ADVANCED LIFE SUPPORT (ALS)

EDUCATION PACKAGE

Oct 2013

This publication assists the preparation of Medical Officers and Registered Nurses for Advanced Life Support Competency Assessment.

Edition 10a
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This document is written by Bendigo Health Nurse Educators and endorsed by the Bendigo Health Resuscitation Committee.

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Dedicated to the memory of:

Julie Macdonald (1961-2002)

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For Bendigo Health staff, additional copies of this document can be downloaded from the Bendigo Health intranet by following the links to Research and Education  Upcoming Education Events  ALS Education Package
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1. INTRODUCTION

Preamble
This Advanced Life Support education package will assist the preparation of healthcare professionals for the practice of Advanced Life Support (ALS). It should be used in conjunction with skills tutorials to develop competency. The material contained herein is comprehensive but not exhaustive and is compiled to comply with Australian Resuscitation Council (ARC) Guidelines and the Bendigo Health Clinical Policy and Procedure Manual. The entire collection of ARC Guidelines can be accessed at www.resus.org.au

This educational material has been collated based on the available scientific literature, with the intention of accuracy and best practice at the time of publication. Therefore, the skills and knowledge gained from this will have a high degree of portability. The information is of general application but clinicians should take individual circumstances into account in practice.

Rationale
Healthcare professionals respond to a variety of life threatening emergencies in diverse clinical settings. There is an expectation that Registered Nurses and Medical Officers who care for the critically ill, will provide Advanced Life Support in addition to Basic Life Support (BLS). Although the Australian Resuscitation Council states (1) that “any attempt at resuscitation is better than no attempt” (ARC Guidelines, Dec 2010), healthcare professionals are expected to provide evidence-based, high quality Basic and Advanced Life Support.

Definition of Advanced Life Support (1)
The Australian Resuscitation Council defines Advanced Life Support as:

The provision of effective airway management, ventilation of the lungs and production of a circulation by means of techniques additional to those of basic life support. These techniques may include, but not be limited to, advanced airway management, tracheal intubation, intravenous access/drug therapy and defibrillation.

(Australian Resuscitation Council Foreword to Guidelines, pg. 1, December 2010).

Aim (2)
All healthcare professionals will demonstrate BLS competency for infants, children and adults, with the inclusion of training in the use of AED’s (Automated External Defibrillators). In addition, Medical Officers and Registered Nurses, who provide care for critically ill patients, will demonstrate ALS competency.

Program Objectives (1, 2, 3)
After completing the Adult ALS program, the candidate will be able to:
- Prioritise steps in the management of a collapsed person using the DRSABCD approach, integrating BLS and ALS protocols
- Conduct a situational assessment and manage Dangers
- Assess patient Responsiveness
- Send for help, demonstrating an understanding of the roles of members of the resuscitation team
- Assess and manage the victim’s Airway, including the use of airway adjuncts and assistance with endotracheal intubation or laryngeal mask insertion.
- Assess and manage the victim’s Breathing, including resuscitator bag use
- Assess and manage the victim’s Circulation including diagnosis of cardiac arrest arrhythmias and life threatening pulsatile cardiac arrhythmias (VT, VF, Asystole, PEA, SVT and bradycardia)
- Perform chest Compressions
- Demonstrate use of an AED if applicable to the workplace
- Demonstrate safe manual Defibrillation
- Demonstrate applied knowledge of first line drugs used in cardiac arrest and life threatening pulsatile cardiac arrhythmias
- Provide immediate post-event care
- Adhere to Occupational Health & Safety legislation
- Be aware of legal and ethical issues associated with resuscitation
- Provide a safe environment, i.e. Assembly and/or checks of equipment contained in the resuscitation trolley

Additions to Adult ALS competency, for senior clinicians, include:
- Demonstration of synchronous cardioversion competency
- Demonstration of transcutaneous pacing competency
- Demonstration of advanced paediatric life support competency

Program Delivery
The options available for undertaking this program include:
- Self-directed learning utilising this package, the ‘Bendigo Health Advanced Life Support (ALS) Education Package’
- Participation in Bendigo Health ALS education sessions
- Workplace tutorials conducted by Bendigo Health ALS assessors

Program Information
Specific information related to program booking, tutorial appointments and competency assessment appointments is available from Clinical Educators. Candidates should contact a Clinical Educator for more information.

ALS Competency Pathways
Participants can attain ALS competency via a number of pathways.
To obtain ALS competency, participants must:
- Possess BLS competency
- Have knowledge of workplace/organisational resuscitation policies
- Complete an ALS competency assessment by a Bendigo Health ALS Assessor
- Registered Nurses (RN’s) must complete an online BLS e-learning package prior to competency assessment and bring a copy of the certificate of completion of the online test to the ALS competency assessment.

Optional:
- Utilisation of this ‘Bendigo Health ALS Education Package’
- Attendance at education sessions and tutorials
Every healthcare professional must refer to specific resuscitation policies that outline essential additional information on the conduct of the resuscitation team in their organisation/work area.

Assessment

In a simulated life-threatening emergency scenario, the candidate will be assessed in relation to their competency to manage the patient with pulsatile life threatening cardiac arrhythmias and cardiac arrest. Candidates will demonstrate BLS (Appendix A) including the use of adjunctive equipment eg. Resuscitator bags (Appendix B) and AED’s. Candidates will also demonstrate Adult ALS skills (Appendix C). The competent demonstration of

- synchronous cardioversion,
- transcutaneous pacing and
- paediatric advanced life support skills

is a requirement of senior clinicians (eg. Medical Registrar, Critical Care qualified RN’s) and is optional for other Adult ALS competency candidates.

Competency will be demonstrated under the supervision of a Bendigo Health ALS Assessor. The performance will be recorded as “competent” or “not yet competent”.

Approximately one hour should be set aside for the assessment.

Articulation

Successful Basic Life Support competency is a pre-requisite for entrance into the Advanced Life Support Competency Program.

References Section 1.

2. BASIC LIFE SUPPORT

Overview
Basic Life Support (BLS) is a temporary measure to maintain ventilation and circulation until advanced treatments can be implemented. Adjunctive equipment is not essential for BLS. In this section, the indications for commencing Cardiopulmonary Resuscitation (CPR), the steps of assessment and the initiation and performance of CPR are presented. Additional information is presented that will assist Advanced Life Support healthcare professionals implement care.

DRSABCD of Resuscitation \(^{(1, 2)}\)

The management of the collapsed person involves:

1. Checking for Danger to self and others
2. Checking for Response of the patient
3. Sending for help
4. Prioritising care:
   - Airway
   - Breathing
   - Compressions
   - Defibrillation
5. Preventing further injury
6. Protecting the patient from the environment
7. Maintaining normal body temperature
8. Reassuring the patient
9. Continually observing the collapsed patient

It is important to keep calm and adhere to DRSABCD!

D. Danger \(^{(1, 2)}\)

Quickly check for dangers to the patient and rescuers.

In some instances it will be necessary to remove the source of danger before further care can commence.

eg. live electricity
    firearms
    needles
    body fluids

Rescuers are required to adhere to standard precautions, eg. don protective gloves and other apparel \(^{(3)}\).
R. Response

To determine if the patient is conscious or unconscious, check the response to a loud verbal stimulus. If no response, then squeeze the shoulders firmly. Tactile stimulation should not exacerbate or cause injury.

A patient is managed as unconscious if they fail to respond (or respond only with minor responses such as groaning) to a verbal or tactile stimulus.

S. Send for help

The rescuer should send for help

It may be possible to summon help by shouting or buzzing an emergency bell 3 times, calling a Code Blue by telephone or summoning the ambulance service as appropriate to the specific work area.

If conscious, allow the patient to adopt a position in which they are comfortable, continue to observe and check DRSABCD.

A. Airway

When a victim is unconscious, all muscles are relaxed. The tongue, which is attached to the back of the jaw, falls against the back wall of the throat and blocks air from entering the lungs. The mouth falls open but this tends to block rather than open the airway.

It is essential to use positioning to achieve a clear airway.

A jaw thrust and a head-tilt/chin lift (‘sniffing’ position) are illustrated (Fig. 1). Gently tilting the head back and thrusting or lifting the lower jaw forward achieves this.

Fig. 1. Ensure a clear airway
Infants (i.e. children less than one year of age) have narrow upper airways that are more easily occluded than adults. The trachea is soft and pliable and may become distorted with excessive backward head tilt or jaw thrust. Airway support is provided with jaw support and neutral head alignment (Fig. 2).

The rescuer places their hand closest to the infant’s head on infant’s forehead, then places index finger of the opposite hand on the point of the infants chin, lifting upward with the index finger, gently tilt the head back until neutral alignment is attained. There must be no pressure on the soft tissues of the neck. Maximum backward head tilt must not be used in infants.

![Fig.2. Infant head supported in neutral alignment](image)

Absence of a Clear Airway \(^{1,2}\)
Recognised by: Absent or noisy breathing
Causes:

**Tongue:** The most common cause of a blocked airway in the unconscious patient is the tongue. Any condition that leads to unconsciousness or loss of tone in the muscles of the jaw can cause the tongue to fall back towards the back of the pharynx and obstruct the airway.

**Foreign material:** Semi-solid material (eg. food, vomit) can block the airway.

**Other causes:** Laryngeal spasm, swelling or injury to the airway

In all age groups fluid can be cleared from the airway with the use of suction. If suction is not available or more particulate matter needs to be cleared, a finger sweep can be used. In the absence of suction, it may be necessary to quickly roll the patient onto their side, e.g. following a near drowning or where the airway is obstructed with vomit, blood or other material. However, it is not necessary to routinely roll all victims onto their side.

![Fig.3. Clearing the airway if obstructed by fluid and if no suction is available.](image)
**Oropharyngeal Airway (OPA), or “Guedel Airway” for Adults** (1, 4)

An OPA may sometimes be required to achieve or maintain an open airway. However the device should only be used in moribund patients as laryngospasm or vomiting may result from OPA insertion in a patient with an intact gag reflex.

The OPA conforms to the shape of the palate. When inserted in the unconscious patient, it can assist in maintaining a clear airway by preventing obstruction by the tongue of the posterior pharynx. This enables the passage of gases through and around the tube, and facilitates suctioning.

**Inserting an adult oropharyngeal airway**

Select an appropriately sized OPA. An oversized tube could obstruct the airway by depressing the epiglottis. The tongue could obstruct a tube that is too small.

Average adult: size 3-5

The correct size can be confirmed by placing the tube at the side of the cheek and ensuring it is level with the front of the teeth and reaches the angle of the jaw.

![Fig. 4. Insertion of the OPA in adults](image)

The airway should be inserted ‘upside down’ and it is then rotated as it nears the posterior wall of the pharynx, so that it points downward.

**OPA for the infant or young child** (5)

An OPA may be used for the unconscious child with an impaired gag reflex to relieve obstruction from the tongue. It may also be useful in maintaining an open airway during bag-mask ventilation.

Determine the size by placing the device next to the child’s face with the flange at the level of the teeth. The tip of the airway should end at the angle of the jaw (Fig. 5). A size that is too small may push the tongue into the oropharynx and a size that is too large will obstruct the trachea. Insert the airway using a tongue depressor to displace the tongue forward. Insert the airway curve down (‘right way up’), over the tongue. Do **not** insert the airway in the inverted position and rotate, as in the adult, as it may traumatize the soft tissue structures of the oropharynx and damage the teeth. (For older children, insert the OPA as per adult method.)
Fig. 5. Measuring & placement of the young child's oropharyngeal airway

**Nasopharyngeal Airway (NPA) Insertion**

Soft plastic NPAs are useful for patients with jaw clenching or oral trauma. They are as effective as OPAs for obtaining or maintaining a clear airway. Nasal airways are contraindicated in patients with known basal skull fractures or obvious nasal trauma. Select an appropriate sized airway, usually the largest which will fit in the patient's nostril. Lubricate tip and insert gently into nostril with the bevel facing the septum. Rotate tube as it reaches the hypopharynx so it sits as shown (Fig. 6).

![Fig 6. Position of nasopharyngeal airway](image)

**B. Breathing**

The next step is to assess whether or not the patient is breathing effectively. **LOOK** for the movement of the upper abdomen or lower chest. **LISTEN** for escape of air from the nose and mouth. **FEEL** for movement of the chest and upper abdomen.

If breathing:
Care for the patient in a lateral position, with the head in a backward tilt and the jaw supported to keep the airway open (Fig. 7). Remain with the patient and continuously check for breathing. A stable position is provided without rotation of the neck.

![Fig 7. Positioning of the breathing, unconscious patient](image)
If not breathing, or only taking an occasional gasp, commence CPR!

If the victim is unresponsive and not breathing normally after the airway has been opened and cleared, the rescuer must immediately commence chest compressions and then rescue breathing. Give 30 compressions and then two breaths allowing about one second for each inspiration.

Even if the victim takes occasional gasps, rescuers should suspect that cardiac arrest has occurred and start chest compressions.

The delivery of chest compressions is described in the next section.

Having commenced compressions, rescue breaths may be delivered by the mouth-to-mask method, or by using a resuscitation bag, as follows.

**The Mouth-to Mask Method**

The mouth-to-mask method of rescue breathing avoids mouth-to-mouth contact by the use of a resuscitation mask, eg. Concord mask. This is used in preference to mouth-to-mouth rescue breathing as the risk of infection transmission is reduced. This is further improved by the use of a bacterial/viral filter (Fig. 8).

Failure to maintain a backward head tilt and jaw thrust is the most common cause of airway obstruction during resuscitation.

Position yourself at the patient’s head, maintain a backward head tilt and chin lift. Place the narrow end of the mask at the top of the bridge of the nose. A lack of a seal around the mask will allow an air leak. Apply firm, even pressure around the rim of the mask. Hold the mask firmly against the face by gripping the fingers under the jaw and placing the thumbs over the mask.

When available it is important to add oxygen to the mask. This is achieved by quickly placing oxygen tubing under the rim of the mask and setting the oxygen flow at the maximum rate.

The mouth of the rescuer should be removed from the port of the mask to allow the patient to exhale. The rescuer should observe the rise and fall of the patient's chest.
Resuscitator Bag Method (1, 4)

Laerdal resuscitator bags and disposable resuscitator bags are available for use at Bendigo Health. Healthcare professionals who use resuscitator bags must be able to check the correct function of the device (Appendix B).

The resuscitator bag has a face-mask, (but it can also be attached to an endotracheal tube or a tracheostomy tube if the mask is removed). It is preferred that oxygen is attached to the bag and set at maximum flow so that 100% oxygen is delivered. Even if no oxygen is available, the resuscitator bag can still be used.

While using a resuscitator bag and mask, the rescuer has the challenge of performing three tasks:
- Maintaining a patent airway
- Ensuring a tight face seal
- Ventilating the patient

If any of these tasks is inadequately performed, inadequate patient ventilation will occur. An oral or nasopharyngeal airway may assist in the maintenance of a clear airway.

