Resource list

The following resources assume three facilitators for every 12 participants. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
Facilitators	3	Allows one facilitator per simulation
Child and/or infant manikins	4	Suitable for intraosseous needle placement and peripheral venous cannulation
Chicken bones	12	One set for each participant
Intravenous catheters 24 gauge and 22 gauge	24	Two for each participant
Intraosseous needles	6	Can be shared between two participants. If IO needles unavailable, use wide-bore spinal needles
Syringes with fluid for injection	6	Can be shared between two participants. Optional: use food colouring dye in fluid to visualise marrow/venous structures in chicken bones
T-connector	6	To attach syringe to hub of IO needle for infusion
Gloves	12 pair	One pair per participant
Feedback sheets	3	As a prompt for each facilitator
Evaluation forms	12	One for each participant
PowerPoint presentation	1	Provided with module

Evaluation

A formal evaluation has been specifically developed for this module. It incorporates the objectives of the module and the perceptions of the participants about whether they have increased their understanding by working through the module. It is highly recommended that this formal evaluation be copied and completed by all participants at the completion of the module.

A range of informal evaluation tools may also be used in conjunction with this evaluation throughout the module, including those available in the Department of Human Services' *Clinical Skills Facilitators Manual* from the basic course conducted in 2007.

References

1. Australian Resuscitation Council, Guideline 12.4: Medications and Fluids in Paediatric Advanced Life Support. February 2006
2. Stoner M.J., Goodman D.G., Cohen D.M., Fernandez S.A. and Hall M.W. 2007 Rapid Fluid Resuscitation in Pediatrics: Testing the American College of Critical Care Medicine Guideline. *Annals of Emergency Medicine* 50: 601–07
3. Carcillo J.A. and Fields A.I. 2002 Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Patients in Septic Shock. *Critical Care Medicine* 30: 1365–78
4. Surviving Sepsis Campaign 2008 International Guidelines for Management of Severe Sepsis and Septic Shock. *Intensive Care Medicine* 34: 17–60
5. Lieberman P. 2003 Use of Epinephrine in the Treatment of Anaphylaxis. *Current Opinion in Allergy and Clinical Immunology* 3: 313–318
6. Australian Resuscitation Council, Guideline 12.2: Advanced Life Support for Infants and Children, Diagnosis and Management. February 2006
7. Australian Resuscitation Council, Guideline 12.6: Techniques in Paediatric Advanced Life Support. February 2006

Prematures and Adults

8. Glaeser P.W., Hellmich T.R., Szewczuga D., Losek J.D. and Smith D.S. 1993 Five-Year Experience in Prehosptial Intraosseous Infusions in Children and Adults. *Annals of Emergency Medicine* 22: 1119–24
9. Rosetti V.A., Thompson B.M., Miller J., Mateer J.R. and Aprahamian C. 1985 Intraosseous Infusion: an Alternative Route of Pediatric Intravascular Access. *Annals of Emergency Medicine* 14: 885–88
10. Peyton J. 1998 *Teaching and Learning in Medical Practice*. Manticore Europe Ltd. Great Britain

Resources

Facilitator feedback form

The following form should be used to assist you in giving feedback after each participant has practised their ALS skills at the skill station.

Feedback using the Pendleton model

Pendleton's model of feedback assists learners to maximize their potential at different stages of training, raise their awareness of strengths and areas for improvement, and identify actions to be taken to improve performance. Pendleton's rules are structured in such a way that the learner identifies the positives first, in order to create a safe environment. This is followed by the facilitator or group reinforcing these positives and discussing skills to achieve them. Different techniques are then suggested. The advantage of this method is that the learner's strengths are discussed first. Avoiding a discussion of weaknesses right at the beginning prevents defensiveness and allows reflective behaviour in the learner.

Below is a series of questions to assist you in this technique:

1. Ask the learner how they feel.
2. Ask the learner what went well and why (this can be combined with question 1 and 3).
3. Tell the learner what went well and why.
4. Ask the learner what could have been done better and why.
5. Tell the learner what could have been done better and why.
6. Summarise the learner's strengths and identify up to three things to concentrate on.

Note: This form does not need to be given to the participant — it is a guide for you, the group facilitator.

Module 3: Shock, fluid resuscitation and circulatory access–evaluation

Thank you for participating in this module. As part of our commitment to quality improvement the following questionnaire will be used to plan future implementation of this module. We appreciate your time completing this evaluation.

1. Overall

How would you rate this module?

☐ poor ☐ fair ☐ good ☐ very good ☐ outstanding

2. Learning objectives

Please consider whether this module was successful in meeting the following learning objectives:

ALS paediatric Learning objectives of Module 3: Shock, fluid resuscitation and circulatory access	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Identified and reviewed the types of shock states seen in the paediatric ALS setting	☐	☐	☐	☐	☐
Reviewed methods of circulatory assessment in paediatric patients	☐	☐	☐	☐	☐
Practised routine peripheral venous cannulation in a paediatric patient in a simulated setting	☐	☐	☐	☐	☐
Practised emergency intraosseous access for a paediatric patient in a simulated setting	☐	☐	☐	☐	☐

3. Important learning outcomes

What are the three most important things you have learned from this module?

4. Module implementation

Please indicate to what extent you agree or disagree with each of the following statements in relation to the implementation of the module.

	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
The facilitator respected my experience	☐	☐	☐	☐	☐
The facilitator encouraged my participation	☐	☐	☐	☐	☐
I was able to ask the facilitator questions	☐	☐	☐	☐	☐
The facilitator was able to answer my questions	☐	☐	☐	☐	☐
The feedback I received was clear	☐	☐	☐	☐	☐
The feedback I received will assist me in my future performance	☐	☐	☐	☐	☐
There was adequate time for the skills stations	☐	☐	☐	☐	☐
There was adequate time for the facilitated discussions	☐	☐	☐	☐	☐
There was adequate time for the simulations	☐	☐	☐	☐	☐
I have increased my confidence in performing paediatric ALS	☐	☐	☐	☐	☐
I have identified future learning needs in this topic area	☐	☐	☐	☐	☐

5. Future module implementation

Do you think the module should be altered in any way? ☐ yes ☐ no

If yes, what recommendations do you have?

Thank you

PowerPoint presentation

1.

Clinical Skills in Hospitals Ptroject

Support (ALS) Paediatric MODULE 3 'Shock, Fluid Resuscitation and Access'

StV

A Victorian Government Initiative

2.

Module Outline

- Introduction
- Facilitated Discussion
- Skill Station 1
  - Paediatric Intravenous Access
- Skill Station 2
  - Intraosseous Needle Access
- Summation
- Evaluation

3.

Types of Shock

- Hypovolaemic shock
- Septic shock
- Cardiogenic shock
- Distributive shock
  - anaphylactic shock
  - neurogenic shock

4.

Access

- Skill Stations
  - Intravenous Access
  - intraosseous Access (IO)

Module 4: Paediatric ALS

Introduction

ALS paediatric (advanced life support) was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *ALS paediatric* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course, as described in the Module Outline.

ALS paediatric covers paediatric advanced life support and does not address issues that are specific to the newly born nor neonatal advanced life support.

ALS paediatric should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

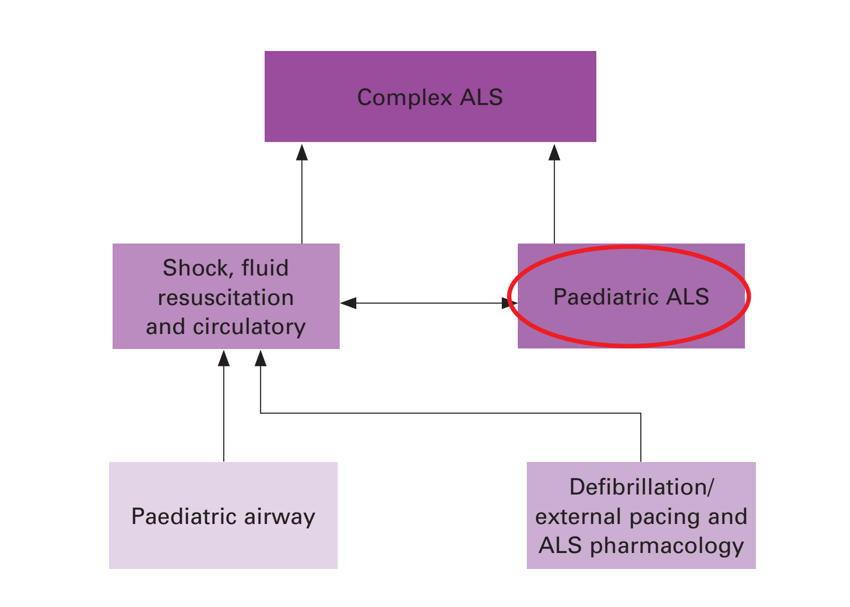
Aims

ALS paediatric aims to make participants confident in their application of advanced life support (ALS) knowledge and skills on children in different environments and settings. *ALS paediatric* is intended for use with medical and nursing participants.

