Alert the Emergency Team.

Dial 777

Specify PAEDIATRIC CODE BLUE (i.e. Paediatric Arrest)

Tell the operator the following information
H Hospital e.g. Starship and whether adult or paediatric patient
E Extension you are calling from
L Location e.g. 24B room 6
P Problem e.g. paediatric code blue

Drug Calculator:

A calculator for Paediatric resuscitation Drug doses can be found on the ADHB Intranet at L:Groups\EVERYONE\Starship\Paed Resus Form

N.B. These guidelines apply to the resuscitation of infants (beyond the newborn period) and children (until puberty)

For neonatal resuscitation please refer to http://www.adhb.govt.nz/newborn/teachingresources/resuscitation/resuscitation.htm

For adult resuscitation please refer to Adult CPR guideline

Disclaimers:
This guideline is intended for health professional use in the hospital resuscitation setting. Lay rescuers should refer to the NZRC guideline: http://www.nzrc.org.nz/assets/Uploads/arcbasiclifesupport.pdf
Cardio-pulmonary Resuscitation

Algorithm

Advanced Life Support for Infants and Children

**Start CPR**
- 15 compressions : 2 breaths
- Minimise Interruptions

**Attach Defibrillator / Monitor**

- **Shockable**
  - **Shock** (4 J/kg)
  - CPR for 2 minutes

- **Assess Rhythm**

- **Non Shockable**
  - **Adrenaline** 10 mcg/kg (immediately then every 2nd cycle)
  - CPR for 2 minutes

- **Return of Spontaneous Circulation ?**

**Post Resuscitation Care**

**During CPR**
- Airway adjuncts (LMA / ETT)
- Oxygen
- Waveform capnography
- IV / IO access
- Plan actions before interrupting compressions (e.g. charge manual defibrillator to 4 J/kg)
- **Drugs**
  - **Shockable**
    - * Adrenaline 10 mcg/kg after 2nd shock (then every 2nd cycle)
    - * Amiodarone 5mg/kg after 3rd shock
  - **Non Shockable**
    - * Adrenaline 10 mcg/kg immediately (then 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)
CARDIOPULMONARY RESUSCITATION (CPR)

ABC - Assess and Manage

Ideally the assessment and management of Airway, Breathing and Circulation should occur simultaneously

Airway

- Position head to open obstructed airway ("neutral" position, not excessively extended or flexed)
- Immobilise cervical spine if trauma
- Jaw thrust or chin lift if still obstructed
- Suction under direct vision if necessary
- Place a Guedel airway if appropriate
- Intubate if necessary

(Note that intubation should only be performed by proficient personnel and should not delay other resuscitation efforts. It will usually be performed after basic life support has been initiated.)

- Endotracheal Tube size – estimated by \[
\left( \frac{\text{Age(years)}}{4} \right) + 4 \] - uncuffed
\[
\left( \frac{\text{Age(years)}}{4} \right) + 3.5 \] - cuffed

Breathing

- If absent or ineffective, start ventilation with a blob mask or bag mask ventilation if competent
- 2 initial breaths
- If patient has adequate respiratory effort place in high flow (>10 L/minute) oxygen via mask
- During active resuscitation the highest available concentration of oxygen should be given
- End Tidal CO$_2$ – continuous End Tidal CO$_2$ monitoring should be used wherever possible
- No End Tidal CO$_2$ with chest compressions – suggests lack of ventilation – check airway (Endotracheal Tube) and ventilation
- Low End Tidal CO$_2$ – suggests inadequate chest compressions, excessive ventilation or a reversible cause like pneumothorax or hypovolaemia or tamponade
- High End Tidal CO$_2$ – suggests inadequate ventilation
- Return of spontaneous circulation may be identified by rapid rise in end tidal CO$_2$
## CARDIOPULMONARY RESUSCITATION (CPR)

**Circulation**

- **PUSH HARD, PUSH FAST, DON’T STOP**
- **Compression Rate**: 100/minute
- **Compression/Respiration ratio**: 15:2

- Check for signs of circulation
  - Unresponsive, absent or ineffective breathing
  - This may include feeling for a brachial or femoral pulse, if absent or inadequate (e.g. less than 60/minute) commence external cardiac compressions
  - If there is any doubt regarding the presence of adequate circulation, then chest compressions must be started

- The lower sternum should be compressed by at least 1/3 of the AP diameter, >5cm (>4cm in infants).
- **DO NOT INTERRUPT** compressions
- Pauses should be brief (ideally <10secs) and only to ascertain presence of a pulse and assess the rhythm or to allow intubation or defibrillation
- If patient is on a bed, a CPR board should be placed under the patient as soon as possible
- Swap in a new person to deliver compressions at frequent intervals (2mins) to avoid inadequate compressions due to rescuer fatigue
- Ensure recoil of chest as well as compression

**NEVER INTERRUPT CPR FOR MORE THAN 10 SECONDS EXCEPT FOR DEFIBRILLATION**

**Obtain ECG rhythm**

This will normally occur **simultaneously** with above manoeuvres or as soon as equipment arrives. Monitoring must be done with a monitor or the manual defibrillator not an Advisory External Defibrillators (AED).

