NHS
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Ambulance Service
NHS Foundation Trust

Trust Clinical Guideline

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1. Scope

1.1 The challenge for ambulance clinicians is to differentiate those patients for whom cardiac arrest is their natural end of life event from those where there is a chance to restore life with a quality acceptable to the patient and in accordance with their wishes.

1.2 This clinical guideline aims to promote the concept of a ‘good death’ for those patients for whom resuscitation is not indicated or would be futile, whilst providing optimum out of hospital care for those with the chance of a positive outcome.

1.3 This guideline must be read in conjunction with current Resuscitation Council UK guidelines.

1.4 The term ‘Enhanced Care support’ is used throughout this document to encompass the additional clinical skills currently available within the Trust. These currently include Specialist Paramedic- Critical Care, HART team and BASICS.

2. Background

2.1 The management of cardiac arrest within the Trust follows the 2015 Resuscitation Council UK Guidelines.[1]

2.2 Confirmation of Death is the term used by the Trust to describe the JRCALC terminology of Recognition of Life Extinct (ROLE).[2] The term 'Enhanced Care support' will be used throughout this document to encompass the additional clinical skills currently available within the Trust. These currently include Specialist Paramedic- Critical Care, HART team and BASICS.

3 Confirmation of Death

3.1 Confirmation of death is the procedure whereby a Trust clinician either decides not to start resuscitation, or stops resuscitation once it has been started. The authority to confirm death is dependent on clinical grade, as detailed in Table 1.

3.2 Table 1 - Authority to Confirm Death by Clinical Grade

	CFR/ Co-Responder	ACA	ECA/Student Paramedic	Advanced Tech/ Practitioner	Nurse	Newly Qualified Paramedic (NQP)	Paramedic	Specialist Paramedic (Critical Care)	Senior Clinical Advisor	Doctor
Conditions unequivocally associated with death	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Conditions when resuscitation can be discontinued without ALS (or not commenced at all)	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓
Conditions when resuscitation can be discontinued following ALS	✗	✗	✗	✓	✓	✓ 1	✓	✓	✓	✓
Authorising cessation outside of guidance	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓

1. Newly Qualified Paramedics must seek clinical validation to discontinue ALS, as detailed in SOP C08 Newly Qualified Paramedic, Ambulance Technician, Ambulance Practitioner Clinical Validation.

3.3 Conditions Unequivocally Associated with Death

3.3.1 The following conditions are unequivocally associated with death in all age groups; in all other cases resuscitation should be considered, whilst facts pertaining to the arrest are established:

- Massive cranial and cerebral destruction.
- Hemicorporectomy (amputation below the waist) or similar massive injury.
- Decomposition/putrefaction.
- Incineration.
- Hypostasis.
- Rigor mortis.
- Foetal maceration.

3.3.2 Appendix I provides a timeline of features that occur post death such as algor mortis, livor mortis (post mortem hypostasis) and rigor mortis.

3.4 Conditions When Resuscitation can be Discontinued without ALS (or not Commenced at all)

3.4.1 Resuscitation can be discontinued in all age groups without ALS (or not commenced at all), if **any** of the following are present:

- The presence of a valid DNAR (Do Not Attempt Resuscitation) order, Treatment Escalation Plan (TEP) advising not for resuscitation or an Advanced Decision to Refuse Treatment (Living Will) that states the wish of the patient not to undergo attempted resuscitation. A DNAR decision does not override clinical judgement in the event of a reversible cause of the patient's cardiac/respiratory arrest e.g. patient choking, anaphylaxis or trauma. CFR's and Co-Responders are also supported to follow any of these documents, in line with their training. Where there is any uncertainty, CPR should be commenced until an ambulance clinician arrives.
- Submersion for longer than 1.5hrs. (See Para 3.4.2).
- Patient is in the final stages of a terminal illness where death is imminent and unavoidable and CPR would not be beneficial, but for whom no formal DNAR decision has been made.
- Based on the information available, the senior clinician (Paramedic, Nurse or Doctor) on scene agrees that resuscitation would not be in the best interest of the patient, as progressive disease or terminal illness would mean that death is imminent and unavoidable.