Package structure

ALS paediatric contains five modules which provide learning opportunities for health professionals at all levels of experience and from medical and nursing disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate. Module 5 is more advanced and regarded as complex.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	



Paediatric ALS skills include advanced airway management (including endotracheal intubation), the recognition and management of common cardiac arrest arrhythmias, manual defibrillation, external cardiac pacing, and fluid resuscitation in shock states (including intraosseous needle placement).

As a clinical skills course, *ALS paediatric* does not cover issues relating to post-resuscitation therapy, such as therapeutic hypothermia, glycaemic control, cerebral perfusion and respiratory support. Educators and participants are referred to the Australian Resuscitation Council's Guideline 12.7: Management after resuscitation in paediatric advanced life support, February 2006 for this information.

ALS paediatric was designed to develop participants' knowledge, skills and behaviours in paediatric ALS, and to expose them to increasingly complex scenarios aimed at testing their ability to combine these individual skills, work as a team and problem solve in more difficult situations.

Educators delivering these modules should be aware of participants' level of experience and choose appropriate modules. Modules presume an increasing level of knowledge as they progress, ranging from a fundamental knowledge of anatomy and physiology for the fundamental modules, up to detailed knowledge of ALS and resuscitation for the complex modules. Novice participants (such as first-year graduates) are expected to start with the fundamental modules, and only move onto intermediate and more complex modules as they demonstrate proficiency. More experienced participants may start at the intermediate level if the educator is satisfied that they have the prior knowledge and skills. Individual educators are responsible for assessing each participant's baseline knowledge and determining which modules they need to complete. More specific descriptions of presumed knowledge are outlined in each module.

The design of these packages presumes that the clinical educators using them have knowledge and expertise in current best practice regarding the teaching of clinical skills and conducting facilitated discussions. Knowledge and expertise are presumed commensurate with the Department of Human Services' basic and advanced Train-the-Trainer programs. Clinical educators are encouraged to refer to the Department of Human Services' *Clinical Skills Facilitators Manual* for theory on:

1. Peyton's model for teaching clinical skills
2. leading small group discussions
3. giving feedback
4. crisis resource management skills.

Module 4: Paediatric ALS

Authors: Dr Nicole Shilkofski, Dr Robert O'Brien, Mr Julian Van Dijk

Definition

For the purposes of these modules, a 'child' is defined as approximately 1–8 years of age and an infant is less than approximately 1 year of age. These modules do not deal with newborn infants or neonates (under 28 days old).

Aims

The purpose of *ALS paediatric—Module 4: ALS* is for participants to apply their paediatric advanced life support (ALS) skills learned in the basic modules to perform a coordinated paediatric ALS response in a controlled setting.

Presumed knowledge

This module is targeted to health professionals who are competent in the component skills of paediatric ALS (advanced airway management in children, paediatric manual defibrillation and paediatric ALS drug therapy). However, they are expected to have an intermediate level of knowledge and skills relevant to:

1. paediatric ALS1 and basic life support[2] (BLS) protocols
2. endotracheal intubation in children
3. cardiac rhythm interpretation as it applies to paediatric ALS: ventricular fibrillation (VF), ventricular tachycardia (VT), severe bradycardia, asystole, pulseless electrical activity/electromechanical dissociation (PEA/EMD)
4. use of the manual defibrillator in children
5. common drugs used in paediatric ALS (adrenaline, amiodarone and atropine)
6. methods of accessing circulation and administering drugs to children in cardiac arrest or shock (for example, intraosseous drug administration).

Participants should have already practised these skills on child manikins and in other skills stations, but may not have had an opportunity to apply them to a clinical scenario. If participants do not yet feel confident with the individual skills, they should be redirected to *ALS paediatric—Module 1: Airway* and *Module 2: Defibrillation/ external pacing and pharmacology*.

Objectives

By the end of this module, participants should have:

1. reviewed the Australian Resuscitation Council (ARC) ALS Guidelines for cardiac arrest in children[1]
2. performed team-based cardiopulmonary resuscitation (CPR) on an infant and child in a simulated environment

3. applied the appropriate airway management to a simulated patient (manikin) in a paediatric ALS setting
4. demonstrated the use of a manual defibrillator on infant and child manikins
5. analysed and applied appropriate drug therapy for life-threatening arrhythmias on simulated paediatric patients (manikins).

Background information for educators

Much of the background information pertaining to advanced airway techniques, defibrillation and paediatric ALS drug therapy is covered in *ALS paediatric—Module 1: Airway, Module 2: Defibrillation/external pacing and pharmacology* and *Module 3: Shock, fluid resuscitation and circulatory access*. Participants undertaking *ALS paediatric—Module 4: ALS* should have the knowledge and skills covered in these earlier modules. The purpose of this module is for participants to put these skills together as a coordinated paediatric ALS response in a team environment.

Standard treatment algorithms[1, 2] should be followed once cardiorespiratory arrest is confirmed. Immediate paediatric BLS management should be initiated if:

- severe bradycardia, asystole or PEA/EMD is present
- VF or VT is present and the defibrillator is not immediately available.

During CPR, if not already done, responders should:

- check electrode/paddle position and contact
- secure IV or IO access
- give adrenaline 10 μg/kg IV or IO every 3 minutes
- consider advanced paediatric airway management
- look for and manage any ‘reversible causes’, for example:
  - hypoxaemia
  - hypovolaemia
  - hypo/hyperthermia
  - hypo/hyperkalaemia
  - cardiac tamponade
  - tension pneumothorax
  - toxins, poisons, drugs
  - pulmonary embolism.

If a 'shockable rhythm' is found (VF or VT):

- attempt defibrillation (2 j/kg for initial monophasic or biphasic shock)
- continue CPR for another 2 minutes
- re-assess rhythm
- repeat defibrillation at a dose of 4 j/kg if VF/VT persists
- administer adrenaline 10 µg/kg IV or IO every 3 minutes
- consider amiodarone 5 mg/kg IV or IO if refractory to above
- consider other paediatric ALS drugs in appropriate circumstances.

If a 'non-shockable rhythm' is found (asystole or PEA/EMD):

- continue CPR
- administer adrenaline 10 µg/kg IV or IO every 3 minutes
- re-assess rhythm
- consider atropine 20 µg/kg IV or IO if bradycardia is suspected to have been initiated by vagal stimulation.

Learning activities

Suggested learning activities and timetables are outlined below. Timetable 1 is designed for 12 participants working in two groups of six. Timetable 2 is designed for six participants working together.

Timetable 1			
Timing	Activity		Objective
20 minutes	Introduction and discussion about simulations		1
	Group 1	Group 2	
10 minutes	Simulation 1	Simulation 2	All
30 minutes	Debrief	Debrief	All
10 minutes	Simulation 2	Simulation 1	All
30 minutes	Debrief	Debrief	All
10 minutes	Summary		All
10 minutes	Evaluation		

Total time = 2 hours

Timetable 2		
Timing	**Activity**	**Objective**
20 minutes	Introduction and discussion about simulations	All
10 minutes	Simulation 1	All
30 minutes	Debrief	All
10 minutes	Simulation 2	All
30 minutes	Debrief	All
10 minutes	Summary	All
10 minutes	Evaluation	

Total time = 2 hours

Introduction

The facilitator should lead a brief discussion amongst participants to refresh or clarify any issues relating to paediatric ALS protocols and introduce the simulation training to follow. This should not be a comprehensive lecture on paediatric ALS. The ARC paediatric ALS protocol[1] should be displayed prominently and can also be given to participants as a handout.

The discussion should highlight any departures form ARC Guidelines peculiar to that institution. Institution-specific 'paediatric cardiac arrest call' nomenclature and phone numbers should be reinforced.

Simulation 1: Anaphylactic shock

Scenario design

In this scenario, a four-year-old boy is admitted to hospital for an asthma exacerbation. He has acute worsening of his wheezing and shortness of breath shortly after exposure to peanut butter. He progresses to anaphylactic shock, which participants are required to recognise and treat supportively with airway management and adrenaline administration.