**Defibrillation**

Early defibrillation is associated with improved outcome – consider this as early as possible in the management sequence if the rhythm is suitable for defibrillation.

DC shocks for VF and VT should be delivered asynchronously, at a dose of 4J/kg

Adhesive pads should be used (instead of paddles) whenever possible

See **Appendix 1** for information on Advisory External Defibrillators (AEDs).
**Medications**

**Obtain venous access**
Attempt to obtain IV access in a large vein (antecubital fossa, external jugular vein) or place an intraosseous (IO) needle. If no success within 1 minute (usually = 1 attempt) proceed to IO. See Appendix 2.
All fluids and all medications on the algorithms can be given via IO route (these need to be ‘pushed’ as will not run in without pressure).

Obtaining venous access should take place simultaneously with other aspects of resuscitation. Initial drugs (epinephrine (adrenaline), atropine, and naloxone) can be given via ET tube pending intravenous access.

Dosing should be based on weight, length is the best method for estimating weight.

**Medication selection**
- Follow the appropriate algorithm based on the ECG rhythm
- High dose adrenaline should not be used (associated with worse outcomes)
- Calcium should not be used routinely (associated with worse outcomes). Calcium is only indicated in the management of hyperkalaemia, hypocalcaemia, hypermagnesaemia or calcium channel blocker overdose.
- Sodium bicarbonate should not be used routinely

**Disability**
Check:
- Level of consciousness (AVPU or GCS)
- Pupils
- Posture
- Glucose - should be measured early

**Exposure**
Beware of temperature loss, which can occur rapidly.

**Secondary Survey**
This is performed by the resuscitation team leader as soon as airway, breathing and circulation are stable. Unstable patients should be reassessed from ABC down at frequent intervals.
The secondary survey involves a detailed clinical examination, aiming to determine possible causes of the episode.
Blood is usually drawn for appropriate laboratory investigation at this stage.
Emergency Team Roles - Medical Roles

The Event Manager (Team Leader)

- Usually the most senior or experienced member of the team
- Identifies self to team and assumes primary responsibility for patient
- Allocates medical staff roles
- Coordinates life support, directs primary and secondary survey and ongoing care of patient
- Summarise patient condition and progress with updates to team
- Signs off on all drugs at conclusion of event
- Makes decisions regarding cessation of resuscitation on discussion with team

Personnel participating in the resuscitation should primarily accept orders from the event manager. Orders should be directed to a specific team member by name. Team members should clearly state back the orders they receive before performing the action, and announce clearly when they have completed the action (closed loop communication)

Junior medical staff may be allocated a number of different roles or responsibilities including airway management, vascular access, defibrillation, medication administration etc.

- If assigned to gather further background information a brief focused history should be obtained from caregivers, the patient’s chart or other sources in the following format
  - A   Allergies
  - M   Medications
  - P   Past history
  - L   Last ate/drank
  - E   Events leading to arrest

Consultants attending a resuscitation must make it clear to their respective registrar, who is running the resuscitation. If the Consultant wishes to take an observing or hands off supervisory role this should be explicitly stated.

Emergency Team Roles – Nursing Role in Ward Areas

Nursing Team Leader (usually senior ward nurse)

- Identifies self as Nursing Team Leader, responsible for co-ordinating and directing emergent nursing care of the patient.
- Checks appropriate emergency call has been placed
- Starts timer as soon as the Emergency trolley arrives.
- Delegates available staff to roles appropriate to their level of practice: Airway, Compression, Monitor & Medications and Runner to collect or remove extra equipment, supplies, labs etc.
- Establishes the patient’s weight and delegates someone to print out an Emergency Drug Worksheet (Icon on desktop of clinical computers).
- Ensures that the patient is placed on CPR back board.
- Reassigns nursing staff once the PICU nurse and additional staff arrive as required.
- Ensure someone is assigned to support family members.
- Documents initial and ongoing vital signs and cardiac rhythm, medication administration, procedures and patient’s response to interventions on the ACH/Starship Resuscitation record (CR8545).
CARDBOPULMONARY RESUSCITATION (CPR)

- Monitors the time interval between adrenaline administration and prompts the Team Leader when 4 minutes has passed since last dose administered.
- Completes, including a brief summation of presenting events and signs the ACH/Starship Resuscitation record (CR8545).
- Ensures the outside copy of the CR8545 form is placed on the Charge Nurse desk and the inside copy is placed in the clinical record.