- Efforts would be futile as **all** of the following exist together:
  - 15 minutes since the onset of collapse.
  - No bystander CPR prior to arrival of the ambulance.
  - Absence of any exclusion factors (hypothermia, poisoning, pregnancy).
  - Asystole rhythm for more than 30 seconds on the ECG monitor screen.

3.4.2 In the case of patients who have experienced submersion, resuscitation should be commenced where **ANY** of the following are present:

- Possibility of their patient being able to breathe from a pocket of air while underwater.
- Anyone showing any signs of life on initial rescue.
- Those whose airway has been only intermittently submerged for the duration of their immersion, e.g. Those wearing lifejackets but in whom the airway is being intermittently submerged, provided the body still has a reasonably fresh appearance.

3.5 Conditions When Resuscitation can be Discontinued Following ALS

3.5.1 For the purpose of cessation of resuscitation, Advanced Life Support is defined as consisting of all of the following elements:

- A registered clinician in attendance (Nurse, Paramedic, Specialist Paramedic, Doctor).
- Reversible causes have been considered and addressed.
- Airway is patent, using an airway device as necessary.
- Ventilation is effective, confirmed with $ETCO_2$ capnography.
- If indicated, defibrillation has been delivered.
- Drug therapy has been administered in accordance with resuscitation guidelines.

3.5.2 Resuscitation can be discontinued once ALS has commenced if the patient remains in asystole or agonal (broad idioventricular rhythm with a rate of 10 or less per minute, as defined in Para 3.5.4) rhythm for at least 20 minutes.

3.5.3 Patient is in the final stages of a terminal illness where death is imminent and unavoidable and further ALS would not be beneficial, but for whom no formal DNAR decision has been made.

3.5.4 Based on the information available, the senior clinician (Paramedic, Nurse or Doctor) on scene agrees that further resuscitation would not be in the best interest of the patient, as progressive disease or terminal illness would mean that death is imminent and unavoidable.

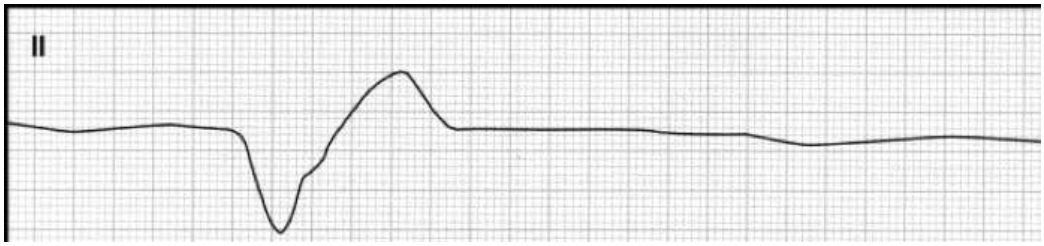
3.5.5 Where there is a suspected cause of drowning or drug induced cardiac arrest, the clinician should apply clinical judgement as to whether the attempt is futile.

3.5.6 An agonal rhythm is a terminal event in the dying process, caused by the death of the myocardium. It does not respond to treatment and is usually the last rhythm before asystole. Resuscitation may only cease under the agonal rhythm criteria in Para 3.5.1 when the senior clinician on-scene can confirm the presence of a broad idioventricular rhythm with a rate of 10 or less per minute. If there is any doubt as to whether the rhythm is agonal or PEA (e.g. the complexes are narrow or faster than 10 per minute), the patient must be managed as a PEA arrest.

3.5.7 The following points are provided as a general guide to the presentation of an agonal rhythm, which is also pictured in Figure 1:

- Rate: Pattern tends to slow as the myocardium progressively dies. Often under 10 complexes per minute;
- Rhythm: Regular or irregular;
- Atrial conduction: P waves are usually not present;
- Ventricular conduction: QRS complexes are wide and often bizarrely shaped. The QRS complexes become broader with a decreasing amplitude over time.

3.5.8 Figure 1 - Example of an Agonal Rhythm



3.6 Cessation Outside of Trust Guidance

3.6.1 Cessation of resuscitation at scene outside of the criteria detailed within this guideline, may only occur in the following situations:

- Doctor is on scene, takes responsibility for the decision and documents their decision rationale on the PCR.
- Specialist Paramedic (Critical Care) or a member of the Senior Clinical Advisor rota is on scene.
- Following discussion with the Senior Clinical Advisor (SCA) on-call. The call must be undertaken on a recorded line, with the SCA details recorded on the PCR. Follow SOP C09 to request a discussion with the SCA via the Clinical Hub.