Case history	
Patient details	
Sex	Male
Age	4 years
Past history	Frequent ear infections, asthma Two prior admissions to hospital (never requiring intubation) Currently on nebulised bronchodilators and prednisone 30 mg daily Weight is 16 kg in admission
Social history	Lives with mother and father
History of present illness	Three days of upper respiratory symptoms precipitating asthma exacerbation and hospital admission 24 hours ago Observed wheezing more and acutely short of breath after having peanut butter sandwich brought in by his mum Soon after eating he developed hypotension, facial flushing, diffuse red rash Anaphylactic reaction is suspected
Presenting symptoms	Bronchospasm, shortness of breath, rash, hypotension

Resources	
General	
Setting/environment	Hospital ward
Patient attire	Hospital gown
Monitoring	Cardiorespiratory monitor with non-invasive blood pressure (BP) and pulse-oximetry nasal cannulae O_2 in place, IV access present
Supporting documentation required	Bedside observation and treatment chart

Equipment		
Equipment	**Number**	**Sourced from**
Paediatric manikin	1	Capable of simulating breath sounds If low-fidelity, assume wheezing breath sounds
Hospital bed/trolley	1	
Hospital gown	1	
Pillow, blanket	1 each	
Hudson mask and tubing	1	
Resuscitation trolley	1	
OP airway	1	
Bag-mask device	1	
Oxygen supply	1	
IV fluid and giving set	2 sets	
Drug props (adrenaline)	1 set May include standard ampoules with saline for dilution of paediatric doses	Anticipate other drugs participants may ask for (for example, steroids, salbutamol)

Roles
Participant 1
You are a health professional working on the ward of your hospital. Another nurse (faculty member) calls you to assist with a child who has become acutely unwell after being admitted 24 hours ago with an asthma exacerbation. You have two colleagues you may call on if you need assistance. The resuscitation trolley is stocked with paediatric equipment and drugs.

Participants 2 and 3
You are health professionals working in the hospital ward. Your colleague (Participant 1) is attending a child who has become acutely unwell, having been admitted 24 hours previously with an asthma exacerbation. Your colleague may call on you for assistance. A nurse is also present (faculty member) to assist with locating equipment and medications.

Faculty role play: Ward nurse
You are a nurse working in the hospital's ward, looking after a child admitted 24 hours ago with an acute asthma exacerbation. He is recovering well and there are plans for potential discharge tomorrow. The child has just eaten lunch—a peanut butter sandwich brought in by his mum—and is now noted to be acutely unwell with shortness of breath and abrupt onset of wheezing. You note that he has a rash and facial flushing and his vital signs show increasing tachycardia and decreasing blood pressure. You request assistance in managing this patient by calling in Participant 1. You assist all participants in finding equipment and appropriate drugs if needed. You may help prepare paediatric ALS medications such as adrenaline if asked. You may assist one of the participants in their management of the airway.

Faculty role play: Senior clinician (optional)
You are a senior clinician working in the hospital. If participants experience difficulties, it is appropriate to enter the scenario and offer assistance. Otherwise, at the conclusion of the scenario, you arrive to take a handover of the patient.

Simulator programming considerations				
System	Baseline state	Change in State 1	Change in State 2	Resolution
Central Venous System	Sinus tachycardia, HR 140, prolonged capillary refill (3 seconds), hypotensive BP 60/40	Sinus tachycardia HR 140, BP 70/45, prolonged capillary refill (3–4 seconds) despite initial fluid admin	Sinus tachycardia, HR 150, BP 90/50, capillary refill 2–3 seconds	Sinus tachycardia, improved perfusion, BP 100/50
Respiratory	Tachypnoeic in respiratory distress with diffuse wheezing, RR 40, O_2 saturation 89% on 2 litres nasal cannulae	Tachypnoeic, RR 30, O_2 saturation 98% on O_2 (facemask), tight breath sounds with poor air movement	Slowing respiratory rate, improved breath sounds, wheezing audible May have ventilation assisted by participant	Spontaneous respirations, improved breath sounds with some scattered wheezing, but good air movement

Simulator programming considerations (cont.)				
System	Baseline state	Change in State 1	Change in State 2	Resolution
Neurologic	Restless, agitated	Somnolent	Rousable, restless	Conversant
Response to participant intervention	No IV fluids, salbutamol then remain in baseline state Bronch-odilator, IV fluids, increase in O_2 go to State 1	No adrenaline then remain in State 1 Additional fluids and adrenaline go to State 2	Assisted ventilation and adrenaline go to resolution	

Debriefing points:

- management of anaphylactic shock
- circulatory assessment and fluid administration
- appropriate ALS drug therapy in anaphylaxis (adrenaline)[3]
- airway assessment and management in anaphylaxis.

Resource list

The following resource list assumes two facilitators for every 12 participants. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
Facilitators	2	Allows one facilitator per simulation
ARC paediatric ALS flowchart	1	For display in tutorial area
ARC paediatric ALS flowchart handout	12	One for each participant
ALS paediatric DVD	1	
Equipment and resources listed for each simulation scenario	As per scenarios	See appropriate resource list for each simulation scenario
Evaluation forms	12	One for each participant

Simulation 2: Paediatric VF arrest

Scenario design

In this scenario, a five-month-old boy suffers a VF arrest in the emergency department (ED) after being brought into ED by his nanny for lethargy and poor feeding. Participants are required to recognise VF, initiate CPR and demonstrate their paediatric ALS skills. They should suspect potential abuse/trauma, and should therefore also consider immobilisation of the infant's cervical spine.

Case history	
Patient details	
Sex	Male
Age	5 months
Past history	Born full term, normal vaginal delivery Healthy, normal development thus far
Social history	Lives with mother and father was home alone with nanny
History of present illness	Was in normal state of health until that morning when his nanny reports he would not feed and became lethargic She brought him to ED where he is awaiting evaluation in a cubicle He had normal vital signs in triage, but was very lethargic and was connected to a monitor A peripheral IV is in place While awaiting further evaluation, the nanny yells out from the cubicle that he has stopped breathing His weight from triage is approximately 7 kg
Presenting symptoms	Apnoea, pulseless, VF

Resources	
General	
Setting/environment	Hospital ED
Patient attire	Nappy/jumper
Monitoring	ECG, non-invasive blood pressure (BP) IV access already obtained
Supporting documentation required	Bedside observation and treatment chart

Equipment		
Equipment	**Number**	**Sourced from**
Infant manikin	1	Capable of simulating VF/VT, responsive to defibrillation and allows for ETT or LMA insertion and ventilation
Hospital bed/trolley	1	
Nappy/jumper	1	
Pillow, blanket	1 each	
Patient treatment chart	1	
Hudson mask and tubing	1	
Resuscitation trolley	1	
OP airway	1	
Bag-mask device	1	
Oxygen supply	1	
Laryngoscopes (curved and straight blades)	1 each	
Appropriate sized ETT (3.5)	1	
Appropriate sized LMA (1.5–2)	1	
Manual defibrillator with paediatric paddles and/or paediatric pads	1	
Defibrillation/conductive gel pads	1 set	
IV cannulae (24 gauge)	2–3	
IV fluid and giving set	2 sets	
ALS drug props (adrenaline, amiodarone and atropine)	1 set	May include standard ampoules with saline for dilution to paediatric doses
Intraosseous needle and connector with syringes	1 each	

Roles
Participant 1
You are a health professional in the ED and have just received handover from a triage nurse (faculty member) about an infant in cubicle 1. Just as she finishes giving you a brief history, the infant's nanny calls out from the cubicle that the baby is not breathing. You will find that your patient is unwell and you need to initiate management. You have two colleagues you may call on if you need assistance. The resuscitation cubicle is stocked with paediatric equipment and drugs as appropriate in a real ED.
Participants 2 and 3
You are health professionals working in the hospital's ED. Your colleague (Participant 1) is attending an infant in cubicle 1 who is unwell. Your colleague may call on you for assistance in managing the patient. A nurse is also present (faculty member) to assist with locating appropriate paediatric equipment and medications.
Faculty role play: ED resuscitation/triage nurse
You are a nurse working in the ED. You have just finished triaging an unwell infant whose nanny brought him into ED for poor feeding and lethargy. The infant had normal vital signs in triage, except for mild tachycardia, but you are concerned that he is not as vigorous as he should be. You have placed him on a monitor and inserted an IV. You are giving handover to Participant 1 about your triage findings when the infant's nanny calls out that the baby has stopped breathing. You assist all participants in finding equipment and appropriate drugs if needed. You may perform chest compressions if asked to do so, but you do not perform defibrillation or airway management. You may assist one of the participants in their management of the airway.
Faculty role play: ED senior clinician (optional)
You are a senior clinician working in the ED. If participants experience difficulties, it is appropriate to enter the scenario and offer assistance. Otherwise, at the conclusion of the scenario, you arrive to take a handover of the patient.
Faculty role play: Nanny
You are the nanny of a five-month-old infant. You are concerned that he is not acting appropriately at home. He has been lethargic and not wanting to feed this morning. You are unable to reach either of his parents at work and so decide to take him to ED. You are waiting in a cubicle in ED when you hear the monitor beep and notice that he has stopped breathing. You call out of the cubicle for help. You stay out of the way during the resuscitation, provide as much history as possible when asked and leave the room to call his parents when CPR begins.