Airway Nurse (usually the patient’s nurse or the nurse who finds the patient)
- Summons help and initiates CPR as required until initial assistance arrives and then assumes responsibility for airway management.
- Maintains airway patency with use of airway adjuncts as required (suction, high flow oxygen, via Hudson mask, blob mask with O2 or bag valve mask ventilation).
- This role becomes the responsibility of the PICU nurse on their arrival.
- Assist with intubation and securing of ETT
- Inserts gastric tube and/or facilitates gastric decompression post intubation as required.
- Assists with ongoing management of airway patency and adequate ventilation
- Supports less experienced staff by coaching/guidance e.g. drug preparation

Compression Nurse
- If CPR in progress, assume responsibility for cardiac compressions (this includes ensuring that staff doing compressions are changed at regular intervals (eg every 2 minutes) to avoid fatigue resulting in inadequate compressions being delivered)
- Assess pulses (including pulse volume) and capillary refill as required

Monitor and Medication Nurse
- Placement of monitors: ECG, O2 saturation and BP
- If a shockable rhythm is present (VF/VT) ensure AED or manual defibrillator pads are applied and connected.
- If CPR is in progress, prepare and independently double check and label 3 doses of adrenaline
- Prepare appropriate medications as per Team Leader request
- Prepare and administer IV fluids as per Team Leader request
- Announce medications to the Team leader as they are being administered.
- Document medications administered (including time)

Duty manager/CNA
- Delegated to one of the above roles by the Nursing Team Leader as required.
- Supports less experienced staff in the above roles as required
- Communicates with all appropriate services when requested, this includes OR and PICU
- Ensures other patients on the ward are adequately cared for and identifies and amends departments staffing requirements
- Ensures breaks for staff following large resuscitations

Starship Orderlies
- Delivers the manual defibrillator and resuscitation case to appropriate area
- Available to obtain additional supplies and transport specimens
It is vital that people not formally part of the Emergency Team do not take on ad hoc roles, obstruct access and confuse lines of responsibility. Extraneous people will normally be requested to leave the room and can best assist by proceeding with the more routine work of the department/ward.

**Post-Resuscitation Management**

Any child successfully resuscitated from a cardiorespiratory arrest should be admitted to PICU.

- **Oxygen**
  - Aim for oxygen saturations of 94 to 98% (PaO₂ 60 to 80 mmHg)
- **Ventilation**
  - Avoid hypo or hypercarbia
- **Perfusion**
  - Maintain adequate blood pressure – inotropes may be required
- **Temperature**
  - Hyperthermia should be avoided
  - Cooling may be used post resuscitation. Therapeutic hypothermia (32-34°C) induced within 6 hours of cardiac arrest and maintained up to 72 hours may optimise neurological outcome.
- **Glucose**
  - Avoid significant hypo or hyperglycaemia

**Ceasing Resuscitation Efforts**

This must be the decision of the team leader, on discussion with other senior members of the team.

In general, if CPR has continued for 30 minutes or more with no return of a stable cardiac rhythm/output, then continued resuscitation is futile. The usual outcome of children transported to hospital in a pulseless state is death (95%). Neurological function of survivors is almost invariably poor.

In some clinical situations, especially in CED, PICU or operating rooms with consultant staff present, it will be appropriate to cease resuscitation efforts much earlier than this.

If the arrest was observed it may be appropriate to continue for longer, particularly if effective CPR and O₂ have been administered from the outset.

It is helpful to clearly state to all present the reasons for stopping resuscitation at the time this decision is made, especially if parents are present in the resuscitation room.
Parents and Family

We support family to be present during the resuscitation if this is their wish. In retrospect most families report this to be helpful even if the child dies. Frequent plain language updates should be given.

Most children who suffer out of hospital cardio-respiratory arrest die. These events are usually sudden and unexpected. Parents react in widely varied ways, but much can be gained by appropriate support for them at this stage. Providing this support may be more stressful and time consuming than the resuscitation itself, but we believe that this is very important to assist the family to resolve issues such as guilt and fear of future events.