The mask is applied to the patient’s face. The index finger of the rescuer holds the portion that covers the chin. The top of the mask is held firmly against the top of the bridge of the nose by the thumb. Pushing down ensures a good seal. The other three fingers grip the base of the jaw, lifting it forward. In adults the head is held carefully in the tilt position. The other hand slowly squeezes the resuscitator bag. The rescuer’s finger and thumb should meet when squeezing the bag (Fig. 9) in order to deliver a tidal volume of approximately 500ml.

If a tight seal cannot be obtained, the rescuer may use both hands to ensure a seal, while the bag is squeezed by another rescuer (Fig. 10). In this instance, it is essential that a chin lift/ head tilt be maintained.

When proper ventilation is being administered, the chest will be observed to gently rise and fall with each squeeze of the bag.

If the patient is breathing spontaneously, a resuscitator bag may be used for oxygen delivery. When this occurs, the mask must be applied with a snug seal against the face and the “duck-bill” valve must be observed to open during inspiration.
Mouth-to-mouth rescue breathing (3)
Healthcare professionals must observe Standard Precautions in relation blood and body fluids. As such, it is not mandated that they provide mouth-to-mouth rescue breaths.

Stomach Distension (1)
Distension of the stomach occurs when the rescuer blows too hard or when the airway is partially obstructed and air enters the stomach rather than the lungs. Do not apply pressure to the stomach.

If regurgitation of stomach contents occurs, suction should be used when available to clear the airway. Alternatively, turn the patient laterally and clear the airway. Reposition the patient and continue resuscitation as before.

The Patient with a Tracheostomy (6)

In the event of collapse of any patient with a tracheostomy:
Check for breathing by listening and feeling for the escape of air from the tracheostomy or stoma.
Watch for any movement of the lower chest and upper abdomen.
If laboured / paradoxical breathing, exclude obstruction of the tracheostomy and clear it by:
  - Turn onto back and suction the tracheostomy
  - Turning patient on their side to clear the stoma.
  - Wipe away any mucus from the tube / stoma using a tissue.
  - Remove any visible valve from an external tracheostomy tube (if indicated)

If patient not breathing:
Connect resuscitation bag (without mask) to tracheostomy tube and ventilate patient. If tracheostomy tube seems blocked and patient cannot be ventilated, remove tracheostomy tube and replace. If patient has an intact upper airway, cover stoma and continue BLS via usual methods.

Points of emphasis for a patient with a laryngectomy & permanent tracheostomy:
A patient who has undergone laryngectomy (removal of the larynx) breathes through a permanent stoma. The upper airway is no longer used and has no anatomical connection to the trachea and lungs, therefore rescue breaths must occur via the stoma.

C. Compressions / CPR (1)

Indications for Chest Compressions (1)

- Rescuers should start chest compressions for all victims who are unresponsive and not breathing normally.
- Even if the victim takes occasional gasps, rescuers should suspect that cardiac arrest has occurred and start chest compressions.
The routine check for a carotid pulse is no longer an essential step for providing Basic Life Support. This is because evidence suggests that rescuers are often unable to determine the presence of a pulse with accuracy.

Most victims requiring resuscitation have had a cardiac arrest. Chest compressions are vital. Giving compressions if the victim has a beating heart is highly unlikely to cause harm.

However, for healthcare professionals in certain clinical settings, the pulse check is still considered an essential part of patient assessment \(^{(4)}\). For example, the patient may have received a sedative or anaesthetic drug and is unresponsive and not breathing normally. This requires expert professional care, e.g. for the support of breathing. If the patient clearly has a strong pulse they do not require chest compressions.

Therefore, healthcare professionals in these special settings may briefly palpate for the presence of a carotid pulse (i.e. in less than 10 seconds).

The important message regarding the pulse check, is that precious seconds must not be wasted searching for a pulse when a patient is unresponsive and not breathing normally and urgently needs chest compressions.

**Pulse check in special settings** \(^{(7)}\)

To assess the carotid pulse, place 2 or 3 fingers gently on the 'Adam's Apple', then slide the fingers laterally. Feel with the flat portion or the pulps of the fingers. Do not block the carotid artery by applying too much pressure. It may be necessary to palpate for a carotid pulse for a maximum of 10 seconds. It is important that only one carotid artery is palpated at a time. If no clear pulse is found, commence chest compressions.

**Fig.11. Carotid pulse check in special settings**

If the patient is unresponsive and not breathing normally (and/or has no carotid pulse) commence chest compressions.

**Technique for performing chest compressions** \(^{(1)}\)

- The patient must be positioned on their back on a firm surface.
The rescuer is positioned comfortably alongside the patient's body, so that vertical pressure can be applied. If the patient is on a bed or trolley, the rescuer will almost always need to kneel on the mattress to achieve the correct posture above the patient.

Direct visualisation may be used to locate the compression point on the lower half of the sternum. Avoid compression beyond the lower limit of the sternum.

All pressure is exerted vertically through the heels of the hands (Fig. 12). The rescuer's body weight is the compressing force. The shoulders should be vertical over the sternum and the compressing arms are kept straight. The heel of the hand remains in contact with the lower half of the sternum so that the correct position is maintained. Compressions should be rhythmic, with equal time for compression and relaxation. The rescuer must avoid rocking backwards and forwards or using thumps or quick jabs.

Rescuers should allow complete recoil of the chest after each compression.

Infants (less than one year old)
- Direct visualisation is used to locate the lower half of the sternum.
- After locating the compression point, the rescuer places the pads of two fingers on that point and compresses the chest (Fig. 12).

Children and Adults
- Direct visualisation is used to locate the lower half of the sternum
- Either a one or two hand technique can be used for performing chest compressions in children (Fig. 12).

Depth of Compression (all age groups) *(1)*

The lower half of the sternum should be depressed by one third of the depth of the chest with each compression (Fig. 13). This equates to more than 5cm in adults, approximately 5cm in children and 4cm in infants.
Rate of Chest Compressions (all age groups) \(^{(1)}\)

Rescuers should perform chest compressions for all ages at a rate of approximately **100 compressions per minute**.

**Cardiopulmonary Resuscitation (CPR)** \(^{(1)}\)

The combination of rescue breaths and chest compressions is known as CPR (cardiopulmonary resuscitation).

**Compression-Ventilation Ratio** \(^{(1)}\)

A universal compression-ventilation ratio of 30:2 (30 compressions followed by 2 ventilations) is recommended for all ages.

Compressions must be paused to allow for ventilations (except if an endotracheal tube is in situ). Compressions must only be paused for a very short time; for **2 breaths of 1 second each**.

Evidence suggests that hyperventilation may increase intrathoracic pressure and decrease venous return impeding resuscitation efforts. Do not deliver too many rescue breaths.

For infants and children only, with two healthcare rescuers present, the compression-ventilation ratio of 15:2 may be performed.

**Compression only CPR** \(^{(1)}\)

When a rescuer is unable or unwilling to perform rescue breaths, they must perform chest compressions at a rate of approximately 100/minute.

**Change over between two rescuers during CPR** \(^{(1)}\)

- One of the two rescuers indicates readiness or need to change.
- The rescuers must change over smoothly with minimal interference to the resuscitation procedure.
- The rescuer performing rescue breathing, having given a rescue breath, moves down to the victim’s side ready to take over compressions. The sequence of 30 compressions to 2 inflations is maintained.
• The change over can be done at the time of rhythm analysis or defibrillation.
• Frequent rotation of rescuers is undertaken (approximately every 2 minutes) to reduce fatigue.

**Minimise interruptions to CPR**  
Evidence has demonstrated that interruption of chest compressions is associated with poorer return of spontaneous circulation and lower survival rates and that both lay people and health professionals experience difficulty in determining presence or absence of pulse in collapsed victims. Therefore, rescuers should **minimise interruptions of chest compressions** and CPR should not be interrupted to check for a pulse.

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**D. Defibrillation**  

**The Automated External Defibrillator (AED)**

In the event of cardiac arrest, the use of AED’s to analyse the electrical rhythm of the heart is an essential element of BLS. AED’s accurately identify the cardiac rhythm as ‘shockable’ or ‘non-shockable’ and provide the operator with audible or visual prompts on actions required for the delivery of a shock, if required.

The importance of early defibrillation to survival is clearly established.

AEDs are now available in many public places where large crowds gather, and are often present in healthcare facilities. Clear signs indicate the presence of an AED (Fig. 14).

![AED sign](Fig.14. AED sign)

Many healthcare facilities possess large manual defibrillators (Fig.15) that have an AED mode that should be used by BLS rescuers.

![Manual / Automated External Defibrillator](Fig. 15. Manual / Automated External Defibrillator)
Many brands of AED are available for use (Figs. 16, 17).

Fig. 16. Powerheart AED  Fig. 17. Philips AED

Promptly apply an AED to patients in cardiac arrest. The patient will be unresponsive and not breathing normally.

AED Instructions for Use \(^1, 6, 8\)

1. **Turn AED ON**
   Follow machine instructions.

2. **Apply chest pads**
   Every effort should be made to minimize interruptions to cardiac compressions.
   Adhere pads firmly to the victim’s exposed chest as indicated on the packaging in an anterior-lateral position (Fig. 18). Connect chest pads to the machine as indicated on the machine.

Fig. 18. Applying AED chest pads

Acceptable alternative positions are the anterior-posterior and apex-posterior positions. In large breasted individuals it is reasonable to place the left electrode pad lateral to or underneath the left breast, avoiding breast tissue.

Pad to skin contact is important for successful defibrillation. There may be a need to rapidly remove moisture or excessive chest hair prior to the application of pads. **Avoid placing pads over implantable devices (eg. pacemaker) or medication patches. Do not place pads over ECG dots or leads.** This increases the risk of poor contact.

Healthcare professionals should check the suitability for younger children, where the AED is available in the workplace.
At Bendigo Health, the Code Blue Team Nurse Coordinator from Intensive & Coronary Care will provide pads suitable for infants and children when required. If these are not available, adult AED pads should be used.

3. Machine Use
- The AED will instruct “Analysing heart rhythm, stay clear of patient”. CPR must be paused while the machine analyses whether the patient requires a shock.
- Ensure self and ALL OTHERS are clear of the patient during analysis by the machine.
- The AED will prompt the rescuer to either check patient and recommence CPR if no shock is advised, OR ‘Shock advised, charging, stay clear of patient, deliver shock now, press the orange button now”….. or similar.
- ALWAYS vocalise the intent to discharge a shock. State ‘STAND CLEAR’ in a loud voice and visually check that all present are clear of the patient and the bed, before pushing the ‘Shock’ button. The rescuer must push the flashing button to deliver the shock.
- Recomence CPR immediately after delivery of a shock.

Safety
Care should be taken not to touch the victim during shock delivery.
There are no reports of harm to rescuers from attempting defibrillation in wet environments. In the presence of oxygen, there are no case reports of fires caused by sparking when shocks were delivered using adhesive pads. However, rescuers should avoid having the victim in contact with metal fixtures, avoid defibrillating in a flammable environment (e.g. petrol) and avoid allowing oxygen from a resuscitator bag to flow over the victim's chest during shock delivery.

If a shock is to be delivered, all rescuers must stand clear until this has occurred. The healthcare rescuer must advise all people to “stand clear” and ensure a safe environment.

It is important to note that the AED sometimes does NOT advise that a shock should be delivered. Some types of cardiac arrest do not require a shock. Follow the machine prompts and recommence CPR if required.

Precordial thump
A precordial thump is a single sharp blow delivered by the rescuer’s fist to the mid sternum of the victim’s chest.
When a monitored pulseless ventricular tachycardia (VT) arrest occurs (ie. the patient is connected to a cardiac ECG monitor), if defibrillation is not immediately available, a single precordial thump may be indicated.

The precordial thump should not be used for unmonitored, unwitnessed arrest.

Cycles of CPR
Each cycle (or loop) of CPR consists of approximately 2 minutes of CPR followed by brief analysis of whether a shock is required, before recommencing CPR. Interruptions to CPR must be minimised.
After every 2 minute cycle of CPR, analysis by the AED must occur.

**Recovery** *(1)*
If the patient can breathe for themselves, is moving or responsive and has a pulse:
- turn them to the left lateral position,
- continually check airway, breathing and circulation,
- apply high flow oxygen if available.

BLS measures are recommenced if there is loss of airway, breathing or circulation.

**Resuscitation in Late Pregnancy** *(9)*
Increased abdominal pressure in late pregnancy increases the risk of pulmonary aspiration of gastric contents. During ventilation, chest expansion may be reduced. The uterus of a pregnant woman exerts increased pressure on the inferior vena cava, when lying flat on her back. This reduces venous return to the heart.

Position the pregnant woman (Fig. 19) with her shoulders flat on the floor and **with enough padding under her right buttock to give a pelvic tilt to the left**. If this cannot be achieved, a rescuer may hold the pregnant uterus toward the left side.

![Fig.19. Left-sided pelvic tilt during late pregnancy](image)

In all other respects, the DRSABCD of Basic Life Support and the Advanced Life Support algorithms should be followed as for all adult patients.

**Duration of Cardiopulmonary Resuscitation**
Generally, the rescuer should continue resuscitation measures until:

- **The patient responds or begins breathing normally** *(1)*.
- **There is evidence of a state clearly incompatible with life.**
- **It is impossible to continue** (e.g. due to rescuer exhaustion).
- **Evidence exists of refusal of CPR by a competent patient.** This *may* include a "Form of Refusal of Treatment Certificate" reproduced as Schedule 1, Section 5(2) of the Medical Treatment Act 1988 *(10)*.
- **CPR may be futile** *(1, 11)*. The following factors can be taken into consideration:
  1. **Unresponsiveness** (i.e. no return of spontaneous circulation, ROSC) to resuscitative efforts of more than 20-30 minutes. End tidal waveform C02 reading less than 10mmHg after 20 minutes of CPR.
Full resuscitative efforts, according to protocol, should continue until a clear and final decision has been made to cease resuscitative efforts.

It may be necessary to consult the patient's relatives to ascertain what the patient's wishes would be regarding resuscitation if they could speak for themselves (12). After consideration of all factors, a consensus decision to withdraw active treatment should be reached amongst medical and other healthcare professionals. Relatives must be given explanations of this clinical decision, but the burden of decision-making must not be placed upon relatives.

It is of great importance that clinicians are mindful that cessation of CPR is not withdrawal of care for a patient and family.

Basic Life Support Flow Chart (1)

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Fig.20. Basic Life Support Flowchart
References Section 2.


8. Philips Medical Systems *Heartstart FR2+ Defibrillator Instructions for Use*, 2010


10. ‘The Medical Treatment Act 1988’ [Accessed online via Bendigo Health intranet]


Figures

Fig. 1. International Liaison Committee on Resuscitation ‘Guidelines 2000 for Cardiopulmonary Resuscitation’ *Circulation*. 102(8) Supplement.

Fig. 2. European Resuscitation Council, reproduced in *ARC Guidelines*, Australian Resuscitation Council, Dec 2010.


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Fig. 7 Gleeson, Ray, Original illustration. Bendigo: Bendigo Health, 2001.