3.7 Actions Following Confirmation of Death

3.7.1 Deceased Children

3.7.1.1 When a child dies unexpectedly, they must be transported to a suitable Emergency Department, unless instructed otherwise by a Senior Police Officer. Please contact the ED prior to transporting the child if there is any uncertainty as to whether it is suitable.

3.7.1.2 Where the child had a pre-existing condition with a TEP or end of life planning in place, these advanced decisions should be adhered to and named professionals consulted if necessary.

3.7.1.3 In cases where a child is left at the scene to facilitate a Police investigation, the Trust will transport the body to an appropriate ED when subsequently requested to do so by the Police.

3.7.1.4 In some cases, siblings may be unknowingly exposed to the same risks as the deceased child. Therefore, any twin/multiple birth sibling of the deceased child **must** be conveyed to an appropriate ED to enable clinical assessment by a paediatrician to rule out congenital disorder, infection or other condition and to ensure that urgent medical screening actions can be taken.

3.7.1.5 Consideration must be given to the need for clinical assessment of other siblings in the property if the death is unexpected and the cause of illness is unknown. In each case the resuscitation and treatment of the initial child takes precedence. Consideration should be given to requesting additional support to scene to facilitate assessment of the siblings if required.

3.7.1.6 Always be alert to safeguarding concerns for other siblings.

3.7.2 Adult death in a public place:

- Contact the Clinical Hub to request attendance of Police.
- Do not move the body.
- Complete Trust documentation.
- Remain on scene until released by Police.
- Conveyance of the body by ambulance should only be carried out in exceptional circumstances.
- If confirmation of death is made when the patient is already in the ambulance and the ambulance clinician decides to convey the deceased patient to hospital, advise Clinical Hub and request Police to attend destination hospital. On arrival at hospital follow local procedures for handover of a deceased patient. The default is to handover to an appropriate Emergency Department.

3.7.3 Adult expected death in a non-public place:

- Police would not normally be required to attend provided end of life arrangements can be confirmed.
- Liaise with family/carer to contact preferred funeral director.
- Notify Clinical Hub that Police are not required to attend. Notify patient's GP.
- Ambulance clinicians may leave the body in the care of a responsible person to await the arrival of the funeral director.

3.7.4 Unexpected adult death in a non-public place:

- Police must be requested to attend in their capacity as Coroner's representatives. Contact via Clinical Hub.
- Provided that there are no suspicious circumstances, the ambulance clinician should consider the need to remain on scene once confirmation of death procedure has been completed.
- Consider the needs of the bereaved; if well supported it may be appropriate to complete all documentation and withdraw from scene, with the body being left in the care of a reasonable person.
- Where appropriate, provide copy of the bereavement leaflet.

3.7.5 If suspicious circumstances are suspected:

- Minimise contamination of scene.
- Contact Clinical Hub to request attendance of Police.
- Complete Trust documentation.
- Remain on scene until released by Police.

3.7.6 It is the responsibility of the Police to inform relatives that are not present of the death of a person attended by the ambulance service.

4. Increasing the Effectiveness of Resuscitation

4.1 In the majority of out of hospital cardiac arrests, the best chance of return of spontaneous circulation is achieved by carrying out the resuscitation attempt at the scene of the collapse. Research suggests that CPR is significantly less effective both when moving a patient to an ambulance and during conveyance to hospital. The exceptions to this, are patients in cardiac arrest following penetrating torso trauma and maternity cases >20 weeks gestation, where a scoop and run approach is appropriate.

4.2 The interventions which increase the likelihood of ROSC most significantly are high performance chest compressions and defibrillation. These interventions take precedence over all other procedures in medical cases.

4.3 A solo responder should not interrupt chest compressions for any reason other than to deliver ventilations, defibrillate the patient or request assistance/back up.

4.4 IV access, drug delivery and advanced airway management require two or more responders. While these procedures are performed, interruptions to chest compressions must be kept to an absolute minimum.