Simulator programming considerations				
System	Baseline state	Change in State 1	Change in State 2	Resolution
CVS*	Ventricular fibrillation, pulseless	Ventricular fibrillation, pulseless	Ventricular fibrillation, pulseless	*Sinus tachycardia after defibrillation and intubation Return of spontaneous circulation (pulses) (assume return of pulses if low-fidelity manikin)
Respiratory	Apnoeic	Apnoeic	Ventilated by participant	Ventilated by participant if ETT/LMA inserted or appropriate bag-mask ventilation initiated Return of spontaneous respirations, RR 26 if no ETT/LMA (assume return of spontaneous respiration if low-fidelity manikin)
Neurologic	Unresponsive	Unresponsive	Unresponsive	Unresponsive if ETT/LMA inserted Return of consciousness GCS → 14 if not (assume GCS 14 if low-fidelity manikin)
Response to participant intervention	No CPR → remains in baseline state CPR and use of defibrillator → State 1	No CPR → remains in State 1 ETT or LMA insertion → State 2 If no ETT or LMA, go to resolution after third defibrillation attempt*	No CPR → remains in State 2 CPR and use of defibrillator → resolution	

* For participants who perform well, the patient could be returned to VF or VT so that prolonged CPR and multiple attempts at defibrillation are needed.

Debriefing points:

- the paediatric ALS algorithm for VF
- effective use of defibrillator with paediatric pads and/or paddles
- appropriate paediatric ALS drug therapy

- timing of ETT/LMA insertion in paediatric ALS compared to bag-valve-mask use by clinicians not skilled in paediatric airway management
- use of cervical spine stabilisation for suspected traumatic injury/abuse.

Resource list

The following resource list assumes two facilitators for every 12 participants. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
Facilitators	2	Allows one facilitator per simulation
ARC paediatric ALS flowchart	1	For display in tutorial area
ARC paediatric ALS flowchart handout	12	One for each participant
ALS paediatric DVD	1	
Equipment and resources listed for each simulation scenario	As per scenarios	See resource list for each simulation scenario
Evaluation forms	12	One for each participant

Summary

The summary session reinforces content covered in the learning activities, and is an opportunity for participants to reflect on what they have learned. No new material should be introduced.

Major points to recap in the summary include:

- assessment and treatment of the child in shock in accordance with paediatric ALS guidelines (shockable compared to non-shockable rhythms)
- use of capillary refill, perfusion and heart rate to assess circulatory status in children
- use of adrenaline in anaphylactic shock to block histamine release, vasoconstrict peripheral vessels to improve blood pressure and dilate bronchioles to improve lung aeration
- timing of advanced airway measures—potential need for ventilatory support with bag-valve-mask, but use of adrenaline for bronchodilatation effect (recognition of anaphylaxis as a potential difficult intubation scenario)
- defibrillation and management of VF arrest in an infant/child
- use of in-line stabilisation and immobilisation of the cervical spine with suspected trauma or suspicion of paediatric abuse situation (non-accidental trauma).

Encourage participants to review the appropriate ARC Guidelines in their own time to reinforce the skills acquired in this module. They should be offered access to equipment and educators in the future if there is a need to practise or improve their skill level or confidence.

Evaluation

A formal evaluation has been specifically developed for this module. It incorporates the objectives of the module and the perceptions of the participants about whether they have increased their understanding by working through the module. It is highly recommended that this formal evaluation be copied and completed by all participants at the completion of the module.

A range of informal evaluation tools may also be used in conjunction with this evaluation throughout the module, including those available in the Department of Human Services' *Clinical Skills Facilitators Manual* from the basic course conducted in 2007.

References

1. Australian Resuscitation Council Guideline 12.3: Flowchart for the Sequential Management of Life-Threatening Arrhythmias in Infants and Children. February 2006
2. Australian Resuscitation Council Guideline 7: Cardiopulmonary Resuscitation. February 2006
3. Lieberman P. 2003 Use of Epinephrine in the Treatment of Anaphylaxis. *Current Opinion in Allergy and Clinical Immunology* 3: 313–318

Resources

Facilitator feedback form

The following form should be used to assist you in giving feedback after each participant has practised their ALS skills at the skill station.

Feedback using the Pendleton model

Pendleton's model of feedback assists learners to maximize their potential at different stages of training, raise their awareness of strengths and areas for improvement, and identify actions to be taken to improve performance. Pendleton's rules are structured in such a way that the learner identifies the positives first, in order to create a safe environment. This is followed by the facilitator or group reinforcing these positives and discussing skills to achieve them. Different techniques are then suggested. The advantage of this method is that the learner's strengths are discussed first. Avoiding a discussion of weaknesses right at the beginning prevents defensiveness and allows reflective behaviour in the learner.

Below is a series of questions to assist you in this technique:

1. Ask the learner how they feel.
2. Ask the learner what went well and why (this can be combined with question 1 and 3).
3. Tell the learner what went well and why.
4. Ask the learner what could have been done better and why.
5. Tell the learner what could have been done better and why.
6. Summarise the learner's strengths and identify up to three things to concentrate on.

Note: This form does not need to be given to the participant — it is a guide for you, the group facilitator.

Module 4: ALS—Evaluation

Thank you for participating in this module. As part of our commitment to quality improvement the following questionnaire will be used to plan future implementation of this module. We appreciate your time completing this evaluation.

1. Overall

How would you rate this module?

☐ poor ☐ fair ☐ good ☐ very good ☐ outstanding

2. Learning objectives

Please consider whether this module was successful in meeting the following learning objectives:

ALS paediatric Learning objectives of Module 4: ALS	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Reviewed the Australian Resuscitation Council (ARC) ALS Guidelines on cardiac arrest in children[1]	☐	☐	☐	☐	☐
Performed team-based cardiopulmonary resuscitation (CPR) on an infant and child in a simulated environment	☐	☐	☐	☐	☐
Applied the appropriate airway management to a simulated patient (manikin) in a paediatric ALS setting	☐	☐	☐	☐	☐
Demonstrated the use of a manual defibrillator on a simulated infant and child (manikins)	☐	☐	☐	☐	☐
Analysed and applied appropriate drug therapy for life-threatening arrhythmias on a simulated paediatric patient (manikins)	☐	☐	☐	☐	☐

3. Important learning outcomes

What are the three most important things you have learned from this module?

4. Module implementation

Please indicate to what extent you agree or disagree with each of the following statements in relation to the implementation of the module.

	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
The facilitator respected my experience	☐	☐	☐	☐	☐
The facilitator encouraged my participation	☐	☐	☐	☐	☐
I was able to ask the facilitator questions	☐	☐	☐	☐	☐
The facilitator was able to answer my questions	☐	☐	☐	☐	☐
The feedback I received was clear	☐	☐	☐	☐	☐
The feedback I received will assist me in my future performance	☐	☐	☐	☐	☐
There was adequate time for the skills stations	☐	☐	☐	☐	☐
There was adequate time for the facilitated discussions	☐	☐	☐	☐	☐
There was adequate time for the simulations	☐	☐	☐	☐	☐
I have increased my confidence in performing paediatric ALS	☐	☐	☐	☐	☐
I have identified future learning needs in this topic area	☐	☐	☐	☐	☐

5. Future module implementation

Do you think the module should be altered in any way? ☐ yes ☐ no

If yes, what recommendations do you have?

Thank you

PowerPoint presentation

1.

Clinical Skills in Hospitals Project

Advanced Life Support (ALS) Paediatric MODULE 4 'Paediatric ALS'

A Victorian Government Initiative

2.

Module Outline

- Introduction
- Scenario 1
  - Debrief
- Scenario 2
  - Debrief
- Summation
- Evaluation

Module 5: Complex ALS

Introduction

ALS paediatric (advanced life support) was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *ALS paediatric* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course, as described in the Module Outline.

ALS paediatric covers paediatric advanced life support and does not address issues that are specific to the newly born nor neonatal advanced life support.

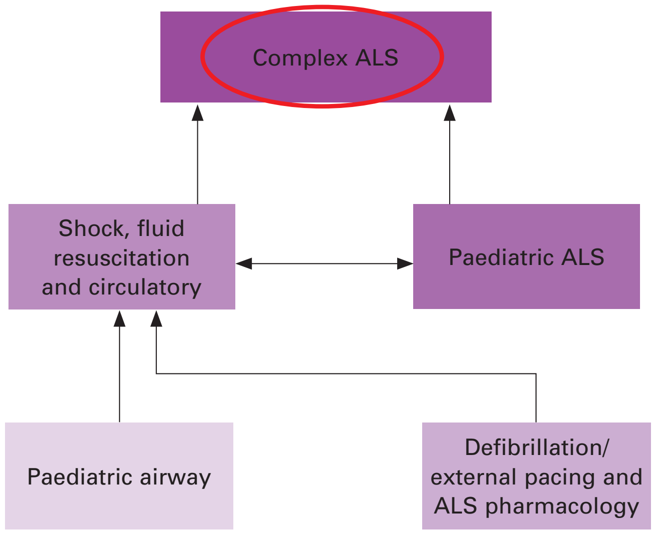
ALS paediatric should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

Aims

ALS paediatric aims to make participants confident in their application of advanced life support (ALS) knowledge and skills on children in different environments and settings. *ALS paediatric* is intended for use with medical and nursing participants.