Fig. 8. International Liaison Committee on Resuscitation ‘Guidelines 2000 for Cardiopulmonary Resuscitation’ *Circulation*. 102(8) Supplement.

Fig. 9. International Liaison Committee on Resuscitation ‘Guidelines 2000 for Cardiopulmonary Resuscitation’ *Circulation*. 102(8) Supplement.

Fig. 10. International Liaison Committee on Resuscitation ‘Guidelines 2000 for Cardiopulmonary Resuscitation’ *Circulation*. 102(8) Supplement.

Fig. 11. International Liaison Committee on Resuscitation ‘Guidelines 2000 for Cardiopulmonary Resuscitation’ *Circulation*. 102(8) Supplement.


Fig. 16. Grimes, H. Photograph ‘Powerheart G3 PRO AED’, 2007.


Fig. 20. Australian Resuscitation Council *Guidelines*. Melbourne: Australian Resuscitation Council, 2010.
3. ADVANCED LIFE SUPPORT (ADULT)

This section contains information related to the practice of Advanced Life Support (ALS) for adult patients. This includes ALS Flowcharts (Figs. 1, 2, 3 & 4), cardiac rhythm recognition, electrical therapies, ALS pharmacology, advanced airway management and transcutaneous pacing.

All ALS candidates must demonstrate:
- BLS (Appendix A) including the use of adjunctive equipment eg. Resuscitator bags (Appendix B).
- Adult ALS skills (Appendix C).

Senior ALS candidates, (eg. Critical Care qualified Registered Nurses, Medical Registrars) must also demonstrate:
- synchronous cardioversion competency
- transcutaneous pacing competency
- paediatric advanced life support competency

To assist candidates with preparation for ALS competency, the Advanced Life Support Assessment Sheet (Appendix C) and an example ALS scenario (Appendix D) are included.
Advanced Life Support for Adults

Start CPR
30 compressions : 2 breaths
Minimise Interruptions

Attach Defibrillator / Monitor

Shockable
Assess Rhythm
Non Shockable

Shock
CPR for 2 minutes

Return of Spontaneous Circulation ?

CPR for 2 minutes

Post Resuscitation Care

During CPR
- Airway adjuncts (LMA / ETT)
- Oxygen
- Waveform capnography
- IV / IO access
- Plan actions before interrupting compressions
  (e.g. change manual defibrillator)
- Drugs
  - Shockable
    - Adrenaline 1 mg after 2nd shock
      (than every 2nd cycle)
    - Amiodarone 300 mg after 3rd shock
  - Non Shockable
    - Adrenaline 1 mg immediately
      (than every 2nd cycle)
- Consider and Correct
  - Hypoxia
  - Hypovolaemia
  - Hyper / hypokalaemia / metabolic disorders
  - Hypothermia / hyperthermia
  - Tension pneumothorax
  - Tamponade
  - Toxins
  - Thrombosis (pulmonary / coronary)

Post Resuscitation Care
- Re-evaluate ABCDE
- 12 lead ECG
- Treat precipitating causes
- Re-evaluate oxygenation and ventilation
- Temperature control (cool)

December 2010
**Fig.2. Pulsatile Broad Complex Tachycardia (Adult) Flowchart**

1. **PULSATILE BROAD COMPLEX TACHYCARDIA-ADULT**

   - **STABLE**
     - Is the patient stable?
     - Unstable if:
       - Reduced conscious level
       - Systolic BP < 90 mmHg
       - Chest pain
       - Heart failure
       - Heart Rate > 150 /min
     - Check for and treat reversible causes
     - If VT or uncertain broad complex rhythm
       - Amiodarone 300mg IV over 20-60 min, then infusion APP
     - Consider Sedation for synchronised DC shock 70-200J

   - **UNSTABLE**
     - Sedate for
       - Synchronised DC shock
       - Up to 3 attempts
       - 70-200 J
     - Identify and treat reversible causes
     - Amiodarone 300mg IV over 10-20 min
     - Repeat Sync DC shock
     - Amiodarone infusion APP

   - **Patients in cardiac arrest must be treated with CPR and interventions per Advanced Life Support policy.**

   - **For Torsades de pointes, with a pulse, give Magnesium 10mmol IV**

---

Bendigo Health Oct 2013 Advanced Life Support Education Package
Fig. 3. Bradycardia (Adult) Flowchart

- Support ABC’s
- Oxygen
- IV access
- Monitor cardiac rhythm, BP, SpO2
- 12 lead ECG
- Identify & treat reversible causes

**BRADYCARDIA - ADULT**

- BP > 100 systolic & GCS = 15 → Oxygen → Medical review
- HR < 60
  - BP < 100 systolic
  - GCS < 15
  - Heart failure
  - Ventricular dysrhythmias
  - Oxygen
  - Atropine 0.5mg IV every 3-5 min, repeat to a maximum of 3mg
  - Adrenaline infusion start at 2mcg/min APP
  - Consider Pacing
Fig. 4. Regular Narrow Complex Tachycardia (Adult) Flowchart

**REGULAR NARROW COMPLEX TACHYCARDIA**

**ADULT**

- **STABLE**
  - BP > 90 systolic
  - GCS = 15
  - Vagal manoeuvres
    - (Carotid sinus massage performed by M.O. only)
  - Adenosine IV rapid push
    - 6mg, 12mg, 12mg at 2 minute intervals
  - Consider antiarrhythmics:
    - Verapamil 2.5-5mg IV over 2min
    - Dilatazam 15-20mg over 2min

- **UNSTABLE**
  - BP < 90 systolic
  - GCS < 15
  - Chest pain
  - Heart failure
  - While preparing for DC shock, consider:
    - Adenosine IV rapid push
    - 6mg, 12mg, 12mg at 2 minute intervals
  - Sedate for
    - Synchronised DC shock
    - Up to 3 attempts
    - 70-200J
  - Amiodarone 300mg IV over 10-20 min
  - Repeat DC shock
  - Amiodarone infusion APP

*Does not include sinus tachycardia

In the peri-arrest setting, assume broad complex tachycardias are ventricular in origin & follow appropriate algorithm

- **Support ABC’s**
- **Oxygen**
- **IV access**
- **Monitor cardiac rhythm, BP, SpO2**
- **12 lead ECG**
- **treat reversible causes**
The cardiac rhythms of patients in cardiac arrest should be thought of as either “Shockable” or “Non Shockable” (Fig. 1). The rhythms that require treatment with a DC shock (defibrillation) are termed “Shockable” rhythms.

**SHOCKABLE RHYTHMS:**

The shockable rhythms are ventricular fibrillation (VF) and ventricular tachycardia (VT).

**Ventricular Fibrillation (VF)**

Ventricular Fibrillation, commonly called VF (or V-Fib), is an immediately life threatening condition. It produces no effective myocardial contraction. The uncoordinated ventricular muscle quivers, therefore there is no effective cardiac output. Left untreated VF invariably leads to ventricular standstill and death.

**What you see on the monitor:**

- **Rhythm:** indeterminate
- **Rate:** indeterminate
- **Other:** size of fibrillatory waves may be variable (fine → coarse)

**Treatment:**

- Immediate defibrillation is performed in *witnessed, monitored* VT/VF, if a defibrillator is immediately available. If a defibrillator is not immediately available, CPR is performed until a shock is delivered. The rescuer delivers a shock, to the chest of the patient, to produce reversion of the VF, followed by 2 minutes of CPR.
  - Biphasic machines **200 J**
  - Monophasic machines **360 J**
- Rescuers will follow the *Advanced Life Support for Adults* flowchart (Fig. 1) on the ‘shockable’ loop of the chart.
Ventricular Tachycardia (VT)\(^{(1,2,3)}\)

![Ventricular Tachycardia](image)

Fig.6. Ventricular Tachycardia

Ventricular Tachycardia (VT) is defined as three or more Premature Ventricular Contractions (PVC’s) in a row, with a rate above 100 bpm. VT is an unstable rhythm. It can occur in short bursts causing few or no symptoms. Alternatively it may be sustained, becoming symptomatic and causing unconsciousness, loss of cardiac output and death.

**What you see on the monitor:**

- **Rhythm:** Regular or slightly irregular ventricular rhythm
- **Rate:** Ventricular rate of 100 bpm or above.
- **P wave:** absent or obscured by QRS complex
- **QRS complex:** wide and bizarre, duration longer than 0.12 seconds.

**Treatment:**

- Treatment depends on whether the patient’s pulse is detectable.

Therefore:

- A patient with **no palpable carotid pulse** or who is unresponsive and not breathing normally is treated according to the *Advanced Life Support for Adults* flowchart (Fig. 1) on the ‘shockable’ loop of the chart.
- A patient with **a palpable carotid pulse** is treated according to the *Pulsatile Broad Complex Tachycardia – Adult* protocol (Fig. 2).

**In summary, for VT/VF cardiac arrest:**

- CPR → check rhythm is VT/VF & shock → CPR 2min → check rhythm is VT/VF & shock → Adrenaline + CPR 2min → check rhythm is VT/VF & shock → Amiodarone + CPR 2min → Check rhythm is VT/VF & shock → Adrenaline + CPR 2min ……

Rescuers must consider reversible causes, advanced airway, oxygen, waveform capnography and plan actions before interrupting compressions.
NON SHOCKABLE RHYTHMS
The cardiac rhythms that do not require treatment with a DC shock are termed “Non Shockable” rhythms. These non shockable rhythms are asystole and pulseless electrical activity (PEA).

Asystole

Asystole is the absence of myocardial electrical activity and therefore produces no cardiac output. The patient is pulseless and non-responsive. Rapid initiation of CPR and ALS measures is vital.

What you see on the monitor:
Asystole appears as a nearly flat line (except for those changes caused by chest compressions). No electrical activity is evident, although there may be P waves for a time. In a patient with a pacemaker, pacing spikes may be visible on the strip however no QRS complexes follow.

Treatment:
- Assess the patient’s responsiveness, breathing (+/- carotid pulse check).
- Begin immediate CPR.
- Follow the Advanced Life Support for Adults flowchart (Fig. 1) on the ‘non-shockable’ loop of the chart.

Pulseless Electrical Activity (PEA)

Pulseless Electrical Activity (PEA) may also be termed Electromechanical Dissociation (EMD). It exists when there is a coordinated electrical rhythm without a detectable cardiac output. Potential causes must be sought and treated, including hypoxia, hyper/hypothermia, hypovolaemia, hyper/hypokalaemia, pulmonary/cardiac embolus,
tension pneumothorax, cardiac tamponade, toxins, thrombus, acidosis and ventricular rupture.

**What you see on the monitor:**
Organised electrical activity, often bradycardia, will be seen. Each case of PEA is unique and the rhythm seen on the monitor will therefore differ from case to case. However all patients with PEA will have no detectable cardiac output.

**Treatment:**
- CPR
- Identify and treat underlying cause.
- Follow the *Advanced Life Support for Adults* flowchart (Fig. 1) on the ‘non-shockable’ loop of the chart.

**In summary, for non-shockable cardiac arrest:**
Adrenaline + CPR 2min → check rhythm → CPR 2min → check rhythm → Adrenaline + CPR 2min → check rhythm → CPR 2min → Check rhythm → Adrenaline + CPR 2min

……..

Rescuers must consider reversible causes, advanced airway, oxygen, waveform capnography and plan actions before interrupting compressions.

**PULSATILE DYSRHYTHMIAS**

**Bradycardia** (1, 2, 3)

![Bradycardia Image]

*Fig. 9. Bradycardia*

**Bradycardia** is characterised by a ventricular rate below 60 beats per min.

**What you see on the monitor:** QRS complexes at a rate <60 bpm

**Treatment:**
- Assess for responsiveness, breathing +/- carotid pulse check. If absent, define as PEA.
- If the patient has a palpable carotid pulse, establish if bradycardia is associated with patient compromise (assess BP, GCS).
- Follow the *Bradycardia – Adult* protocol (Fig. 3).
Supraventricular Tachycardia (SVT) (1, 2, 3, 4)

Fig.10. Supraventricular Tachycardia

Supraventricular tachycardia (SVT) is a general term that refers to those tachyarrhythmias where impulses originate at or above the AV node. This includes all sinus mechanisms, atrial rhythms and AV nodal rhythms. Narrow complex tachycardias, excluding sinus tachycardia, are treated as per the Regular Narrow Complex Tachycardia – Adult flowchart (Fig. 4). (Broad complex tachycardias are treated as VT until proven otherwise.)

What you see on the monitor:

**Rhythm:** Regular (irregular if rapid AF)

**Rate:** 160-250 bpm

**P wave:** Present, however may not be visible with higher rates

**PR interval:** May be normal, but is difficult to measure

**QRS complex:** If the QRS complex is truly narrow in all 12 leads then the rhythm must be SVT

**Treatment:**
- Per Regular Narrow Complex Tachycardia – Adult protocol (Fig. 4).
Direct Current Reversion

Direct current reversion (DCR) refers to electrical therapies that utilize a direct current, i.e. defibrillation and cardioversion, to treat cardiac arrhythmias \[^{3}\]. All ALS competent healthcare professionals \[^{5}\] must be able to safely perform defibrillation for patients in VT/VF cardiac arrest using a manual defibrillator (Fig. 11). With a manual defibrillator, the rescuer must diagnose the patient’s rhythm \[^{1}\]. (Senior ALS clinicians must also be able to safely perform synchronised cardioversion for pulsatile VT and SVT when indicated \[^{5}\].)

**Fig. 11. A defibrillator that operates in manual or AED mode**

**Factors affecting successful DCR \[^{1,6}\]**

The aim of DCR is to deliver sufficient energy with the lowest possible electrical current that will pass through the chest wall to the myocardium and revert the presenting arrhythmia. Two factors affect current flow through the heart. Successful DCR requires selecting an appropriate energy to generate an adequate current flow. Too much current to the myocardial cells will cause damage to the cells and result in unsuccessful DCR, too little current and the cells will fail to depolarise. Therefore, the ‘threshold’ is the minimum amount of current required to achieve successful DC reversion. The second factor, which effects successful DCR, is thoracic impedance, or resistance to current flow through the body. It is influenced by:

- Energy level selected
- Electrode size
- Pressure applied to electrodes during DCR
- Distance between the electrodes
- The number of shocks the patient has received
- The amount of skin, fat, bone and lungs

**Use of self-adhesive pads or paddles \[^{1}\]**

Self-adhesive defibrillation pads have advantages compared with hand held defibrillation paddles, i.e. pads can be charged during compressions and can be used for transcutaneous pacing.

**Paddle placement \[^{1}\]**

One uncharged paddle/self-adhesive pad is placed on the left mid axillary line over the 6\(^{th}\) intercostal space and the other on the right parasternal area over the 2\(^{nd}\) intercostal space (Fig. 12).
Alternatively, uncharged self-adhesive pads may be placed in the anterior-posterior position (Fig. 13.) where the “sternum” pad is placed anteriorly over the precordium and the “apex” self-adhesive pad is placed posterior to the heart in the infrascapular area.