4.5 When a suitable number of responders are present, the Trust Cardiac arrest checklist should be utilised and one team member of **any** grade should adopt the role of arrest leader by following the checklist.

5. Adult Basic and Advanced Life Support

5.1 Adult basic and advanced life support must be performed in accordance with Resuscitation Council UK Guidelines (2015), as detailed in Appendix A and B.

5.2 Where resuscitation is indicated (refer to Section 3), the first action is to apply defibrillation pads and ascertain the presenting rhythm. When two responders/clinicians are present, one operator should commence uninterrupted chest compressions until the defibrillator pads are attached to the patient.

5.3 When a suitable number of responders are present, allocate a team leader and utilise the SWAST Cardiac Arrest Checklist:

- The team leader can be of any grade or a CFR who is confident to adopt the role- it does not need to be the senior clinician on scene.
- They should maintain situational awareness and observe the whole environment.
- Co-ordinate activities and assign tasks to named individuals.
- Plan and prepare ensuring all information is shared with the team.

5.4 Adult Chest Compressions

5.4.1 Compress the chest at a rate of 100-120 per minute. The rate refers to the speed at which compressions are given, not the total number delivered in each minute. Each time compressions are resumed, place your hands without delay in the centre of the chest, ensure the full compression depth of 5-6 cm is achieved.

5.4.2 Allow the chest to recoil completely after each compression and take approximately the same amount of time for compression and relaxation. Combine compressions with ventilations at a ratio of 30:2. If airway is secured with a supraglottic airway (with adequate seal) or endotracheal tube, commence uninterrupted chest compressions at a rate of 100-120 per minute (except for defibrillation or further assessment as indicated).

5.4.3 Minimise interruptions in chest compressions and rotate the carrying out of chest compressions to avoid fatigue and to help maintain quality of CPR. Over-the-head CPR and straddle CPR may be considered for resuscitation in confined spaces.

5.4.4 Consider requesting CCP back up to enable the use of mechanical CPR delivery, where resuscitation is likely to be prolonged or is in a confined space.

5.5 Adult Airway and Ventilation

5.5.1 Each inspiration phase of ventilation should be delivered over 1 second. There should be a pause of no longer than 5 seconds between sets of chest compressions to deliver the ventilations. Ventilate 10 - 12 times per minute to avoid hyperventilation. Add supplemental oxygen as soon as possible, provided this does not adversely impact on performing chest compressions.

5.5.2 Manage the airway using a stepwise approach, in line with Clinical Guideline (CG03) Airway Management. If the airway is secured with an endotracheal tube, the tube verification procedure detailed in CG03 **must** be completed.

5.5.3 **Waveform $ETCO_2$ monitoring (capnography) must be applied to all patients who are ventilated via supraglottic airway (e.g. igel) or endotracheal tube, according to Clinical Guideline (CG11) End Tidal CO_2 Monitoring. Failure to use appropriate $ETCO_2$ monitoring is a serious risk to patient safety, and any such incident will be considered under the Disciplinary Policy.**

5.5.4 Where the cause of the arrest is thought to be due to asthma, COPD or an anaphylactic reaction and there is resistance to ventilation, consider the benefit of early intubation and utilise the T-piece as indicated in Clinical Guideline (CG22) T-Piece Nebulisation.

5.6 Adult Defibrillation

5.6.1 All defibrillators within SWASFT should be used in the AED mode during any resuscitation attempt.

5.6.2 Where the function is available, manual mode should only be used where:

- It is necessary to override the unit e.g. in the case of pulsed VT where the defibrillator advises a shock.
- The senior clinician on scene judges that there are sufficient responders present to ensure active monitoring of the defibrillator, and bandwidth exists to support this as an individual function. If in any doubt that this capability exists, continue in AED mode.

5.6.3 When used in manual mode, to minimise the pre-shock pause, chest compressions should continue whilst the defibrillator is charging. The rapid charging time of the Zoll AED Pro may prevent this from occurring.

5.6.4 As with manual analysis, CPR must not be conducted whilst the defibrillator is analysing the rhythm.

5.6.5 For safe practice, the operator delivering chest compressions must be the only one to press the shock button.

5.6.6 Following defibrillation, immediately resume CPR for two minutes without re-assessing the rhythm or feeling for a pulse.