Package structure

ALS paediatric contains five modules which provide learning opportunities for health professionals at all levels of experience and from medical and nursing disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate. Module 5 is more advanced and regarded as complex.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	

Paediatric ALS skills include advanced airway management (including endotracheal intubation), the recognition and management of common cardiac arrest arrhythmias, manual defibrillation, external cardiac pacing, and fluid resuscitation in shock states (including intraosseous needle placement).

As a clinical skills course, *ALS paediatric* does not cover issues relating to post-resuscitation therapy, such as therapeutic hypothermia, glycaemic control, cerebral perfusion and respiratory support. Educators and participants are referred to the Australian Resuscitation Council's Guideline 12.7: Management after resuscitation in paediatric advanced life support, February 2006 for this information.

ALS paediatric was designed to develop participants' knowledge, skills and behaviours in paediatric ALS, and to expose them to increasingly complex scenarios aimed at testing their ability to combine these individual skills, work as a team and problem solve in more difficult situations.

Educators delivering these modules should be aware of participants' level of experience and choose appropriate modules. Modules presume an increasing level of knowledge as they progress, ranging from a fundamental knowledge of anatomy and physiology for the fundamental modules, up to detailed knowledge of ALS and resuscitation for the complex modules. Novice participants (such as first-year graduates) are expected to start with the fundamental modules, and only move onto intermediate and more complex modules as they demonstrate proficiency. More experienced participants may start at the intermediate level if the educator is satisfied that they have the prior knowledge and skills. Individual educators are responsible for assessing each participant's baseline knowledge and determining which modules they need to complete. More specific descriptions of presumed knowledge are outlined in each module.

The design of these packages presumes that the clinical educators using them have knowledge and expertise in current best practice regarding the teaching of clinical skills and conducting facilitated discussions. Knowledge and expertise are presumed commensurate with the Department of Human Services' basic and advanced Train-the-Trainer programs. Clinical educators are encouraged to refer to the Department of Human Services' *Clinical Skills Facilitators Manual* for theory on:

1. Peyton's model for teaching clinical skills
2. leading small group discussions
3. giving feedback
4. crisis resource management skills.

Module 5: Complex ALS

Authors: Dr Nicole Shilkofski, Dr Robert O'Brien, Mr Julian Van Dijk

Definition

For the purposes of these modules, a 'child' is defined as approximately 1–8 years of age and an infant is less than approximately 1 year of age. These modules do not deal with newborn infants or neonates (under 28 days old).

Aims

The purpose of *ALS paediatric—Module 5: Complex ALS* is for participants to use their clinical, management and personal skills in dealing with a complex paediatric advanced life support (ALS) scenario.

Presumed knowledge

This module is targeted to health professionals with significant experience in paediatric ALS. However, they are expected to have completed *ALS paediatric—Module 3: Shock, fluid resuscitation and circulatory access* and *Module 4: ALS*, and also have a high level of knowledge and skills relevant to:

- paediatric ALS[1] and basic life support[2] (BLS) protocols
- advanced airway management in children and infants
- use of the manual defibrillator in paediatric patients
- use of the external cardiac pacer in paediatric patients
- paediatric cardiac arrest management.

Participants should also have practised these skills on child manikins, and had an opportunity to apply them to the clinical scenarios in *ALS paediatric—Module 3: Shock, fluid resuscitation and circulatory access*, and completed the pacing skills station in *ALS paediatric—Module 4: ALS*. If participants do not yet feel confident with the individual skills, they should be redirected to *ALS paediatric—Module 3: Shock, fluid resuscitation and circulatory access* and *Module 4: ALS*.

Objectives

By the end of this module, participants should have:

1. reviewed the Australian Resuscitation Council (ARC) paediatric ALS Guidelines[1]
2. practised paediatric ALS on a simulated patient as a team member in a simulated difficult clinical setting
3. reflected on their ability to problem solve and communicate effectively under stress
4. recognised factors that influence team performance in crisis situations.

Background information for educators

Much of the background information pertaining to paediatric ALS airway management, manual defibrillation and external pacing covered in *ALS paediatric—Module 1: Airway, Module 2: Defibrillation/external pacing and pharmacology* and *Module 4: ALS. Except for external pacing*, participants should have practised these skills and worked as teams in *ALS paediatric—Module 3: Shock, fluid resuscitation and circulatory access*.

The purpose of this module is for participants to use these skills in more complex scenarios where the issues are not necessarily clinical. Clinical knowledge is assumed. As evident in the learning activities, most of the discussion will revolve around opinions and experiences, rather than hard clinical facts.

Managing critical patients is a stressful challenge. Success relies on clinical knowledge and skills, but also on effective individual performance, teamwork and health care systems. Health professionals may need to deal with deficiencies in each of these aspects while simultaneously confronting distressing emotional responses in staff and the child's parents/family.

Crisis resource management[3] (CRM) describes a set of strategies or skills developed to help individuals and teams to perform efficiently in these high risk/high stress situations. Common CRM principles include:

- know your environment (workplace, equipment, staff and policies)
- anticipate and plan (proactive contingency planning, expect the unexpected)
- call for help early
- exercise leadership
- communicate clearly
- use all available information
- allocate attention wisely (determine focus, avoid fixation, prioritise)
- distribute workload evenly.

Clinical educators are referred to Chapter 2 in the *Clinical Skills Facilitator's Advanced Course Manual* for more detailed information and references.

The performance of individuals—either on their own or as part of a team—has important implications for managing critical events. Individuals should be aware of factors that might influence personal performance in themselves or their colleagues, such as:

- experience and knowledge levels
- situational stress (some stress is good, too much may be harmful)
- fatigue and tiredness

- difficult environments (noise, distractions, unfamiliarity, workload, staff, resources)
- negative life events (illness, family crises)
- attitude and personality (anti-authority, impulsive, invulnerable, macho)
- drug and alcohol use.

Some of these issues might need to be directly addressed (adequate sleep, drug and alcohol counselling, education); for others, recognition and support may be adequate (for example, family crises). Similarly, effective and efficient teamwork and leadership are crucial in dealing with critical clinical situations. Effective teams are characterised by[3, 4]:

- organisation
- leadership
- familiarity of members
- designated roles
- effective communication
- situational awareness (the 'big picture')
- avenues for conflict resolution.

Effective team leaders are characterised by:

- clear communication of plans and goals
- allocation of tasks
- remaining free to oversee management
- being receptive to input from team members
- situational awareness, maintaining team focus
- prioritisation and problem solving
- promoting a positive group culture.

Effective communication is characterised by:

- directed assertive communication in simple language (using eye contact and people's names)
- calm, polite, controlled tone and voice
- passage of information through leader as central relay
- verification of task completion and referral back to leader ('closing the loop')
- team awareness of situation.

Despite the best efforts of health professionals, many children will die because of their cardiac arrest, particularly if this occurs outside the hospital setting[5, 6].

Conversations to this effect with parents are difficult and emotionally charged. While not unanimous, the literature generally supports parents being present during resuscitation and invasive procedures[7, 8]. Recent studies show that seeing the events of the resuscitation efforts often affect family members' ability to believe the outcome[7]. This difficult task may be made a little easier by:

- choosing an appropriate private setting
- establishing trust
- asking the parents what they understand
- responding to emotions
- offering support
- appreciating and accommodating cultural variations in the way families deal with resuscitation and death
- 'hope for the best, but prepare for the worst'.

Learning activities

Suggested learning activities and timetables are outlined below. Timetable 1 is designed for 12 participants working in two groups of six. Timetable 2 is designed for six participants working together.

Timetable 1			
Timing	Activity		Objective
40 minutes*	Facilitated discussion		1
	Group 1	Group 2	
15 minutes	Simulation 1	Simulation 2	2, 3, 4
30 minutes	Debrief	Debrief	2,4
15 minutes	Simulation 2	Simulation 1	2, 3, 4
30 minutes	Debrief	Debrief	2,4
10 minutes	Summary		2,4
10 minutes	Evaluation		

Total time = 2 hours 30 minutes

* Time allocated for the facilitated discussion may be reduced if participants have previously undertaken *BLS paediatric—Module 5: Complex BLS*.

Timetable 2		
Timing	**Activity**	**Objective**
40 minutes*	Facilitated discussion	1
15 minutes	Simulation 1	2, 3, 4, 5
30 minutes	Debrief	2, 3, 4, 5
15 minutes	Simulation 2	2, 4, 5
30 minutes	Debrief	2, 4, 5
10 minutes	Summary	2, 4, 5
10 minutes	Evaluation	

Total time = 2 hours 30 minutes

* Time allocated for the facilitated discussion may be reduced if participants have previously undertaken *BLS paediatric—Module 5: Complex BLS*.