- Ensure skin is clean and dry
- Paddles require firm pressure applied during DCR to ensure good contact
- If performing DCR on a patient with a permanent pacemaker or implantable cardioverter defibrillator (ICD), if feasible, place the pads or electrodes at least 8 cm from the device generator, as DCR may cause damage to the device. Pacemaker and ICD functions should be checked following DC reversion.

Safety during DCR \(^{(1,6)}\)

- Ensure no flammable material, oxygen, fluids or metal objects are in contact with the patient.
- Do not charge pads/paddles unless they are placed on the victim’s chest.
- Do not place pads/paddles over ECG dots (risk of poor contact, burns or sparks), ECG leads (may melt), medication patches or implantable devices (pacemaker, ICD, portacath, central line).
- Do not deliver shocks with a gap between the paddle and the chest wall (spark hazard).
- Do not discharge or wave paddles/pads in the air whilst charged.
- Do not hold both paddles/pads in one hand or allow them to come into contact with each other.
- Ensure self and all others are clear of danger before discharging.
- Always vocalize intent to charge pads/paddles. State “charging defibrillator, stand clear”, in a loud voice
- When self-adhesive pads are used, CPR can be performed during charging. When paddles are used, all present must be clear of the patient and bed during charging.
• The operator states, “stand clear, shocking” in a loud voice and ensures that CPR has stopped, no one is in contact with the patient and visually checks that all present are clear of the patient and bed
• The operator discharges the shock.

---

**DEFIBRILLATION**

Defibrillation refers to the emergency application of a high energy electrical current applied through the chest to the myocardium in the arrested patient in VT/VF.

Information regarding defibrillation using an AED was discussed in Section 2. ‘Basic Life Support’. However, defibrillation can also be achieved manually by an ALS competent operator.

The aim of defibrillation is to produce a simultaneous depolarisation of all the rhythm generating and transmitting cells within the heart allowing one of the normal, “intrinsic” pacemakers to take over and re-establish a stable rhythm\(^{(1,6)}\).

**Indications**\(^{(1)}\)
In accordance with the Advanced Life Support for Adults Flowchart (Fig. 1), defibrillate:

- Ventricular Fibrillation (VF)
- Pulseless Ventricular Tachycardia (VT)

**Background**\(^{(1)}\)
A key factor that influences the patient’s chances of survival is the time to defibrillation.

**Energy levels**\(^{(1)}\)

*Biphasic machines: 200J*

*Monophasic machines: 360J*

(Other energy levels may be used where a manufacturer of a defibrillator can demonstrate adequate shock success, in line with ARC requirements.)

Lower energy levels used with biphasic shocks have been shown to have at least an equivalent success rate in terminating VF compared with monophasic shocks.

**Sequence for defibrillation**\(^{(1,8)}\)
In VT/VF, CPR must be commenced immediately. As soon as a defibrillator becomes available, the rescuer delivers a single shock. CPR must be provided if there is a delay obtaining a defibrillator. The shock is followed by 2 minutes of CPR, regardless of the rhythm. If still in VT/VF, single shocks are delivered every 2 minutes. Effective BLS will increase the likelihood of successful defibrillation.

Every patient in VT/VF must receive cycles of 2 minutes of CPR followed by a single shock (Fig. 14).

During CPR, ALS interventions such as adrenaline (a vasopressor) and antiarrhythmic drugs are given and causes of arrest are sought and treated.
It is important to note that when using paddles it is not possible to perform CPR while the defibrillator is charging, as the paddles are charged on the patient’s chest. However, it is possible to perform CPR while, self-adhesive pads are charging, but it is essential that the rescuer using the defibrillator ensures that all rescuers stand clear prior to discharge of the shock!

It is imperative that there is minimal interruption to chest compressions.

**DEFIBRILLATION TECHNIQUE**

Confirm the patient is unresponsive and not breathing normally

↓

Place self-adhesive pads in the appropriate position

(or use gel pads and paddles)

↓

Turn defibrillator on and analyse rhythm

Call- “Stand clear assessing rhythm”,

Assess if the rhythm is shockable (VT/VF)

(Ensure machine is not in the synchronised mode.)

↓

If shockable rhythm detected

↓

Check that the area is free from danger

(Patient not in contact with metal fixtures, pools of fluid, not defibrillating over ECG dots)

↓

Indicate your intention to charge only

Call – “Charging Defibrillator”

(If self-adhesive pads are used, CPR continues. If paddles are used, CPR must stop.)

↓

Charge the defibrillator

↓

If shockable call “Shockable Rhythm, Stand Clear, Shocking”

Scan the bed area to ensure that all rescuers are clear of the bed and are not in direct contact with the patient.

↓

Discharge the shock for VT/VF

↓

Commence CPR, regardless of rhythm

It is vital that 2 minutes of CPR commence after delivery of shocks, regardless of the rhythm. The patient is then reassessed and treatment is directed as necessary.

Performing compressions on a victim with a beating heart is unlikely to do harm. Indeed, most victims will have a non-perfusing rhythm for the first minutes after successful defibrillation. Therefore, 2 minutes of CPR is required after defibrillation.

Failure to defibrillate

- Recomence CPR
- Check pad connections are firm
- Check paddle/pad position
- Check that there is adequate skin contact
- Consider changing the defibrillator gel pads
- Check for flat battery, plug into power source
- Check that the synchronise mode has not been activated for defibrillation
- Check for lead fracture
- If using disposable self-adhesive pads check the expiration date and avoid using damaged pads.
- Check that excessive chest hair is removed prior to applying pads or electrodes. This helps improve contact and reduce thoracic impedance.

Consider:
- Anterior/posterior paddle placement
- Acidosis
- Electrolyte imbalance
- Hypothermia
- Hypoglycaemia
- Digoxin toxicity
- Prolonged arrest

**CARDIOVERSION**

Cardioversion (2,3) refers to the application of an electrical shock to the myocardium. However, rather than the electrical current being applied at a random point in the cardiac cycle, it is **synchronised** with the patient’s R-wave on the ECG waveform. There is a danger that if DC reversion is applied during the vulnerable repolarization period of the cardiac cycle (i.e. period that immediately precedes the apex of the T wave) it may trigger ventricular fibrillation! By synchronizing the shock with the R-wave of the patient’s ECG, this vulnerable period may be avoided. Synchronisation with the ECG can be achieved by applying the defibrillator monitor leads to the patient or by using a “slave cable” (auxiliary cable) between the cardiac monitor and the defibrillator. The patient’s ECG must be visible on the defibrillator monitor in order to synchronise.

**The machine must be synchronous with the R-wave to safely revert pulsatile VT and SVT.**

**Indications** (2,3)
- Pulsatile VT (Refer to Fig. 2)
- Atrial fibrillation (Refer to Fig. 4)
- Atrial Flutter (Refer to Fig. 4)
- Supraventricular tachycardia (Refer to Fig. 4)

As the patient usually remains conscious with these arrhythmias, adequate sedation **must** be delivered prior to the procedure.
Fig. 14. Successful cardioversion

Contraindications (3, 7)
- Hypo/hyperkalaemia
- Complete heart block
- Sick sinus syndrome
- Digoxin Toxicity
- Chronic AF (> than 6 months duration)

Energy levels (2)
Energy levels are prescribed by the senior treating doctor and usually fall into the ranges below.

Energy Levels:
- VT with a pulse: 70 – 200J up to 3 attempts
- SVT: 70 – 200J up to 3 attempts

CARDIOVERSION TECHNIQUE

1. Informed consent (when appropriate)
2. Turn on the defibrillator and ensure ECG trace appears on screen
   - Either attach chest leads or "slave" the cardiac rhythm from the cardiac monitor
3. Engage synchronisation mode by pressing the “sync” button
4. Confirm synchronisation mode by looking for markers on the R-wave.
   - If markers do not appear on R-waves, adjust the amplitude, change electrode placement or lead selection until R-waves are accompanied by a marker.
5. Ensure sedation & airway management
6. Position self-adhesive pads or gel pads & paddles.
7. Select energy level
8. Check that the area is free from danger
   - Patient not in contact with metal fixtures, pools of fluid
9. Indicate your intention to cardiovert
   - Call – “Charging to … joules, Stand Clear”
10. Charge the defibrillator and scan the bed area to ensure that all staff are clear of the bed and are not in direct or indirect contact with the patient.
Scan the bed area to ensure safety and call “Stand Clear, Shocking”
Discharge shock - hold button down for a couple of seconds
Observe the patient and monitor display to determine effect of cardioversion
If further shocks are required ensure that the machine is in synchronous mode prior to every shock.

Successful discharge of shock
In synchronous cardioversion, during discharge of the shock the machine quickly ‘searches’ for the first R-wave to occur. It may be necessary for the operator to hold the discharge button down for a couple of seconds until an R-wave is detected and the shock discharged by the machine. This can seem like a short delay. Proof that the shock has been delivered to the patient is evidenced by muscle spasm.

Potential complications of DC reversion
- Myocardial ischaemia, cardiac enzyme elevations and arrhythmias due to myocardial damage associated with high energy shocks.
- Respiratory arrest
- Burns to the skin
- Pulmonary oedema
- Hypotension
- Emboli formation

MONOPHASIC VS BIPHASIC DEFIBRILLATORS
Modern defibrillators deliver energy or current in “waveforms” and the energy required for successful defibrillation varies with the type defibrillator and waveform used.
Traditional monophasic defibrillators achieve defibrillation by delivering a current that travels in a single direction, from one paddle or electrode to another. Monophasic defibrillators may require escalating energy levels in order to overcome high defibrillation thresholds.
Biphasic defibrillators are now rapidly replacing monophasic defibrillators in the clinical setting. Biphasic defibrillators deliver current in two phases. During the first phase, the current passes from one electrode to another through the heart; during the second phase, it reverses direction and passes through a second time. This waveform is thought to compensate for thoracic impedance allowing for lower energy levels to be utilized during defibrillation.

Fig.15. Flow of current between paddles or self-adhesive pads
Pharmacology

The following is only a brief guide to the use of ALS drugs. Prior to use or for more information, comprehensive texts, product information and other sources must be consulted.

All IV drugs delivered via a peripheral cannula to the arrested or hypotensive adult patient must be followed by at least 20-30ml IV fluid flush.

FIRST LINE DRUGS IN CARDIAC ARREST & ACUTE DYSRHYTHMIAS (1,2,11)

ADRENALINE (1,2,11)

Action: Adrenaline is a powerful cardiac stimulant. Increased cardiac output is achieved by an increase in myocardial rate and contractility (β effects). Adrenaline is a potent alpha-receptor activator. The α-adrenergic effect of vasoconstriction shunts peripheral blood supply to the central circulation, therefore improving coronary artery blood flow.

Pharmacokinetics: When administered IV, adrenaline has a rapid onset and short action duration. The drug is metabolised by the liver and other tissues, however the majority is taken up and metabolised by sympathetic nerve endings.

Presentation:
Min-I-jet 1mg in 1ml (1:1000) (clear colourless solution)
1mg in 10ml (1:10,000)
Ampoules 1mg in 1ml (1:1000)
1mg in 10ml (1:10,000)

Dose: 1 mg
Route: IV
Frequency: In shockable rhythms, deliver after the 2nd shock and then every 4 minutes during cardiac arrest.
In non-shockable rhythms, deliver immediately and then every 4 minutes during cardiac arrest.

Adverse effects:
Cardiovascular: pallor, palpitations, hypertension, ventricular arrhythmias, myocardial infarction.
Respiratory: respiratory difficulty, pulmonary oedema,
CNS: fear, anxiety, tenseness, restlessness, headache, tremor, weakness, dizziness, cerebrovascular haemorrhage, convulsions, rigidity and tremor may be exacerbated in parkinsonian patients.
Integumentary: Tissue necrosis at injection site.
Renal: Renal failure with anuria
Metabolic: Metabolic acidosis, elevated serum glucose,
Other: Psychiatric disorders may be exacerbated.

Contraindications (in cardiac arrest):
- Arterial or intracardiac administration.
**AMIODARONE**\(^{(1,2,11)}\)

**Action:** Amiodarone is a class III antiarrhythmic that prolongs the action potential duration and hence the refractory period of atrial, nodal and ventricular tissues. Amiodarone also increases coronary blood flow, decreases cardiac oxygen requirements without producing negative inotropic effects, and suppresses ectopic pacemakers.

**Pharmacokinetics:** The half-life of amiodarone is long, usually in the range of 14 to 59 days. Amiodarone appears to accumulate in adipose tissue and in highly perfused organs (lung, bone marrow, adrenals, liver, pancreas, heart, spleen and kidney).

**Delivery:** In VT/VF between the 3\(^{rd}\) and 4\(^{th}\) shock.

**Dose in cardiac arrest:** 300mg in 10-20mL of 5% glucose bolus over 1-2 minutes in VT/VF. This may be followed by an additional dose of 150mg.

**Dose in pulsatile VT or SVT:** infuse dose, usually 300mg, over 10-60 min, dependent on patient instability (per Fig. 2 Pulsatile Broad Complex Tachycardia Flowchart and per Fig. 4 Regular Narrow Complex Tachycardia Flowchart).

**Route:** IV in emergency then oral maintenance

**Presentation:** 150mg/3ml ampoules (clear pale yellow solution)

**Adverse effects:**
- **Cardiovascular:** Moderate and transient reduction in BP. Circulatory collapse may be precipitated by rapid administration or over dosage. Torsades de pointes, bradycardia, exacerbation of cardiac failure, sinus arrest.
- **CNS:** Tremor, insomnia, headaches, dizziness, vertigo, fatigue, vivid dreams, paraesthesia, gait abnormalities and abnormal nerve conduction.
- **Respiratory:** Cases of pulmonary toxicity have been reported. Bronchospasm.
- **GIT:** Temporary nausea, vomiting, constipation, salty or metallic taste in the mouth.
- **Metabolic:** Abnormal liver function tests, abnormal thyroid function tests.
- **Integumentary:** Photosensitivity, bluish skin discoloration, erythema, hair loss.
- **Other:** Hot flushes and sweating, weight gain.

**Contraindications:** Bradycardia and AV block with syncope, sick sinus syndrome, severe conduction disorder (unless pacemaker insitu), sinus bradycardia, sinoatrial heart block, hypersensitivity to iodine, thyroid dysfunction, hypotension, severe respiratory failure, myocardiopathy, heart failure, circulatory collapse, severe arterial hypertension, pregnancy, lactation.

**ATROPINE**\(^{(1,2,11)}\)

**Action:** An anticholinergic agent that competitively inhibits the muscarinic actions of acetylcholine. It induces a parasympathetic blockade, allowing the sympathetic nervous system effects to dominate; thus increasing heart rate, reducing secretions and gastrointestinal tone, also pupil dilation. Indicated in bradycardias.