The following points have been described as helpful by families who have experienced sudden death of a child:

During resuscitation
- Give accurate honest plain language information
- Provide for privacy & physical needs
- Allow for hope while resuscitation is proceeding
- Give frequent brief updates
- Allow the family to stay in the room if they wish, supported by a staff member

Informing of death
- Use the child's name
- Use the words death or died (not euphemisms)
- Allow the family time and space to express their emotions
- Specifically address issues of guilt and pain eg. Was it my fault? Was there much pain? Why did it happen? What will happen now?

Viewing the child
- Most parents will want to hold the child and spend time alone / with partner and the child
- Warn the family about tubes, wires, blood and discolouration before they view the child
- Time needed may be minutes to several hours
- When the family leaves the room, a staff member should stay with the child
- If there is any suspicion of non-accidental injury a staff member must remain with the child at all times until collected by the police.

Other support
- The family should be assisted to contact other relatives, clergy, and community support groups as available
- Parents may wish to participate in final care of the child - washing, dressing, obtaining photographs, palm or foot prints and lockets of hair
- Provide a contact telephone number for the family for further questions
- Contact the child's usual health practitioners
- Arrange follow up: a further meeting between the family & paediatrician is helpful several weeks later - there are usually many questions at this time
Documentation Requirements

ACC form

- Assistance may be available to the family from the ACC for funeral and other costs if the death was due to injury.

Notification of Coroner

- Virtually all deaths in CED and many deaths in the rest of Starship will be Coroner’s cases.
- Refer to Deaths Reported to the Coroner guideline.

- An “autopsy form” must be completed by a doctor and be handed to police or accompany the child’s body to the mortuary.

- A “statement of identification form” must be completed for the police by either a doctor or family member.

Death Certificate

In most cases a death certificate cannot be provided for a child who dies in CED, refer to Death Reported to the Coroner guideline - Documentation but should be completed for all deaths that are not coroner’s cases.

Police interview

In most coroners cases the police will wish to speak briefly with a staff member to document further the circumstances of death. In general the most senior member of medical staff available should speak to the police.

Bereavement Form (CR2043) should be completed and faxed to x5926

References


Appendix 1 - Advisory External Defibrillators (AEDs)

Children > 8 years
- AEDs may be used
- Paediatric energy adjustment is not required

Children ≤ 8 years
- Manual defibrillator is preferred
- AEDs may be used
  - Ideally with “teddy bear” paediatric pads for the FR2 AED (which reduce energy delivered to 50J).
  - If these are not available then defibrillate without energy adjustment

Appendix 2 - Intraosseous Insertion

Intraosseous (IO) infusions are a safe and reliable means of delivering drugs and fluids in patients when intravenous access is unavailable. Drugs should be flushed with 10mls of normal saline. IO fluids require pressure assisted flow as gravity flow is generally slow. Relative contraindications include osteoporosis, osteogenesis imperfecta, fractured bone, recent use of the same bone for IO infusion, or insertion through areas of cellulitis, infection, or burns. In most resuscitations at Starship if intraosseous access is required the EZ-IO drill is used.

1) Identify the infusion site.
   - The landmarks for the upper tibial and lower femoral sites are shown below.

<table>
<thead>
<tr>
<th>TIBIAL</th>
<th>FEMORAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior surface, 2 - 3 cm</td>
<td>Anterolateral surface, 3 cm above</td>
</tr>
<tr>
<td>below the tibial tuberosity</td>
<td>the lateral condyle</td>
</tr>
</tbody>
</table>

2) Clean the skin over the chosen site

3) EZ-IO drill
   a) Attach appropriate length needle to drill
   b) Insert needle at 90° to the skin (at least 5mm of needle must be free from skin upon contact with cortex
   c) Drill through cortex

4) Cook IO needle
   a) Grasp needle with fingers and thumb near tip of needle and flat plastic portion resting in palm
   b) Insert the needle at 90° to the skin
   c) Continued to advance the needle with a twisting motion until a give is felt as the cortex is penetrated

5) Attach the 5 ml syringe and aspirate or infuse to confirm correct positioning

6) Attach the filled 50 ml syringe and push in the infusion fluid in boluses
7) Possible Complications
- Extravasation of fluid - especially in fractured bone or after previous IO attempts in same bone
- Infection - osteomyelitis, cellulitis
- Epiphyseal injuries - decrease risk by observing landmarks and keeping needle perpendicular to bone
- Fat embolism - theoretical complication only