Facilitated discussion

The facilitator should introduce the simulation training to follow and lead a discussion amongst participants around individual performance, teamwork and CRM principles. The time allowed for this discussion may be reduced if participants have previously completed *BLS paediatric—Module 5: Complex BLS*.

While the clinical conditions in the scenarios are straightforward, non-clinical issues make the scenarios more complex and difficult for the participants. Therefore, some time should be spent in the facilitated discussion on exploring participant's experience with resuscitations where human factors and communications issues affected their ability to function clinically.

Major issues which the facilitator should cover include:

- teamwork principles
- barriers to individual performance
- effective leadership
- effective teams
- effective team communication
- effective communication with parents and relatives of paediatric patients
- dealing with parental presence during resuscitation.

PowerPoint slides are available for the facilitator to use to summarise these main points at the end of the discussion, or as triggers if participants have not identified the major issues. However, facilitators should avoid delivering a didactic lecture.

Simulation session

This exercise allows participants to practise their paediatric ALS skills in a team environment complicated by human factor issues. Participants are exposed to a mock cardiac arrest situation with a paediatric patient and are expected to manage the clinical aspects within the confines of their paediatric ALS skills.

The program assumes two facilitators for every 12 participants. Participants should be divided into two groups of six (Table 1). Three participants will each participate in one scenario and observe a second. The debriefing period should include all six participants of that group, that is, the active participants and their observers.

As a more complex scenario, it may be difficult to enrol 12 participants. However, it would be possible to run these scenarios with smaller groups. If only six participants are present, Simulations 1 and 2 can be run sequentially (Table 2).

These scenarios can be run on low-fidelity simulators (for example, Resus Anne), but are also quite suitable for more sophisticated simulators (for example, Sim Man, HPS METI).

Simulation 1: VT reverting to PEA/EMD

Scenario design

In this scenario, a four-year-old girl with Down's syndrome and relapsed acute leukaemia is brought to ED by her parents for fever and lethargy. She is found to be anaemic and IV antibiotics and a blood transfusion are ordered. While arrangements are underway for transport to the children's hospital, her father confides that they have been contemplating palliative care for her since her relapse. Halfway through the transfusion, she becomes more tachycardic and subsequently develops VT arrest. She responds to defibrillation, but returns from defibrillation to PEA/EMD. Participants must consider the potential aetiology of her VT and treat appropriately for possible hyperkalaemia with resolution to sinus tachycardia. The patient's parents are present and are in some disagreement between them about the extent to which they desire resuscitation. Ultimately they agree that they would like her intubated and defibrillated until they can speak with her oncology team. They are visibly upset by the turn of events.

Case history	
Patient details	
Sex	Female
Age	4 years
Past history	Down's syndrome, acute lymphocytic leukaemia Relapsed after initial chemotherapy on maintenance prednisone at home Weight is approximately 14 kg in triage
Social history	Lives at home with her mother and father, only child
History of present illness	Brought to local ED for fever and suspected infection with lethargy Found to be anaemic and neutropaenic Given IV antibiotic and blood transfusion during which she became more tachycardic and then suddenly collapsed and became unresponsive
Presenting symptoms	Sinus tachycardia and lethargy progressing to apnoea and pulseless VT

Resources	
General	
Setting/environment	Hospital emergency department
Patient attire	Hospital gown
Monitoring	ECG, non-invasive BP, pulse oximetry IV access in form of central line in place
Supporting documentation required	Emergency department observation chart

Equipment		
Equipment	Number	Sourced from
Child manikin	1	Capable of simulating VT and PEA/EMD receptive to defibrillation and able to be intubated
Hospital gown	1	
Emergency department observation chart	1	
Hudson mask and tubing	1	
OP airway	1	
Paediatric bag-mask vent device	1	
Oxygen supply	1	
Manual defibrillator with paediatric paddles and/or pads	1	
Defibrillation pads/gel pads	1 set	
Paediatric ALS drug props (adrenaline, amiodarone and atropine)	1 set	Include standard ampoules and saline to dilute paediatric doses
Laryngoscope (Macintosh 2)	1	
Appropriate sized ETTs (4.5–5.0)	1 each	

Roles
Participant 1
You are a health professional working in the emergency department of your hospital. You are looking after a four-year-old with Down's syndrome and relapsed leukaemia whose parents brought her in for fever, lethargy and suspected infection. She is initially tachycardic, but otherwise stable in triage. You administered IV antibiotics via her central line, hung a blood transfusion and called for transport to the children's hospital. During the blood transfusion, you are called into her room by the ED nurse because the alarm is sounding on her monitor and she is becoming increasingly tachycardic. You will arrive to find her unwell. You have access to all the usual drugs and equipment available in the emergency department. You have two colleagues and a resuscitation nurse in the ED to assist should you need them.
Participants 2 and 3
You are health professionals working in the emergency department of your hospital. You may be called to assist your colleague in the care of a paediatric patient who is unwell. You have access to all the usual drugs and equipment available in the emergency department.
Faculty role play: Emergency department nurse
You are a nurse working in the ED, and are looking after a four-year-old with Down's syndrome and relapsed leukaemia whose parents brought her in for fever, lethargy and suspected infection. She is initially tachycardic, but otherwise stable in triage. She has received IV antibiotics via her central line and is in the middle of receiving a blood transfusion after she is discovered to be anaemic. Transport to the children's hospital for further care has already been arranged. Her father confides to you that they have been contemplating palliative care since her relapse. During the blood transfusion, you note that her monitoring has alarmed and she has become more tachycardic. You call for Participant 1 to assist you. You should assist the participants in finding equipment and preparing and administering appropriate drugs if needed. You may perform chest compressions if asked to do so, but you do not perform defibrillation or airway management. At the start of the resuscitation, you should mention to the participants that the parents are considering palliative/hospice care for their child.
Faculty role plays: Patient's mother and father
You are the parents of a four-year-old girl with Down's syndrome and leukaemia who has recently relapsed after prolonged chemotherapy. You were told recently by her oncologists that additional chemotherapy has dubious benefits, and that her prognosis is grim. The two of you have been discussing hospice/palliative care options for her and are opposed to further chemotherapy or aggressive treatments. You brought her to the ED because she is lethargic and febrile and you are concerned she has an infection. As it becomes clear that she is deteriorating, you discuss between yourselves whether you want her to be fully resuscitated. Ultimately, you decide that you favour her being intubated and shocked in order to stabilise her long enough to discuss the situation with her oncologists. You are upset as you and worried that she may not survive, but you can see that the hospital staff are doing all they can. If asked to leave you do so; otherwise you remain in the room. You are concerned, but do not interfere with the progress of the resuscitation.
Faculty role play: Senior clinician (optional)
You are a senior clinician working in the cardiac ward. If participants experience difficulties, it is appropriate to enter the scenario and offer assistance. Otherwise, at the conclusion of the scenario, you arrive to take a handover of the patient.

Simulator programming considerations				
System	Baseline state	Change in State 1	Change in State 2	Resolution
CVS	Sinus tachycardia, 170 BPM BP 80/50	Ventricular tachycardia, pulseless	PEA/ EMD with idioventricular rhythm on the monitor, HR 40 BPM	Sinus tachycardia, 150 BPM BP 80 mmHg systolic
Respiratory	Spontaneous respiration 22 per minute	Apnoeic	Apnoeic	Spontaneous respiration 26 per minute (unless intubated/ventilated)
Neurologic	GCS 14	Unresponsive	Unresponsive	GCS 15, depending whether intubated/sedated
Response to participant intervention	Go to State 1 after initial discussion/ history from parents/ faculty nurse	No CPR or defibrillation then stay in State 1 Defibrillation go to State 2	No CPR, adrenaline fluids, treatment for possible hyperkalemia/ hypovolemia then remain in State 2 Successful treatment of PEA and possible hyperkalemia/ hypovolemia go to resolution	

Debriefing points:

- effective paediatric ALS management of VT and PEA/EMD
- aetiology of VT in paediatric patient (in this case, suspicion of hyperkalemia, because of the occurrence during blood product infusion and/or hypovolemia given pancytopenia)
- recognition of need for use of calcium, bicarbonate, insulin, glucose
- effective use of defibrillator with paediatric pads
- communication with relatives
- relatives' presence at resuscitation
- effective teamwork and leadership
- supporting colleagues
- resuscitation of children with chronic disease.

Simulation 2: Unstable SVT

Scenario design

In this scenario, a six-year-old boy presents to the ED 'feeling like his heart is thumping hard'. He rapidly deteriorates as he progresses from stable to unstable SVT with hypotension and impaired consciousness. Participants should manage the SVT appropriately via electrical cardioversion after failed chemical conversion attempts. His mother is present and is initially anxious about procedures (IV placement), and then quite distraught about his abrupt deterioration, which she feels is due to his condition being ignored when he initially arrived to the ED.