**Pharmacokinetics:** With intravenous administration, increased heart rate effect peaks within 2-4 minutes. Serum levels of atropine drop rapidly within the first 10 minutes and then decrease more gradually. Atropine is metabolised by the liver. Approximately 30-50% of the dose is excreted in the urine unchanged.
Dose: 0.5mg increments to a total of 3mg (per Fig.3 Bradycardia Flowchart)
Route: IV
Presentation: Min-I-jets 1mg in 10mL / ampoules 600 micrograms in 1mL
Frequency: each 3-5 minutes

Adverse effects:
Cardiovascular: Tachycardia and palpitations, possible atrial arrhythmias, atrioventricular dissociation, multiple ventricular ectopic beats and angina
CNS: Thirst, dryness of mouth, dilatation of pupils, blurred vision, photophobia, tremor, headache, nervousness, drowsiness, weakness, insomnia and fatigue, hallucinations, delirium.
Renal: Urinary difficulty and retention
GIT: Constipation.
Integumentary: Flushing, dryness of skin.

Contraindications: Severe ulcerative colitis, toxic megacolon, GI obstruction, closed angle glaucoma, obstructive uropathy, myasthenia gravis, tachycardia due to cardiac insufficiency or thyrotoxicosis, acute haemorrhage with unstable cardiovascular status, fever, high ambient temperature, prostate enlargement, pregnancy induced hypertension.

ADENOSINE (1, 2, 11)
Action: Adenosine depresses conduction through the AV node. The action interrupts the re-entry circuits of aberrant tachycardic electrical activity through the AV node therefore re-establishing sinus rhythm. It is indicated in the treatment of SVT.

Pharmacokinetics: IV adenosine is removed from the circulation very rapidly with the half-life estimated to be less than 10 seconds. Therefore, adenosine and a subsequent IV flush, need to be administered rapidly.

Presentation: Ampoule, 6mg/2ml.
Dose: 6mg, then 12mg, then 12mg (per Fig. 4 Regular Narrow Complex Tachycardia – Adult Flowchart)
Route: IV adenosine administered via rapid IV injection into a large vein, immediately followed by a 20-30mL flush.
Frequency: Deliver at increased dose after 2 min if cardioversion does not occur.

Adverse effects (usually transient):
Cardiovascular: Bradycardia, hypotension, facial flushing, headache, sweating, palpitations & chest pain.
Respiratory: Bronchoconstriction, dyspnoea, chest pressure, hyperventilation.
Central Nervous System: Light-headedness, dizziness, tingling in arms, numbness, apprehension, blurred vision, burning sensation, heaviness in arms, neck and back.
Gastrointestinal: Nausea, metallic taste, tightness in throat, pressure in groin.

Warning: Cases of prolonged asystole, ventricular tachycardia, ventricular fibrillation, transient increase in BP and bronchospasm have been reported in conjunction with adenosine use.
**Used with caution in asthmatics as it may cause bronchospasm.**

**Contraindications:**
- Known hypersensitivity to adenosine
- Second or third degree atrioventricular block (except in patients with a functioning artificial pacemaker).
- Sick Sinus Syndrome

**SECOND LINE DRUGS**

**LIGNOCaine**

**Action:** Lignocaine is a class 1B antiarrhythmic. Lignocaine stabilises the neuronal membrane and prevents the initiation and transmission of nerve impulses. Lignocaine is a sodium channel blocker. Lignocaine is indicated when amiodarone cannot be used in pulsatile VT, and in VT/VF arrest, not responsive to defibrillation.

**Pharmacokinetics:** In the heart, lignocaine reduces automaticity by decreasing the rate of diastolic depolarisation. The duration of the action potential is decreased to the blockade of the sodium channel and the refractory period is shortened. Lignocaine is distributed rapidly to all body tissues, with a half-life of 1.6 hours. About 80% of the dose is metabolised by the liver, less then 10% is excreted via the kidneys. **If a successful bolus dose is administered, ongoing lignocaine infusion must be considered.**

**Dose:** 1mg/kg, usually 50-100 mg.

**Route:** IV or ETT

**Presentation:**
- Min-I-jets 100mg/5ml
- Ampoules 100mg/5ml
- Pre-made IV infusion bags

**Frequency:** If arrhythmia persists after 15-30 minutes, a second dose of 0.5mg/kg may be given.

**Adverse effects:**
- **CNS:** light-headedness, drowsiness, dizziness, apprehension, euphoria, tinnitus, blurred vision, sensations of cold or numbness, difficulty swallowing, slurred speech, convulsions, unconsciousness,
- **Cardiovascular:** hypotension, arrhythmias and heart block, bradycardia,
- **Respiratory:** dyspnoea, respiratory depression
- **GIT:** vomiting;
- **Other:** increased energy levels may be required for defibrillation, anaphylaxis.

**Contraindications:** Stokes-Adams syndrome, myasthenia gravis, severe shock, impaired cardiac conduction, serious CNS diseases.

**MAGNESIUM SUPHATE (MgSO4)**

**Action:** Essential electrolyte for cell membrane stability. Considered 2nd line in VT/VF.

**Dose:** 5mmol

**Route:** IV slow bolus over 2 minutes during cardiac arrest

**Presentation:** 10mmol in 5 ml

**Adverse effects:** Hypermagnesaemia – nausea, vomiting, flushing, hypotension, muscle weakness, muscle paralysis, blurred or double vision, CNS depression, and loss of reflexes. More severe hypermagnesaemia may result in respiratory depression,
respiratory paralysis, renal failure, coma, cardiac arrhythmias and cardiac arrest. Use with caution in patients receiving digitalis.

POTASSIUM CHLORIDE (KCl)
Action: Potassium is an essential electrolyte in intra and extracellular physiological function. Hypokalaemia can disrupt electrical and mechanical cardiac function. Indicated in arrhythmias with Se K+ < 4.0 and considered 2nd line in VT/VF.
Dose: 5mmol
Route: IV
Presentation: 10mmol in 10ml
Delivery: bolus of 5mmol
Adverse effects: Flaccid paralysis, listlessness, mental confusion, weakness and heaviness of legs, fall in BP, cardiac arrhythmias and heart block, nausea, vomiting, diarrhoea and abdominal discomfort, hyperkalaemia with ECG changes eg: peaked T-waves, VF, ventricular standstill.

SODIUM BICARBONATE (NaHCO3)
Action: Sodium Bicarbonate buffers excess hydrogen ions and therefore raises blood pH. Considered 2nd line in cardiac arrest, but early efficient CPR with adequate ventilation negates its need. Routine administration in cardiac arrest is not recommended.
Dose: 1 mmol/kg
Route: Slow IV injection over 2-3 minutes.
Presentation: 50mmol in 50ml Minijet, or 100mmol in 100ml glass infusion vial
Adverse effects: Alkalosis, hypokalaemia, hyperirritability or tetany, vascular irritation, acidosis with inadequate ventilation, extravasation of hypertonic sodium bicarbonate solution has been reported to cause chemical cellulitis and ulceration.

VERAPAMIL
Action: Anti-arrhythmic action by prolonging impulse conduction in the AV node. Inhibits calcium ion influx and the decrease of the vascular smooth muscle tone prevents coronary spasms and lowers raised blood pressure. It is indicated 2nd line in SVT.
Dose: 1mg/min to a maximum of 10mg
Route: IV
Presentation: 5mg/2ml ampoules
Adverse effects: Hypotension, AV block, bradycardia, asystole, myocardial insufficiency, elevation of the pacing and sensing threshold in pacemaker wearers, frequently causes nausea, bloating, constipation. May cause headache, nervousness, dizziness, fatigue, sensory disturbances.
VASCULAR ACCESS

PERIPHERAL IV
Access the circulation via a large bore IV cannula in a large vein above the diaphragm.

CENTRAL VENOUS CATHETER (CVC)
If a central venous catheter (CVC) or Peripherally Inserted Central Catheter (PICC line) is available and functioning, then this should be used for drug delivery.

INTRAOSSEOUS (IO) DRUG ADMINISTRATION (1,18)
If IV access cannot be achieved within 2 minutes in the arrested adult, intraosseous (IO) access should be obtained. In adult patients, intraosseous access can be obtained with the use of an intraosseous drill. With paediatric patients, IO access should be achieved within 1 minute and can be obtained manually with an intraosseous needle (in an infant) or with an intraosseous drill and is referred to in Section 4. All IV medications, IV fluids and blood products can be delivered via the IO route. Tibial and humeral sites are usually readily accessible.

Intraosseous access is quickly obtained with the use of an IO drill.

ETT DRUG ADMINISTRATION (1,2)
If IV or IO access cannot be achieved and an endotracheal tube (ETT) is present, endotracheal administration of some medications is possible, although the absorption is variable and plasma concentrations are substantially lower than those achieved when the same drug is given by the intravenous route. Dilution with water instead of 0.9% saline may achieve better drug absorption.

This route cannot be used if a Laryngeal Mask Airway is present.

Administration of drugs via the tracheal route should only occur when the IV or intra-osseous route is unobtainable.

Procedure
- Suction airway if secretions are copious
- Pre-oxygenate with 2 insufflations of the resuscitator bag
- **Administer 3-10 times the IV dose**, ensuring the total volume exceeds 10ml (i.e. either administer neat from a Mini-jet or draw up from an ampoule and dilute in Water for injection.)
- Syringe medication directly down ETT or tracheostomy tube. Do not use a mixing cannula or needle.
- Re-connect resuscitator bag and administer 2 insufflations to disperse the drug.

Adrenaline, Lignocaine and Atropine are the only ALS drugs that can be given via the endotracheal tube (ETT) or tracheostomy tube in cardiac arrest.
Advanced Airway Management

ENDOTRACHEAL INTUBATION

Introduction
An ALS accredited healthcare professional is expected to:
- prepare equipment and drugs for an endotracheal intubation,
- prepare the patient for endotracheal intubation,
- assist during endotracheal intubation,
- understand expected outcomes and alternative equipment when standard intubation is not achievable.

Indications for Endotracheal Intubation
To maintain a patent airway, where airway compromise is either real or potential
- To protect an airway, e.g. loss of gag reflex, patients at risk of aspiration
- To enable suctioning for clearance of secretions
- To institute mechanical ventilation
- To deliver high concentrations of oxygen

In the arrested patient, intubation also:
- Decreases the risk of gastric insufflation
- Provides access for drug administration

Techniques
In the arrested patient, orotracheal intubation is the standard method of intubation through direct visualisation. General anaesthesia is not usually required. However, in patients with some cardiac output and level of awareness, medical staff will institute sedative and paralysing agents. Refer to ‘Pharmacology for Intubation’ that follows this section.

Nasotracheal intubation- may be indicated under the following circumstances:
- following head & neck surgery
- inability to open mouth
- intolerance of rapid sequence induction
- upper airway obstruction e.g. epiglottitis

Personnel
Endotracheal intubation requires skilled assistance. The intubator coordinates the intubation procedure. Assistants must be available to:
- hand up equipment.
- administer drugs.
- apply cricoid pressure.

Equipment
Emergency drugs, e.g. Adrenaline
Monitoring- cardiac rhythm, BP, SpO2
Stethoscope
Resuscitation trolleys contain equipment for endotracheal intubation:
- Gloves and protective eye wear
- Oropharyngeal (Guedel) airways
- Resuscitation bag - connected with maximum flow oxygen
- Yanker suction - connected and tested
- IV access
- End-tidal CO2 detector
- Endotracheal tubes: females 7-8mm, males 8-9mm
- Laryngoscopes
- Introducer stylet
- Bougie
- Magill's forceps
- 10ml syringe
- Lubricant
- Tapes

Procedure (1,12)
- Informed consent where applicable (N/A with arrested patient)
- Pre-oxygenation with full flow oxygen for 5 minutes, when possible
- Place functioning suction & resuscitator bag near head of patient
- Check laryngoscope has an adequate, secure light source
- Lubricate ETT prn
- Position patient supine in the 'sniffing position'
- Anaesthetic agents if required (N/A with arrested patient)
- Cricoid pressure by assistant

Cricoid pressure (12)
Cricoid pressure should be applied, on the instruction of the intubator (Fig. 16).
Cricoid pressure reduces the risk of regurgitation of gastric contents (and therefore pulmonary aspiration) and facilitates visualisation of the glottis.

The cricoid is a full cartilaginous ring. Pressure upon it will occlude the oesophagus behind it, while maintaining a patent airway. Firm downward pressure with the thumb and index finger is applied below the thyroid cartilage (Adam's apple). Cricoid pressure should not be performed during vomiting due to the risk of oesophageal rupture. Pressure must not be released until the intubator is satisfied that tube position is clinically confirmed as being in the airway and the cuff is inflated.

In the arrested patient, the application of cricoid pressure may prevent the regurgitation of gastric contents into the pharynx until the airway can be protected with a cuffed ETT.

Procedure (1,12)
- Intubation of trachea
- Cuff inflation with 5-10mls of air
- Confirm ETT position
Confirmation of ETT position

It is essential that the position of the ETT in the trachea is assessed by:

- Visualisation by intubator of tube passing between vocal chords
- Symmetric bilateral chest expansion on bagging with resuscitation bag
- Bilateral air entry on chest auscultation at axilla
- Absence of gurgling over epigastrium
- Capnograph/exhaled CO₂ detection device - confirms CO₂ present. CO₂ is exhaled only from functioning alveolar/capillary interface in the lungs. (So will not be sustained when circulation is absent.)
  - On monitor, capnograph waveform must be sustained.
  - 'Easy Cap CO₂ Detector' Exhaled CO₂ turns indicator from purple to yellow
- Improvement in skin color
- SpO₂ sustained or improving
- Condensation on ETT with exhalation
- Confirm ETT position on X-ray when available, tube tip should be in the trachea level with the aortic knuckle.
- Secure ETT with tape
- Length at lip approx: males, 21-23cm, females 19-21cm
- Ongoing ventilation with resuscitator bag or mechanical ventilator

Complications of Endotracheal Intubation

During intubation: incorrect tube placement, laryngeal trauma, cardiovascular response to laryngoscopy and intubation, increased intracranial pressure, hypoxaemia and aspiration.
While tube is in place: blockages, dislodgment, tube deformation, damage to larynx, and complications of mechanical ventilation.
Following extubation: aspiration, post-extubation airway obstruction, laryngeal and tracheal stenosis.

Specific documentation

ETT size
ETT length at lip
Volume or pressure of air in cuff
Adverse events/findings/complications
Full respiratory, cardiovascular and neurological assessment
Pharmacology

In the arrested patient, attempts to secure an ETT should not interrupt CPR for periods of longer than 20 seconds.

Waveform Capnography

End-tidal CO₂ (ETCO₂) is exhaled when cellular metabolism is occurring. When end-tidal CO₂ is present and sustained, evidence exists of perfusion and cellular metabolism. Therefore, waveform capnography can be used as a measure of the adequacy of cardiac output during CPR. Generally, when ETCO₂ exceeds 10mmHg, survival is more likely. High levels of CO₂ may be tolerated during resuscitation and over ventilation should be avoided.
LARYNGEAL MASK AIRWAY \(^{(1,6,12,13,14,17)}\)

The Laryngeal Mask Airway (LMA) is designed to act as an intermediate airway management device, providing improved airway and ventilation to that of a resuscitator bag and mask and oropharyngeal airway, but not providing the security of endotracheal intubation (Fig. 17).

The LMA can be used in an emergency where an ETT is either not available or when the attempts to secure an ETT are prolonged \(^{(1)}\). Once in position some types of LMA can serve as a guide to pass stylets, bougies, the bronchoscope or even an ETT into the trachea \(^{(13)}\).

The LMA has been studied specifically during CPR, looking at insertion and ventilation success rates. The studies suggest that relatively inexperienced personnel can insert the device, however, training is required. Although, the airway is not completely secure, the LMA has the advantage of being comparatively easier to insert.

The LMA has a distal elliptical spoon-shaped mask with an inflatable rim (Fig. 18), which is positioned blindly into the pharynx to form a low-pressure seal (capable of withstanding 20cmH2O pressure) against the laryngeal inlet (Fig. 17).

Indications
- Airway management when endotracheal intubation fails or is not available.
• Airway management of the unconscious patient without a gag reflex who requires assisted ventilation.
• Inability to adequately oxygenate and ventilate using a resuscitator bag and mask.

Contraindications
• Patient not sufficiently unconscious
• Unconscious patient unable to open mouth sufficiently (e.g. trismus)
• Suspected epiglottitis or upper airway obstruction due to other causes
• Gross or morbid obesity
• >14 weeks pregnant
• Patients who require high pressure ventilation (e.g. increased airway resistance, decreased pulmonary compliance, advanced pregnancy and morbid obesity)
• Significant volume of vomit in the airway

The LMA does not prevent passive regurgitation or gastric distention.

Procedure
• Pre-oxygenation with full flow oxygen for 5 minutes, when feasible
• Place functioning suction and resuscitator bag near head of patient
• Check LMA cuff by inflating/deflating (Fig. 19)
• Lubricate top part of cuff (Fig. 19)

![Fig. 19. Checking LMA cuff and lubricating cuff](image)

• Position patient supine in the 'sniffing position'
• Anaesthetic agents if required (N/A with arrested patient)
• The operator stands behind the head of the patient
• Holding the LMA like a pen, the index finger is placed anteriorly at the junction of the tube and cuff. The opening should be facing the patient’s chin (Fig. 20).
• The tip of the cuff should be pressed up against the hard palate, avoiding folding of the cuff
Fig.20. LMA opening is facing patient’s chin.

Fig.21. Inserting LMA

- Advance the airway in one fluid movement, through the oropharynx while maintaining pressure upwards as the LMA is advanced to ensure the tip remains flattened and avoids the tongue. Advance until resistance is felt (Fig. 21).
- Withdraw finger while holding the tube in place with the other hand, ensuring an anchor finger is on the chin as well.
- Inflate the cuff with the recommended volume of air (Fig. 22).

Fig.22. Inflating the cuff

Fig. 23. Ventilating with LMA

- The tube will rise during inflation of cuff and as the mask finds its correct position.
- Assess for correct position by connecting to resuscitator bag and gently ventilating to observe chest rise and fall and minimal air leak.
- Auscultate to ensure equal and adequate ventilation.
- Secure the tube as per endotracheal tube.
- Ventilate with resuscitation bag (Fig. 23) or mechanical ventilator. (Avoid high pressures as the LMA has a low pressure seal with the glottis. Pressures should not exceed 20cm H2O.)

<table>
<thead>
<tr>
<th>Patient Weight (kg)</th>
<th>LMA size</th>
<th>Cuff Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6.5</td>
<td>1</td>
<td>2-5</td>
</tr>
<tr>
<td>5-10</td>
<td>1.5</td>
<td>2-8</td>
</tr>
<tr>
<td>10-20</td>
<td>2</td>
<td>2-10</td>
</tr>
<tr>
<td>20-30</td>
<td>2.5</td>
<td>2-15</td>
</tr>
<tr>
<td>&gt;30</td>
<td>3</td>
<td>10-25</td>
</tr>
<tr>
<td>&gt;70</td>
<td>4</td>
<td>20-30</td>
</tr>
<tr>
<td>&gt;80</td>
<td>5</td>
<td>20-40</td>
</tr>
</tbody>
</table>

Table 1. LMA size selection
**LMA Tips**
Some operators prefer to inflate the cuff partially before insertion, although the device was initially designed to be inserted with the cuff deflated.

Successful use of the LMA depends in part on appropriate size selection (Table 1). Generally sizes are determined by weight. However judgment should be used as patient anatomy and physiology are more important than weight in size selection.

It is also important not to exceed the maximum cuff inflation amounts as indicated in Table 1.

If the maximum inflation volume is necessary to maintain a seal, the use of a larger size mask should be considered.

The following information can be used as a guide when choosing an LMA size:

<table>
<thead>
<tr>
<th>Size 3</th>
<th>Small adult female &lt;50 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 4</td>
<td>Ordinary sized female</td>
</tr>
<tr>
<td>Size 5</td>
<td>Ordinary sized male</td>
</tr>
<tr>
<td>Size 6</td>
<td>Large male &gt;100 kg</td>
</tr>
</tbody>
</table>

- Choose the largest size you think will fit and inflate with the smallest volume required to obtain an adequate seal. The larger the size used, the lower the intracuff pressure needed to obtain an adequate seal.
- Consider changing to a larger sized mask if leaks occur when the lungs are inflated to peak airway pressure <20 cm H2O.
- It is better to use a large size with small inflation volumes than a small size with large volumes.
- Always have a larger and smaller sized LMA immediately available.
PHARMACOLOGY FOR INTUBATION (11,12,13)

The following brief summary reminds the reader of a few key points in relation to the use of drugs during intubation. Further information must be sought from the product information and evidence based reliable sources before the use of such drugs.

**Sedative Drugs**

**Midazolam:** Short acting benzodiazepine sedative. Effects include amnesia.
Dose: 1-2.5mg increments slowly IV.
Onset: 30 seconds-5min
Duration: 10-90min
Adverse effects: respiratory depression, cardiac arrhythmias, hypotension.

**Propofol (Diprivan):** Short acting anaesthetic agent without analgesic properties.
Dose: 1-2mg/kg slowly IV
Onset: Rapid
Duration: 5-10min
Adverse effects: hypotension, respiratory depression, bradycardia, pain at injection site.

**Fentanyl:** Short acting opiate with analgesic effects, blunts intracranial pressure response to intubation. Used in conjunction with other sedatives.
Dose: 50-100mcg IV.
Onset: 1min
Duration: 30-60min
Adverse effects: respiratory and cardiovascular depression, muscle rigidity, nausea and vomiting.

**Ketamine:** A dissociative anaesthetic agent. May cause bronchodilation. Analgesic effects. Myocardial depression is uncommon.
Dose: 1-2mg/kg
Onset: 60 seconds
Duration: 5-10min
Adverse effects: Hypertension, tachycardia, increased ICP, hallucinations.

**Neuromuscular Blockers**

**Suxamethonium:** Depolarising muscle relaxant. Combines with the cholinergic receptors of the motor end plate to produce depolarisation.
Dose: 0.3-1mg/kg
Onset: 30seconds
Duration: 2-6min
Adverse effects: Muscular fasciculations, malignant hyperthermia, apnoea, salivation, cardiac arrhythmias, hypo/hypertension, increased intraoculular pressure.

**Rocuronium:** Rapid onset, non-depolarising neuromuscular blocking agent that prevents acetylcholine binding to receptors on the muscle end plate. Dose: 0.6mg/kg IV bolus
Onset: 1-2min
Duration: 30-50 min
Adverse effects: tachycardia, hypotension, bronchospasm, skin reactions, hiccups.
Atracurium: Non-depolarising skeletal muscle relaxant. It prevents acetylcholine binding to the receptors on the muscle end plate. Drug of choice in kidney and liver failure.
Dose: 0.4-0.5mg/kg
Onset: 2min
Duration: 15-35min
Adverse effects: Anaphylactoid reaction, hypertension, tachycardia, bradycardia, bronchospasm, skin reactions.

Transcutaneous Pacing

Introduction
Transcutaneous (external) pacing is initiated in an emergency setting for haemodynamically compromised bradycardia not controlled with drug therapy. It is a temporary therapy used as a bridge to the insertion of a temporary transvenous pacing wire or permanent pacemaker insertion.

The aim of transcutaneous pacing is to deliver a current across the patient’s chest to induce contraction of the myocardium and induce contractions at an adequate heart rate to optimise cardiac output. Cutaneous nerves and skeletal muscle may also be stimulated, causing pain and discomfort.

Fig.24. Defibrillator with pacing capability
Equipment
Defibrillator with capacity to perform transcutaneous pacing (Fig. 24) buttons front right.
ECG leads
Pacing self-adhesive pads (Fig. 25)
Pad connection lead (Fig. 26)
Full resuscitation and monitoring capability

Preparation of Patient
Explanation to patient
Informed consent PRN
Supine position
Oxygen
Primary survey assessment
IV access x 2
Baseline vital signs & ECG
Analgesia/sedation

Procedure
Establish ECG trace on defibrillator via defibrillator's ECG leads or slave from monitor
Don gloves & apply self-adhesive pacing pads to patient's chest, eg:
- +ve pad posterior below L scapula and -ve pad anteriorly at V4, or,
- +ve pad R parasternal border and –ve pad anteriorly at V4
Connect pads to connection lead
Attach connection lead to defibrillator
Turn pacer function ‘on’
Ensure pacing mode is ‘demand’
Select pacing rate as ordered (usually 60-80bpm)
Select pacing output of approx. 30mA
Press ‘start’
Pacing spikes should be visible on the ECG display (Fig. 27)

Fig.25. Self adhesive pads
Fig. 26. Pad connection lead
Fig.27. Pacing spikes
Increase the output until 'capture' is achieved (this energy level is the ‘threshold’)

*Every* pacing spike must be followed by a paced beat (Fig. 28)

Increase the output by a further 5mA as a safety margin

![Fig. 28. Paced rhythm](image)

**Patient management**
- Continuous O2 and airway management
- Continuous observation and monitoring
- 15 min documentation of patient status & pacer settings (mode, rate, output)

**Patient education and support**

**Sedation/analgesia as required**
- Maintain integrity of pacing equipment/leads/connections
- Caregivers to wear protective gloves if touching pacing pads
- Keep patient skin and linen dry

**Defibrillation**
- If this is required for VT/VF, the self-adhesive pads also function as defibrillation pads.
  - Immediately prepare to defibrillate the patient according to section 3.

**Troubleshooting**

**Noisy ECG signal**
- Shave excessive chest hair
- Place ECG dots on clean, dry skin
- Select another ECG lead to view
- Move dots away from pacing pads

**Discomfort (ranging from tingle/twitch to intolerable pain)**
- Analgesia
- Sedation (consider protection of airway with cuffed ETT)

**Failure to capture**
- Insufficient output
- Correct acidosis, hypoxia
- Change pad position

**Undersensing**
- (Does not detect intrinsic QRS & delivers a pacing spike- danger of ‘R on T’ → VF)
  - Increase ECG amplitude
  - Reposition and refresh ECG dots
  - Select another lead to view

**Oversensing**
(Pacing inhibited due to signals like artefact or P waves being incorrectly interpreted as R waves)

- Decrease ECG amplitude
- Select another lead to view
- Reduce causes of artefact
- Reposition/refresh ECG dots

<table>
<thead>
<tr>
<th>Post Resuscitation Care</th>
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</table>

During CPR, if responsiveness or normal breathing becomes apparent, the cardiac rhythm should be briefly assessed. If the rhythm appears consistent with those that produce cardiac output, then a carotid pulse must be checked.

Post resuscitation care commences upon the return of spontaneous circulation (ROSC).

**After ROSC, resuscitation must continue.**

Comprehensive discussion of post resuscitation care is beyond the scope of the package, however, the following should be considered:

1. Perform a primary survey ABCDE Airway/Breathing/Circulation/Disability/Exposure
2. Consider:
   a. 12-lead ECG
   b. Chest x-ray
   c. Thrombolytics or percutaneous coronary intervention
   d. Advanced airway
   e. Treat causes of cardiac arrest
3. Induced therapeutic hypothermia
   Comatose adults with ROSC after VT/VF cardiac arrest should be cooled to 32-34°C for 12-24 hours. Other groups of post cardiac arrest patients may also benefit. Cold (4°C) normal saline 30ml/kg can be infused IV. Practice should be guided by institutional policy.
4. Hyperthermia must be avoided.
References Section 3.


Figures
Fig. 1. Australian Resuscitation Council *Guidelines*. Melbourne: ARC, 2010.


Fig. 6. Weill Cornell Physicians ‘Ventricular Tachycardia’ [online]. Available: [http://wo-pub2.med.cornell.edu/cgi-bin/WebObjects/PublicA.woa/6/wa/viewHContent?website=wmc+physicians&contentID=7909&wosid=D0TwQNfmSmWrFSRHgY5umM](http://wo-pub2.med.cornell.edu/cgi-bin/WebObjects/PublicA.woa/6/wa/viewHContent?website=wmc+physicians&contentID=7909&wosid=D0TwQNfmSmWrFSRHgY5umM) [Accessed 14/12/06]

Fig. 7. Medical Online (n.d.) Advanced Life Support [online]. Available: [http://www.themediweb.net/resuscitation/ALS.htm](http://www.themediweb.net/resuscitation/ALS.htm) [Accessed 28/11/06]

Fig. 8. Medical Online (n.d.) Advanced Life Support [online]. Available: [http://www.themediweb.net/resuscitation/ALS.htm](http://www.themediweb.net/resuscitation/ALS.htm) [Accessed 28/11/06]

Fig. 9. Loyola University Health System ‘Shock’ [online]. Available: [http://www.loyolaems.com/ce_jul05.htm](http://www.loyolaems.com/ce_jul05.htm) [Accessed 14/12/06]

Fig. 10. Weill Cornell Physicians ‘Supraventricular Tachycardia’ [online]. Available: [http://wo-pub2.med.cornell.edu/cgi-bin/WebObjects/PublicA.woa/6/wa/viewHContent?website=wmc+physicians&contentID=7907&wosid=ylVUim8a71xinspik0s3qw](http://wo-pub2.med.cornell.edu/cgi-bin/WebObjects/PublicA.woa/6/wa/viewHContent?website=wmc+physicians&contentID=7907&wosid=ylVUim8a71xinspik0s3qw) [Accessed 14/12/06]

Fig. 11. Philips Medical Systems [online]. Available: [http://www.medical.philips.com/au/](http://www.medical.philips.com/au/) [Accessed 14/12/06]


Fig. 13. Heart Rhythm Society ‘Cardioversion’ [online]. Available: [http://www.hrspatients.org/patients/treatments/cardioversion.asp](http://www.hrspatients.org/patients/treatments/cardioversion.asp) [Accessed 14/12/06]

Fig. 14. Cardiovascular Consultants of Maine ‘Cardioversion’ [online]. Available: [http://www.heartmaine.com/Patient%20Education/Cardioversion.htm](http://www.heartmaine.com/Patient%20Education/Cardioversion.htm) [Accessed 14/12/06]


Fig. 16. Australian Resuscitation Council *Guidelines*. Melbourne: ARC, 2006.