Case history	
Patient details	
Sex	Male
Age	6 years
Past history	Several episodes in the past of 'fluttering in his chest' with exercise/activity—otherwise healthy
Social history	Lives with mother and father, one sibling who is healthy with normal development
History of present illness	Playing with his dog in the yard when he suddenly felt like his heart was racing/thumping hard His mother felt his heart beating very fast and brought him to hospital
Presenting symptoms	Presenting symptoms Tachycardia to 230, diaphoretic, anxious, but conversant while in resuscitation cubicle, becomes more obtunded with fall in BP Weight is approximately 20 kg in triage

Resources	
General	
Setting/environment	Hospital ED
Patient attire and appearance	Hospital gown
Monitoring	ECG, non-invasive BP, pulse oximetry
Supporting documentation required	Emergency department observation chart

Equipment		
Equipment	**Number**	**Sourced from**
Paedriatric manikin	1	Capable of simulating VF/VT, receptive to defibrillation and able to be intubated
Hospital gown	1	
Emergency department observation chart	1	
Hudson mask and tubing	1	
OP airway	1	
Paediatric bag-mask vent device	1	
Oxygen supply	1	
Manual defibrillator with paediatric paddles and/or pads	1 set	
Defibrillation pads/gel pads	1 set	
IV catheters (20 and 22 gauge)	2–3 each size	
Three-way tap	1	
Bag of ice	1	For vagal manoeuvre attempts if requested
Syringes	At least 2	
ALS drug props (adenosine, adrenaline and amiodarone)	1 set	Include standard ampoules with saline and flushes for dilution to paediatric doses
Laryngoscope (Macintosh 2)	1	
Appropriate sized ETTs (5, 5.5, 6)	1 each size	

Roles
Participants 1, 2 and 3
You are health professionals working in the emergency department of your hospital, and are looking after a boy who presented with ‘thumping in his chest’ and diaphoresis. This has happened to him before, but he has never sought medical attention during prior episodes. He is otherwise healthy. You are called to see him by the resuscitation nurse because she is concerned about his rapid heart rate. You have access to all the usual paediatric drugs and equipment available in the emergency department.
Faculty role play: Resuscitation nurse
You are a nurse working in the emergency department, and are looking after a boy who was brought to the ED by his mother with a fast heart rate. He is otherwise healthy. You request assistance from the participants because he is quite tachycardic. You assist the participants in finding equipment and appropriate drugs if needed. You may prepare and administer medications if asked to do so, but you do not perform electrical cardioversion or airway management. If the participants do not recognise SVT as he progresses and becomes unstable, you may need to prompt that he is becoming less responsive.
Faculty role play: Patient's mother
You are the mother of a six-year-old. He is a healthy boy other than several prior episodes of ‘feeling his heart racing’ with modest activity. He has recovered from these spontaneously and you have not sought medical attention. You brought him to emergency today because you could feel his heart beating very fast when he complained of his ‘chest thumping’ while in the yard with his dog. You are concerned he may have a heart condition and your young nephew died suddenly about a year ago from a heart problem around the same age as your son. You feel things are moving slowly in ED and he is being ignored. You are quite frightened of needles and are opposed to any procedures that are not well explained to you. You are by his bedside when he becomes progressively unresponsive and are frustrated by what you perceive as a lack of action on the part of the medical staff. You are fearful and ask many questions of the participants. If asked to leave during the resuscitation, you are reluctant to leave his bedside.
Faculty role play: Senior Clinician (optional)
You are a senior clinician working in the emergency department. If participants experience difficulties, it is appropriate to enter the scenario and offer assistance. Otherwise, at the conclusion of the scenario, you arrive to take a handover of the patient.

Simulator programming considerations				
System	Baseline state	Change in State 1	Change in State 2	Resolution
CVS	Stable SVT HR 230 BPM BP 100/60 Capillary refill at 2–3 seconds	Unstable SVT HR 230 BPM BP 60/30 Poor perfusion with capillary refill at 4 seconds	Unstable SVT HR 230 BPM BP 50/20 Poor perfusion with capillary refill at 6 seconds	Normal Sinus Rhythm 110 BPM BP 90/65 Return of circulation with capillary refill improved to 2 seconds (assume return if low-fidelity manikin)
Respiratory	Spontaneous respiration 25 per minute Oxygen saturation 98% on room air	Spontaneous respiration 35 per minute Oxygen saturation 85% on room air	Ventilated by participant Oxygen saturation improved to 98% on O_2	Return of spontaneous respirations (RR 18) if not (assume return of spontaneous respiration if low-fidelity manikin) Participants should not intubate; but if they do, assume spontaneous respiration and eye opening with bucking against ETT
Neurologic	GCS 15, frightened/ anxious, but conversant	GCS 10, then falling to 6 Confused/ disoriented, progressing to unresponsive	Unresponsive	Unresponsive if sedated or intubated for cardioversion GCS 14 if not intubated (assume GCS 14 if low-fidelity manikin)
Response to participant intervention	Go to State 1 after attempts at IV access and/or vagal manoeuvres	If IV access and trial of adenosine not given → stay in State 1 If IV access established and adenosine attempted, oxygen or ventilation applied → go to State 2	No cardioversion → stay in State 2 Synchronised electrical cardioversion → go to resolution	

Debriefing points:

- effective paediatric ALS management of stable compared to unstable SVT
- use of and administration techniques for adenosine in paediatric SVT
- difficult communication with relatives/colleagues
- parent's presence at resuscitation.

Summary

The summary session reinforces content covered in the learning activities, and is an opportunity for participants to reflect on what they have learned. No new material should be introduced.

Points to cover in the summary include:

- management of SVT
- teamwork principles
- individual and team performance issues
- leadership
- effective communication
- communication with parents and family members.

Participants should be encouraged to explore the literature relevant to CRM, teamwork and performance issues. They may be interested in attending further training in CRM through other complex modules or packages included in this project, or through courses run by clinicians outside their parent institution.

Resource list

The following resource list assumes two facilitators for every 12 participants. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
Facilitators	2	Based on 12 participants
ARC paediatric ALS flowchart	1	For reference in introduction
PowerPoint presentation	1	For use in discussion
Equipment as listed for each individual scenario		
Feedback forms	2	As a prompt for each facilitator
Evaluation forms	12	One for each participant

Evaluation

A formal evaluation has been specifically developed for this module. It incorporates the objectives of the module and the perceptions of the participants about whether they have increased their understanding by working through the module. It is highly recommended that this formal evaluation be copied and completed by all participants at the completion of the module.

A range of informal evaluation tools may also be used in conjunction with this evaluation throughout the module, including those available in the Department of Human Services' *Clinical Skills Facilitators Manual* from the basic course conducted in 2007.

References

1. Australian Resuscitation Council Guideline 12.3: Flowchart for the Sequential Management of Life-Threatening Arrhythmias in Infants and Children. February 2006
2. Australian Resuscitation Council Guideline 7: Cardiopulmonary Resuscitation. February 2006
3. Murray W. and Foster P. 2000 Crisis Resource Management Among Strangers: Principles of Organising a Multidisciplinary Group for Crisis Resource Management. *J Clin Anesth* 12: 633–638
4. Sundar E., Sundar S. and 2007 Pawlowski J. Crew Resource Management and Team Training. *Anesthesiology Clin* 25: 283–300
5. Meyer A., Bernard S., Smith K., McNeil J. and 2001 Cameron P. Asystolic Cardiac Arrest in Melbourne, Australia. *Emerg Med Austral* 13: 186–189
6. Donoghue A.J., Nadkarni V., Berg R.A., Osmond M.H., Wells G., Nesbitt L. and Stiell I.G. 2005 Out-of-Hospital Pediatric Cardiac Arrest: an Epidemiologic Review and Assessment of Current Knowledge. *Ann Emerg Med* 46: 512–522
7. Mcgahey-Oakland P.R., Lieder H.S., Young A. and Jefferson L.S. 2007 Family Experiences During Resuscitation at a Children's Hospital Emergency Department. J *Pediatr Health Care* 21: 217–225
8. Dingeman R.S., Mitchell E.A., Meyer E.C. and Curley M.A. 2007 Parent Presence During Complex Invasive Procedures and Cardiopulmonary Resuscitation: a Systematic Review of the Literature. *Pediatrics* 120: 842–854

Resources

Facilitator feedback form

The following form should be used to assist you in giving feedback after each participant has practised their ALS skills at the skill station.