Fig. 24. Bendigo Health *Philips defibrillator*

Fig 25. [http://www.cpr-pro.com/Files/Pictures/philips_fr2_img22.jpg](http://www.cpr-pro.com/Files/Pictures/philips_fr2_img22.jpg)


4. ADVANCED LIFE SUPPORT (PAEDIATRIC)

This section contains information related to the practice of Advanced Life Support for paediatric patients \(^{(1)}\). This includes flowcharts (Figs. 1 & 2) and techniques utilised in the care of paediatric patients requiring resuscitation.

This learning package does not contain extensive information specific to resuscitation of the newborn. The ARC flowchart ‘Newborn Life Support’ is included (Fig. 15), however the relevant ARC Guidelines and other comprehensive evidence based material should be consulted for further information.

It is important to note that Basic Life Support for paediatric patients is contained in Section 2 of this manual. The material in Section 2 ‘Basic Life Support’ and Section 3 ‘Advanced Life Support- Adult’, is prerequisite for commencing this section.

Senior clinicians who undertake competency assessment \(^{(2)}\) of paediatric advanced life support skills will have access to relevant flow charts and tables during the competency assessment.
ALS Flowcharts (Paediatric)

Fig. 1. Advanced Life Support for Infants and Children Flowchart (1)

Bendigo Health Oct 2013 Advanced Life Support Education Package
Figure 1: Management of Tachydyssrhythmias

Management of Tachydyssrhythmias

- Are pulses palpable?
  - Yes
    - History, exam, ECG
    - What is the QRS duration?
  - No
    - Treat as pulseless VT

<0.08 secs

- Sinus tachycardia
  - Treat cause
- Supraventricular tachycardia
  - What is the BP/perfusion?
    - Normotensive: Vagal stimulation
      - Adenosine 100 mcg/kg
        - Synchronised DC shock 0.5-1 J/kg (up to 2J/kg) (monophasic or biphasic)
    - Hypotensive: Vagal stimulation
      - Adenosine 100 mcg/kg
        - Synchronised DC shock 0.5-2 J/kg (monophasic or biphasic)

>0.08 secs

- Wide QRS complex supraventricular tachycardia
  - What is the BP/perfusion?
    - Normotensive: Synchronised DC shock 0.5-1 J/kg (up to 2J/kg) (monophasic or biphasic)
    - Hypotensive: Amiodarone 5 mg/kg OR procainamide 15 mg/kg

Ventricular tachycardia

- What is the BP/perfusion?
  - Normotensive: Magnesium 0.1-0.2 mmol/kg (for torsade de pointes)
  - Hypotensive: Synchronised DC shock 0.5-2 J/kg (monophasic or biphasic)
INTRODUCTION (1)

During the management of paediatric cardiorespiratory arrest, clinicians can be assisted by using paediatric flowcharts and drug delivery tables, after the initial BLS measures have been commenced. Clinicians must be able to rapidly commence BLS measures and then when those measures are proceeding, rapidly locate relevant information on the charts. The use of tables and flowcharts is particularly relevant for clinicians who rarely care for the collapsed child. In paediatric resuscitation, all drug doses, fluid volumes, and electrical therapies are determined by the patient’s weight. If an accurate weight is unavailable, an estimate by age should be used. A colour-coded Broselow tape/scale is also very useful.

**Approximate weight:**
- A newborn: 3.5kg
- One Year: 10kg
- 9 years and less: (age x 2) + 8kg
- 10 years and over: age x 3.3kg

Read in conjunction with previous sections of this manual, the following is a brief outline of the care an infant or young child in cardiorespiratory arrest will require. For broader and deeper education regarding this specialist area of practice, further sources should be used.

**DEFINITIONS**

NEWBORN: MINUTES TO HOURS FOLLOWING BIRTH

INFANT: LESS THAN 1 YEAR

YOUNG CHILD: 1 – 8 YEARS

OLDER CHILD: 9 – 14 YEARS

Older children are treated using adult protocols however they do not have the same susceptibility to ventricular fibrillation.

Children >8 years of age are treated using adult protocols

**Causes of Arrest in Childhood (1)**

Cardiac arrest in infants and children usually occurs as a result of hypoxaemia or hypotension or both. Early recognition of seriously ill children and early intervention to prevent deterioration are crucial. The initial cardiac rhythm discovered is usually severe bradycardia or asystole, which influences the order of resuscitative actions. Respiratory arrest may occur alone and if treated promptly may not progress to cardiorespiratory arrest.

**Diagnosis and Initial Management (1)**

The diagnosis and immediate care of the paediatric patient in cardiorespiratory arrest must occur as described in Section 2. The implementation of Basic Life Support is essential. The establishment of resuscitator bag ventilation, the display of cardiac rhythm and access
to circulation should occur simultaneously as skilled rescuers arrive. From that point, specific care will be guided by the cardiac rhythm (Figs. 1 & 2).

In all emergency situations the rescuer should follow DRSABCD

The following interventions are performed in addition to the BLS measures already outlined (Section 2).

**AIRWAY- PAEDIATRICS**

Where BLS measures have not established a clear airway, a laryngoscope can be used by a skilled operator, to visualise any obstructions and to aid their removal with suction or Magill’s forceps.

**Endotracheal Intubation**

If endotracheal intubation can be performed “expeditiously and expertly” (1), it should proceed.

Intubation achieves a number of objectives:

- It establishes and maintains a patent airway
- Facilitates mechanical ventilation
- Reduces the risk of pulmonary aspiration
- Facilitates suctioning
- Provides a route for the administration of drugs (adrenaline, atropine, lignocaine and naloxone)

Endotracheal intubation should be achieved as soon as safely possible, by a skilled operator.

An overview of the assistance this operator requires from other team members is described in Section 3 ‘Advanced Airway Management’.

Un-cuffed, or cuffed (as a short term measure) endotracheal tubes may be used in paediatric patients. To determine the appropriate size of endotracheal tube and the insertion depth at the lip level (Fig. 4).

Confirmation that the tube is correctly placed relies on assessment of many factors as described in Section 3. Small sized disposable end tidal CO₂ detectors are available for use in infants (Fig. 3), in order to assess endotracheal tube placement.

*Fig.3. Paediatric end-tidal CO₂ detector*
# TABLE of DRUGS, FLUIDS, ENDOTRACHEAL TUBES and DIRECT CURRENT SHOCK FOR PAEDIATRIC RESUSCITATION

<table>
<thead>
<tr>
<th>Age</th>
<th>0</th>
<th>2m</th>
<th>5m</th>
<th>1y</th>
<th>2y</th>
<th>3y</th>
<th>4y</th>
<th>5y</th>
<th>6y</th>
<th>7y</th>
<th>8y</th>
<th>9y</th>
<th>10y</th>
<th>11y</th>
<th>12y</th>
<th>13y</th>
<th>14y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.5</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>25</td>
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<td>32</td>
<td>36</td>
<td>40</td>
<td>46</td>
<td>50</td>
</tr>
<tr>
<td>Height cm</td>
<td>50</td>
<td>58</td>
<td>65</td>
<td>75</td>
<td>85</td>
<td>94</td>
<td>102</td>
<td>109</td>
<td>115</td>
<td>121</td>
<td>127</td>
<td>132</td>
<td>138</td>
<td>144</td>
<td>151</td>
<td>157</td>
<td>162</td>
</tr>
</tbody>
</table>

| Adrenaline 1 in 1000: mL (10 mcg/kg) | 0.035 | 0.05  | 0.07  | 0.10  | 0.12  | 0.14  | 0.16  | 0.18  | 0.2   | 0.22  | 0.25  | 0.28  | 0.32  | 0.36  | 0.4   | 0.46  | 0.5 mL |
| Adrenaline 1 in 10,000: mL (16 mcg/kg) | 0.35  | 0.5   | 0.7   | 1     | 1.2   | 1.4   | 1.6   | 1.8   | 2     | 2.2   | 2.5   | 2.8   | 3.2   | 3.6   | 4     | 4.6   | 5 mL  |

| Amiodarone: mg (5 mg/kg) | 17.5  | 25    | 35    | 50    | 60    | 70    | 80    | 90    | 100   | 110   | 125   | 140   | 160   | 180   | 200   | 230   | 250 mg |

| Lignocaine 1%: mL (1mg/kg) | 0.3   | 0.5   | 0.7   | 1     | 1.2   | 1.4   | 1.6   | 1.8   | 2     | 2.2   | 2.5   | 2.8   | 3.2   | 3.6   | 4     | 4.6   | 5 mL  |

| Sodium bicarbonate 8.4%: mL (1 mmol/kg) | 3.5   | 5     | 7     | 10    | 12    | 14    | 16    | 18    | 20    | 22    | 25    | 28    | 32    | 36    | 40    | 46    | 50 mL |

| Fluid volume: mL (20 mL/kg) | 70    | 100   | 140   | 200   | 240   | 280   | 320   | 360   | 400   | 440   | 500   | 560   | 640   | 720   | 800   | 920   | 1000 mL |

| Endotracheal tube | Uncuffed size: Age/4 + 4 mm (2 years and above) | 3.5  | 3.5  | 3.5  | 4    | 4.5  | 4.5  | 5    | 5.5  | 5.5  | 5.5  | 6    | 6.5  | 6.5  | 7    | 7    | 7.5 mm |
|                   | Cuffed size: Age/4 + 3 mm          | 3    | 3    | 3    | 3.5  | 3.5  | 4    | 4.5  | 4.5  | 4.5  | 5    | 5    | 5    | 5.5  | 5.5  | 6    | 6.5 mm |
|                   | Oral length: Age/2 + 12 cm (2 years and above) | 9.0  | 11   | 11.5 | 12   | 13   | 13.5 | 14   | 14.5 | 15   | 15.5 | 16   | 16.5 | 17   | 17.5 | 18   | 18.5 cm |
|                   | Nasal length: Age/2 + 14 cm (2 years and above) | 11   | 12   | 13   | 14   | 15   | 16   | 17   | 18   | 19   | 19   | 20   | 20   | 21   | 21   | 22   | 22 cm |

| Direct Current shock (biphasic or monophasic) | VF, pulseless VT, First Shock (4J/kg) and all subsequent shocks, unsynchronized: Joules | 10   | 20   | 30   | 50   | 50   | 70   | 70   | 70   | 100  | 100  | 100  | 150  | 150  | 150  | 150  | 150  | 150  | 200  | 200 J |
|                                               | Palpable VT, synchronized (approx 2J/kg): Joules | 5    | 10   | 15   | 20   | 20   | 30   | 30   | 40   | 40   | 40   | 50   | 50   | 70   | 70   | 80   | 90   | 100 J |
|                                               | SVT, synchronized (approx 1J/kg): Joules | 3    | 5    | 7    | 10   | 10   | 15   | 15   | 20   | 20   | 20   | 30   | 30   | 30   | 50   | 50   | 50   | 50 J |

* 50th percentiles


Guideline 12.4
Page 6 of 6

December 2010

Fig. 4. Paediatric Quick Reference Chart
Resuscitator bag ventilation

If there is not an ETT insitu, standing at the child's head, the rescuer places an appropriately sized resuscitator mask with resuscitator bag over the child's mouth and nose to ventilate the patient (Fig. 5). The inspiratory time should be approximately one second. If an endotracheal tube has been inserted, the mask must be removed from the device and the bag connected directly to the endotracheal tube. High flow oxygen should be connected to the resuscitator bag.

![Fig.5. Bag/mask ventilation](image)

**Gentle chest rise and fall must be seen with each ventilation.**

It is important that resuscitator bags designed for use with newborns are *not* used with older patients, as insufficient ventilation may occur (Fig. 6).

![Fig.6. Resuscitator bags](image)

- 1500ml resuscitator bag - older children and adults
- 500ml resuscitator bag - infants and young children
- 250ml resuscitator bag - newborn or small neonates ONLY

**Inflation of the stomach may occur with mask ventilation. A nasogastric tube should be inserted after endotracheal intubation, to decompress the stomach.**

Healthcare professionals who use resuscitator bags for paediatric patients must be able to check the correct function of the device (Appendix B).
If the patient appears to have absent or inadequate circulation (unresponsive, not breathing normally), chest compressions should be immediately commenced. Having implemented Basic Life Support, the cardiac rhythm must be displayed to guide specific care (Figs 1 & 2).

**Chest compressions must occur when a pulse is not palpable, regardless of the electrical cardiac rhythm displayed.**

Pulses can be assessed at the brachial, femoral or carotid pulse sites (Figs. 7 & 8).

Cardiac compressions should be started in paediatric patients with an absence of a pulse for >10 seconds or a heart rate less than 60 bpm. A brachial or femoral pulse is preferred to the carotid site as infants have a short, fat neck, which makes identification of the carotid pulse difficult.

The universal compression to ventilation ratio of 30:2 is recommended for all ages, however for infants and children, with two healthcare rescuers present, the compression to ventilation ratio of 15:2 may be performed.

**Two healthcare rescuers may use a ratio of 15:2 compressions to ventilations in paediatric patients.**

For infants, the two-thumb technique with the hands encircling the chest and the thumbs compressing the sternum, may be used to deliver chest compressions (Fig. 9). It is important not to restrict chest expansion during rescue breaths. Alternatively, the two-finger technique may be employed, as described in Section 2.
After the airway is secured with an ETT, there is no longer a need to pause compressions to deliver breaths, however care should be taken to avoid hyperventilation.

Access to circulation

Access to circulation should occur simultaneously as skilled rescuers arrive. Access to the peripheral circulation is important to provide a secure route for drug administration. Peripheral access points include the dorsum of the hand, wrist, forearm, cubital fossa, foot and ankle (long saphenous vein). In newborns and infants scalp veins may be used or the umbilical vein may be accessed up to one week after birth. Cannulation of the external jugular or femoral vein may also provide good access to circulation.

Fig. 10. Blood supply of bone marrow

If peripheral access to circulation cannot be achieved within 60 seconds, access must be gained with an intra-osseous (IO) cannula.

Bone marrow has a rich blood supply and forms part of the peripheral circulation. Insertion of an intra-osseous cannula into the bone marrow provides valuable access through which all drugs and fluids may be given. The needle is inserted perpendicular to the bone surface and a rotary action used to traverse through the cortex. A loss of resistance signals entry into the bone marrow and the position is confirmed either by aspiration of bone marrow or injection of saline without extravasation. The anterior surface, 2-3cm below the tibial tuberosity or the anterolateral surface 3cm above the lateral condyle, are appropriate sites for IO insertion. An intra-osseous drill may also be used, according to manufacturer’s instructions, to gain access to the circulation.

All IV and intra-osseous drugs should be flushed with small boluses of fluid.

Fig. 11. Sites for IO needle insertion

Endotracheal drug administration

Some ALS drugs can be delivered via the ETT. ETT drug doses are as follows:

- Adrenaline 100mcg/kg (IV/IO dose is 10mcg/kg)
- Lignocaine 2-3mg/kg (IV/IO dose is 1mg/kg)
If necessary, the diluent used should be sterile water, to achieve a volume to be delivered of:

- 1-2ml for infants
- 2-5ml for young child
- 5-10ml for older child

**Glucose administration**

Critically ill paediatric patients may be hypoglycaemic. The blood glucose level must be checked during and after cardiac arrest (n= 3-8mmol/L). If the blood glucose level is low, it is treated with 0.25g/kg glucose IV or IO.

Check BSL, if low give Glucose 0.25g/kg IV/IO.

**Fluid therapy**

Saline (or colloid) is given IV or IO where hypovolaemia is suspected (Fig. 3). Repeated doses may be required.

Give normal saline 20ml/kg IV/IO for suspected hypovolaemia.

**DIRECT CURRENT REVERSION**

The safe application of DCR must be adhered to as described in Section 3. However, the dose of joules delivered is smaller in infants and children.

When performing DCR, the safety of the patient, rescuers and others is paramount.

Defibrillation is the most effective treatment of pulseless ventricular tachycardia or ventricular fibrillation (VT/VF). The use of this therapy is according to protocol (Fig. 1). The dosage table (Fig. 3) assists rescuers to calculate the shock to be delivered, dependent upon the age/size of the child.

In VT/VF, shocks of 4J/kg are delivered, every 2 minutes, with either a monophasic or biphasic defibrillator.

Older children, >8 years are treated per adult protocols.
Small sized pads are available for infants < 1 year of age (Fig. 12).

For infants < 1 year, use the small sized ‘pink’ pads with manual operation of the Philips Heartstart XL defibrillator, as they are small enough to fit onto an infant’s chest.

Defibrillation should always be followed by 2 minutes of CPR.

Pads with a larger surface area are suitable for all other age groups. The larger surface area reduces the risk of burns (Fig. 13).

For all patients > 1 year of age, ‘red’ pads are suitable for manual operation of the Philips Heartstart XL defibrillator.
Some Automated External Defibrillators (AED’s) have paediatric sized self-adhesive chest pads. Where these are available, the automatic energy dose is attenuated to a universal paediatric dose of 50J and is suitable for all patients <8 years (Fig. 14).

For children <8yrs, ‘light blue’ pads are used with the Philips AED.

![Image of AED and pads]

_Fig. 14. ‘Light blue’ pads for <8yrs with Philips AED_

Use adult pads for children if no other pads are available.

**FURTHER CONSIDERATIONS**

**Prediction of Outcome**
Resuscitative efforts should be continued longer than in other circumstances if the circumstances involve the following:
- Witnessed VF arrest
- Near drowning in cold water

**Care of Parents**
Parents must be kept informed of the progress of resuscitative efforts. They should be invited, but not coerced to be present during resuscitation. Parents usually wish to be present, but require information and support by a healthcare professional.

**Care of Rescuers**
When the cardiac arrest of paediatric patients occurs, the skills of individuals and the preparedness of organisations like hospitals come to the fore. It is important to remember the psychological impact such events may have on health professionals and the need for sensitive debriefing that may arise.

**RESUSCITATION OF THE NEWBORN**

“Newborn” refers to babes in the immediate minutes to hours following birth. This learning package does not contain information specific to resuscitation of the newborn. The ARC flowchart ‘Newborn Life Support’ is included (Fig. 15), however the relevant ARC Guidelines and other comprehensive evidence based material should be consulted for further information.
Fig. 15. Newborn Life Support Flowchart
References Section 4.


Figures

Fig. 1. Australian Resuscitation Council *Guidelines*. Melbourne: ARC, 2010.

Fig. 2. Australian Resuscitation Council *Guidelines*. Melbourne: ARC, 2010.


Fig. 4. Australian Resuscitation Council *Guidelines*. Melbourne: ARC, 2010.


Fig. 6. Laerdal Pty Ltd *Product information*


Fig. 13. Philips Medical Systems [online]. Available: [http://www.medical.philips.com/au/](http://www.medical.philips.com/au/)


Fig. 15. Australian Resuscitation Council *Guidelines*. Melbourne ARC, Dec 2010.
### APPENDIX A.

**PRACTICAL ASSESSMENT OF BASIC LIFE SUPPORT SKILLS FOR HEALTHCARE PROFESSIONALS**

Participant’s Name: ................................................................. Dept: .........................

**Scenario:** While in a patient care area, a person slumps, apparently unconscious. What do you do?

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>PERFORMANCE CRITERIA</th>
<th>Age ranges:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checks Danger</td>
<td>Assesses &amp; manages dangers to ensure safety for rescuers &amp; victim</td>
<td>Infant &lt;1yr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child &lt;8yr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adult &gt;8yr</td>
</tr>
<tr>
<td>Checks Response</td>
<td>Elicits response to verbal &amp; tactile stimulus; talk &amp; touch</td>
<td></td>
</tr>
<tr>
<td>Sends for help</td>
<td>Activates emergency procedure</td>
<td></td>
</tr>
<tr>
<td>Checks Breathing</td>
<td>Looks, listens &amp; feels. If breathing, places in lateral position &amp; observes until help arrives.</td>
<td></td>
</tr>
<tr>
<td>Checks need for CPR</td>
<td>If unresponsive &amp; no adequate breathing, CPR is indicated. Healthcare rescuers may check for other signs of circulation including a brief pulse check.</td>
<td></td>
</tr>
<tr>
<td>Performs Chest Compressions</td>
<td>Locates compression point on lower ½ of sternum &amp; compresses ½ depth of chest. Rate ≈ 100 compressions/min.</td>
<td></td>
</tr>
<tr>
<td>Performs CPR</td>
<td>Demonstrates 30 compressions: 2 breaths (Optional: for 2 healthcare professionals- children &amp; infants 15:2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lies victim on back, delivers 2 rescue breaths by mouth-to-mask method or resuscitator bag. Observes chest rise &amp; fall.</td>
<td></td>
</tr>
<tr>
<td>*Uses airway adjuncts, eg. oropharyngeal airway, oxygen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominates Defibrillator</td>
<td>Aware of AED use only when CPR is indicated</td>
<td></td>
</tr>
<tr>
<td>Applies Defibrillator</td>
<td>*Applies AED to adults &amp; children&gt;8yr and follows instructions in a safe manner.</td>
<td></td>
</tr>
<tr>
<td>Recovery</td>
<td>Places the responsive, breathing patient in lateral position, gives oxygen if available &amp; observes until help arrives.</td>
<td></td>
</tr>
<tr>
<td>Provides a safe care environment</td>
<td>Adheres to standard precautions &amp; OHS, locates &amp; checks adjunct equipment if applicable, eg. resuscitator bag.</td>
<td></td>
</tr>
<tr>
<td>Knowledge of BLS protocols</td>
<td>Provides evidence of satisfactory completion of BLS online test</td>
<td></td>
</tr>
</tbody>
</table>

**COMPETENT/ NOT YET COMPETENT (circle)**

*Requirement to be competent in shaded elements is dependent upon workplace availability and candidate’s workplace responsibilities. Competency must be evident in all other elements to obtain a ‘competent’ grade. Competency is current for one year. Only those elements where performance is 'not yet competent' need to be repeated satisfactorily to pass.

**Candidate/Assessor comments:**

☐ CPR (mandatory)  ☐ AED competent

Assessor to initial where candidate competent:

Candidate’s signature & print name: ................................................................. Date: .........................

Assessor/s signature/s & print name: ................................................................. Date: .........................

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Bendigo Health, Nursing Education Faculty 2011 *Education Curriculum for Basic Life Support (Health Professionals)* Internal document
APPENDIX B.

CHECKING OF ADULT AND PEADIATRIC LAERDAL BAG (1, 2)

Introduction
All resuscitator bags require rigorous, systematic checking to ensure correct function in the event of an emergency. The manufacturer’s instructions must be followed regarding the checking of resuscitator bags. Many clinical areas have access to single-use-only resuscitator bags. Laerdal resuscitator bags are supplied to some departments. Where supplied, they must be carefully checked by a competent person.

Laerdal Resuscitator Bags

Basic Components: (Fig.1)
Check correct placement and presence of:
- Face mask (including mask-cover for soft masks)
- Pressure regulator
- Non-rebreathing patient valve (‘Duckbill’ valve)
- Exhalation valve
- Ventilation Bag (Fig. 2)
  - 1500ml resuscitator bag older children and adults
  - 500ml resuscitator bag infants and young children
  - 250ml resuscitator bag newborn or small neonates ONLY
- Intake valve
- O2 nipple
- O2 reservoir valve
- O2 reservoir bag
- O2 tubing

Checking Procedure
1. Ensure all attachments are tight.
   Remove face-mask and occlude patient outlet (and occlude the pressure regulator in paediatric device)
2. Squeeze ventilation bag - there should be no air movement.
   Ensure there is passive re-inflation of ventilation bag after releasing.
3. Remove occlusion from patient outlet and squeeze ventilation bag. Observe opening and closing of non-rebreathing valve (‘Duckbill’).
4. (Paediatric device) Remove occlusion from pressure regulator and occlude patient outlet. Air should escape through the pressure regulator.
5. Ensure yellow exhalation valve is in place, and outer “lip” can move freely.
6. Attach O2 tubing to nipple and O2 supply.
   Turn on O2 - observe filling of O2 reservoir bag.
7. Squeeze ventilation bag and observe emptying of O2 reservoir bag.
9. Date and sign tag to indicate correct functioning of bag.
Fig. 1. Laerdal bag components

Fig. 2. Laerdal bags

References Appendix B.
APPENDIX C.

PRACTICAL ASSESSMENT OF ADVANCED LIFE SUPPORT SKILLS

Participant’s Name: ............................................................... Dept: .........................

Scenario No:

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>PERFORMANCE CRITERIA</th>
<th>EVIDENT</th>
<th>NOT YET EVIDENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Advanced Life Support Competency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provides a safe environment</td>
<td>Adheres to standard precautions &amp; OHS legislation, assembles &amp;/or checks equipment used, ie. resuscitator bag, defibrillator</td>
<td></td>
<td></td>
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<tr>
<td>Prioritised approach</td>
<td>Integrates advanced skills into BLS using applied knowledge of ALS Protocols</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognition of cardiac arrhythmias</td>
<td>Diagnoses VT, VF, PEA, Asystole, bradycardia, SVT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defibrillation</td>
<td>Demonstrates safe use of manual defibrillation in Pulseless VT/VF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management of airway &amp; breathing</td>
<td>Demonstrates an applied knowledge of the intubation procedure &amp; performs a clinical support role</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied knowledge ALS drugs</td>
<td>Discusses indication, actions, dose, route, frequency &amp; adverse effects of first line drugs appropriate to scenario</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second line intervention</td>
<td>Nominates an appropriate second line drug or intervention in scenario</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Synchronous Cardioversion Competency

*Synchronous cardioversion Demonstrates safe use of synchronous cardioversion when indicated |         |                 |

Transcutaneous Pacing Competency

*Transcutaneous pacing Demonstrates safe use of transcutaneous pacing when indicated |         |                 |

Paediatric Advanced Life Support Competency

*Paediatric advanced life support Demonstrates advanced life support knowledge and skills for paediatric patients |         |                 |

COMPETENT / NOT YET COMPETENT (circle)

*Requirement to be competent in shaded elements is dependent upon the candidate’s workplace responsibilities.

Competency must be evident in all other elements to obtain a 'competent' grade. Only those elements where performance is 'not yet competent' need to be repeated satisfactorily to pass.

Competency is current for one year in accordance with policy M 2.

Candidate/Assessor comments:

Assessor to initial where candidate competent:

☐ Adult Advanced Life Support (mandatory elements)

☐ Synchronous Cardioversion ☐ Transcutaneous Pacing ☐ Paediatric Advanced Life Support (optional)

Candidate’s signature & print name: .................................................. Date: ..................

Assessor/s signature/s & print name: .................................................. Date: ..................

Bendigo Health, Nursing Education Faculty 2011 Education Curriculum for Basic Life Support (Health Professionals) Internal document
APPENDIX D.

EXAMPLE ALS SCENARIO

The following ALS scenario is representative of the type of scenario you may encounter as part of your competency assessment, so may assist you in your preparation.

Mrs. D is a 50 year old who has arrived in your department following an inferior AMI. She complains of chest pain despite morphine. This rhythm is seen on the cardiac monitor:

![ECG Image]

Q- What is this arrhythmia?  
**Answer- Bradycardia**

She states she feels faint. Her SBP is 90mmHg, her GCS is 14 and her skin is pale and moist. The patient has high flow oxygen and IV access insitu.

Q- What intervention is required?  
**Deliver Atropine.**

Q’s:  
Action? Parasympathetic blockade, sympathetic effects eg. increased HR  
Dose? 0.5mg boluses to max 2.5mg  
Route? IV  
Adverse effects? Tachyarrhythmias, angina, dry mouth ..............

Q- Demonstrate the use of a Min-i-jet.

After increments of atropine, the heart rate is unchanged and the patient’s BP is now 80mmHg, GCS 12.

Q- What is the next drug given?  
**Adrenaline infusion**  
Action? Alpha (peripheral vasoconstriction) and beta adrenergic (∆contractility & heart rate)  
Dose? Infusion prepared as per protocol and commenced at 2mcg/min  
Route? IV  
Adverse effects? HT, tissue necrosis, metabolic acidosis……

As you are preparing for delivery of the infusion, you observe this on the cardiac monitor:
Q- What do you do?
DR (unresponsive)
S
AB (not breathing)
C commence chest compressions +/- pulse check, 
or defibrillate if immediately available- per below*.

Q- What is this arrhythmia?
VF

Q- Describe & demonstrate the intervention required:
*Demonstrate safe defibrillation as soon as defibrillator available
200J (Biphasic defibrillator)
OR
360J (Monophasic defibrillator)

then CPR 2 minutes

Mrs. S remains in the arrhythmia.
Q- What else do you do?
Continue 2 minute cycles of CPR followed by a shock

Q- What else?
Adrenaline after 2nd shock and then every 2nd cycle (ie- 4 minutely)
Dose? 1mg
Routes? IV

Q- What volume of IV Normal Saline flush is required?
20-30ml

Q- Can any other drug be considered as well?
Amiodarone between 3rd and 4th shock
Action? Antiarrhythmic that prolongs the refractory period of atrial, nodal & ventricular cells.
Dose? 300mg over 2min
Routes? IV
Adverse effects? Bradycardia, hypotension........

Q- What else can be considered?
Correct reversible causes
Advanced airway, oxygen, waveform capnography
Plan actions before interrupting compressions

Q- If IV access is unobtainable, what route can be considered for adrenaline delivery?
Intraosseous- same as IV dosing
Or via ETT
Q- Describe the ETT method of adrenaline administration:
Dose? 3-10mg (3-10 times the usual IV dose of the drug)
Suction
Syringe only with no needle attached.
Pre-oxygenate with 2 insufflations
Dilute drug with Water for injection (or normal saline)
Distributed with 2 insufflations of bag

Mrs. S. reverts to a sinus rhythm.