Feedback using the Pendleton model

Pendleton's model of feedback assists learners to maximize their potential at different stages of training, raise their awareness of strengths and areas for improvement, and identify actions to be taken to improve performance. Pendleton's rules are structured in such a way that the learner identifies the positives first, in order to create a safe environment. This is followed by the facilitator or group reinforcing these positives and discussing skills to achieve them. Different techniques are then suggested. The advantage of this method is that the learner's strengths are discussed first. Avoiding a discussion of weaknesses right at the beginning prevents defensiveness and allows reflective behaviour in the learner.

Below is a series of questions to assist you in this technique:

1. Ask the learner how they feel.
2. Ask the learner what went well and why (this can be combined with question 1 and 3).
3. Tell the learner what went well and why.
4. Ask the learner what could have been done better and why.
5. Tell the learner what could have been done better and why.
6. Summarise the learner's strengths and identify up to three things to concentrate on.

Note: This form does not need to be given to the participant — it is a guide for you, the group facilitator.

Module 5: Complex paediatric ALS—evaluation

Thank you for participating in this module. As part of our commitment to quality improvement the following questionnaire will be used to plan future implementation of this module. We appreciate your time completing this evaluation.

1. Overall

How would you rate this module?

☐ poor ☐ fair ☐ good ☐ very good ☐ outstanding

2. Learning objectives

Please consider whether this module was successful in meeting the following learning objectives:

ALS paediatric Learning objectives of Module 5: Complex ALS	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Reviewed the Australian Resuscitation Council (ARC)paediatric ALS Guidelines[1]	☐	☐	☐	☐	☐
Practised paediatric ALS on a simulated patient as a team member in a simulated difficult clinical setting	☐	☐	☐	☐	☐
Reflected on their ability to problem solve and communicate effectively under stress	☐	☐	☐	☐	☐
Recognised factors that influence team performance in crisis situations	☐	☐	☐	☐	☐

3. Important learning outcomes

What are the three most important things you have learned from this module?

4. Module implementation

Please indicate to what extent you agree or disagree with each of the following statements in relation to the implementation of the module.

	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
The facilitator respected my experience	☐	☐	☐	☐	☐
The facilitator encouraged my participation	☐	☐	☐	☐	☐
I was able to ask the facilitator questions	☐	☐	☐	☐	☐
The facilitator was able to answer my questions	☐	☐	☐	☐	☐
The feedback I received was clear	☐	☐	☐	☐	☐
The feedback I received will assist me in my future performance	☐	☐	☐	☐	☐
There was adequate time for the skills stations	☐	☐	☐	☐	☐
There was adequate time for the facilitated discussions	☐	☐	☐	☐	☐
There was adequate time for the simulations	☐	☐	☐	☐	☐
I have increased my confidence in performing paediatric ALS	☐	☐	☐	☐	☐
I have identified future learning needs in this topic area	☐	☐	☐	☐	☐

5. Future module implementation

Do you think the module should be altered in any way? ☐ yes ☐ no

If yes, what recommendations do you have?

Thank you

PowerPoint presentation

1.

Clinical Skills in Hospitals Project

Advanced Life Support (ALS) ADULT MODULE 5 'Complex Paediatric ALS'

A Victorian Government Initiative

2.

Module Outline

- Discussion
- Simulation
  - Debrief
- Simulation
  - Debrief
- Summation
- Evaluation

3.

Crisis Resource Management

- Know your environment
- Anticipate and plan
- Call for help early
- Exercise leadership
- Communicate clearly
- Use all available information
- Allocate attention wisely
- Distribute workload evenly

4.

Individual Performance

- Experience and knowledge
- Situational stress
- Fatigue, tiredness
- Environment
- Negative life events
- Attitude and personality
- Drug, alcohol use

5.

Effective Teams

- Organisation
- Leadership
- Familiarity
- Designated roles
- Effective communication
- Situational awareness
- Conflict resolution

6.

Effective Leaders

- Clear communication
- Allocation of tasks
- Overseeing management
- Receptive to team input
- Situational awareness
- Prioritisation
- Positive group culture

7.

Effective Communication

- Directed and assertive
- Calm, polite, controlled
- Central relay via leader
- Verification of completed task
- Team awareness

Acronyms, abbreviations and measurements

Acronyms

A/C	assist control
AAFB	acid and alcohol fast bacilli
ABG	arterial blood gas
ACS	acute coronary syndromes
AEDs	automated external defibrillator(s)
AF	atrial fibrillation
AHA	American Heart Association
ALS	advanced life support
AMI	acute myocardial infarction
APO	acute pulmonary oedema
APTT	activated partial thromboplastin time
ARC	Australian Resuscitation Council
ASB	assisted spontaneous breathing
AV node	atrioventricular node
BBB	bundle branch block
BiPAP	bilevel positive airway pressure
BLS	basic life support
BUN	blood urea nitrogen
CABG	coronary artery bypass graft
cath lab	catheterisation laboratory
CE	cardiac enzymes
CHB	complete heart block
CK	creatine kinase
CKMB	creatine kinase Mb
CMV	controlled mandatory ventilation
CNS	central nervous system
COAD	chronic obstructive airways disease
COPD	chronic obstructive pulmonary disease
CPAP	continuous positive airway pressure
CPR	cardiopulmonary resuscitation
CRM	crisis resource management
CVA	cerebrovascular accident
CVC	central venous catheter
CVS	cardiovascular system
CXR	chest X-ray
DIC	disseminated intravascular coagulation
DKA	diabetic ketoacidosis
DKS	Damus-Kaye-Stansel [procedure]

DRABC	D: danger R: response A: airway B: breathing C: circulation
DVT	deep vein thrombosis
ECF	extracellular fluid
ECG	electrocardiogram
ED	emergency department
EMD	electromechanical dissociation
ENT	ear, nose and throat
EPAP	expiratory positive airways pressure
ET	endotracheal
FBE	full blood examination
FFP	fresh frozen plasma
FRC	functional residual capacity
g	gram
GCS	Glasgow Coma Scale
GI	gastro-intestinal
GIT	gastro-intestinal tract
GTN	glyceryl trinitrate
Hb	haemoglobin
HIV	human immunodeficiency virus
HME	heat moisture exchanger
HPS METI	a brand (Human Patient Simulator) of fully automatic, high-fidelity patient simulator
HR	heart rate
I:E ratio	inspiration-to-expiration ratio
ICF	intracellular fluid
ICP	intracranial pressure
INR	international normalised ratio
IO	intraosseous
IPAP	inspiratory positive airways pressure
IPPV	intermittent positive pressure ventilation
IV	intravenous
LBBB	left bundle branch block
LDH	lactate dehydrogenase
LMA	laryngeal mask airway
mA	milliampere
MET	medical emergency team
NBM	nil by mouth

NGT	nasogastric tube
NIMC	national inpatient medication chart
NIPPV	non-invasive positive pressure ventilation
NIV	non-invasive ventilation
NP airways	nasal prong airways
NSEACS	non-ST elevation acute coronary syndrome
NSR	normal sinus rhythm
OP	oropharyngeal airway
OTC	over-the-counter medications
PCA	patient-controlled analgesia
PCI	percutaneous coronary intervention
PEA	pulseless electrical activity
PEEP	positive end expiratory pressure
pH	the measure of the acidity or alkalinity of a solution
PICC	peripherally inserted central catheter
PIP	peak inspiratory pressure
PRVC	pressure regulated volume control
PS	pressure support
PTX	pneumothorax
QRS	wave form seen on electrocardiogram
RA	room air
RBBB	right bundle branch block
RIC line	rapid infusion catheter exchange set
RMO	registered medical officer
rPA	retaplase
RR	respiration rate
RSI	rapid sequence induction
rt-PA	alteplase
RV	right ventricular
SIMV	synchronised intermittent mandatory ventilation
SK	streptokinase
SR	Sinus rhythm
STEMI	ST elevation myocardial infarction
SVC	superior vena cava
TPN	total parenteral nutrition
UWSD	underwater seal drainage
V/Q mismatch	ventilation/perfusion mismatch
VF	ventricular fibrillation
VT	ventricular tachycardia
WCC	white cell count
WOB	work of breathing
WPW	Wolf-Parkinson-White syndrome

Chemical formulae

$CaCl_2$	calcium chloride
CO_2	carbon dioxide
$ETCO_2$	end-tidal carbon dioxide
FiO_2	fraction of inspired oxygen
H_2CO_3	bicarbonate
$MgCl_2$	magnesium chloride
$MgSO_4$	magnesium sulphate
$PaCO_2$	partial pressure of carbon dioxide in arterial blood
PaO_2	partial pressure of oxygen in arterial blood
SpO_2	percentage of oxygen saturation in blood
SaO_2	saturation of oxygen in arterial blood flow

Units of Measurement

abbreviation	unit
mmHg	millimetres of mercury
L	litre
mL	millilitre
µg	microgram — one-millionth (10-6) of a gram
mmol	millimole
J	joule
mg	milligram
cm	centimetre
m	metre