5.7 Adult Drugs

5.7.1 Obtain access using a stepwise approach:

- Attempt IV cannulation at standard sites (e.g. ACF, arm).
- Review potential to insert cannula into a leg, foot or other unconventional site.
- Consider external jugular vein (EJV) access (where competent and trained to do so). EJV is an underutilised technique that may be obtained as quickly as IO, and offers excellent flow rates without the IO related issue of needing to push fluids.
- If IV or EJV access cannot be obtained in a timely fashion, obtain IO access inline with Clinical Guideline CG13 Intraosseous Access.

5.7.2 Administer Adrenaline 1:10,000 (1mg) in accordance with JRCALC drug guidelines, with subsequent doses every 3-5 minutes whilst the patient remains in cardiac arrest (if hypothermic refer to Section 5.10). All IV/IO drugs should be flushed with at least 20mls normal saline. This may be achieved by setting up an intravenous infusion of 500ml normal saline with a 3-way tap device.

5.8 Refractory/Persistent Ventricular Fibrillation

5.8.1 Administer amiodarone (300mg) after the third shock (post adrenaline). A further dose of 150mg may be given if the patient remains in VF/VT after the 5th shock.

5.8.2 Consider alternative pad position e.g. Anterior/posterior. The use of double sequential defibrillation is **not** recommended by the Trust and must not be used other than by a Critical Care Doctor who is competent and confident in the technique.

5.8.3 Consider early conveyance to ED if unable to manage reversible cause on scene. Consider critical/enhanced care support to enable mechanical CPR delivery during conveyance.

5.8.4 If ROSC is achieved and the patient suffers subsequent further arrest with shockable rhythm, the defibrillation count is restarted.

5.9 Witnessed Monitored Arrest

5.9.1 A pre-cordial thump may be administered only when a patient experiences a witnessed VT/VF arrest whilst connected to an ECG monitor. If the patient is already connected to a defibrillator, a shock must be delivered. In such cases, consider delivering up to three stacked shocks before starting chest compressions.

5.10 Hypothermia

5.10.1 Accidental hypothermia is often under-diagnosed in temperate climates. In a normal person, hypothermia can develop during exposure to cold environments and in people who have been immobilised or immersed in cold water. In the elderly and very young where thermoregulation is impaired, hypothermia can follow a very mild insult. The risk of hypothermia is also increased by exhaustion, illness, injury, neglect, reduced level of consciousness or when drugs or alcohol have been ingested.

5.10.2 Severe hypothermia is associated with the depression of cerebral blood flow and oxygen requirement, reduced cardiac output and decreased arterial pressure. Patients can appear to be clinically dead because of significant depression of brain and cardiovascular function, but full resuscitation with intact neurological recovery is possible.

5.10.3 The patient's peripheral pulses and respiratory effort may be difficult to detect, therefore resuscitation should not be withheld based on clinical presentation. Consider whether on the basis of history, hypothermia is believed to be the primary cause of the cardiac arrest.

5.10.4 Pre-hospital temperature measurement is ineffective and difficult so should not be relied upon to confirm hypothermia.

5.10.5 In a hypothermic patient, resuscitation should not be withheld unless the cause of the cardiac arrest is clearly attributable to fatal illness, prolonged asphyxia, lethal injury or the chest is incompressible.

5.10.6 Palpate a major artery, obtain an ECG and look for signs of life before concluding that there is no cardiac output. If the patient is pulseless, start chest compressions and ventilations at the same rate as for normothermic patients.

5.10.7 Hypothermia can cause stiffness of the chest wall, making chest compressions and ventilations difficult.

5.10.8 It is important to prevent further heat loss from the patient's body core, by removing wet garments, protecting against heat loss and wind chill by using blankets and insulating equipment.

5.10.9 Maintain the horizontal position and avoid rough movement and excessive activity where possible.

5.10.10 The hypothermic heart may be unresponsive to cardio-active drugs and defibrillation, therefore, where the primary cause is hypothermia, double intervals between drugs should be used e.g. adrenaline every 6-10 minutes.

5.10.11 Give drugs via a large proximal vein, EJV or by intraosseous access (preferably proximal humeral site, if landmark is easily identified).

5.10.12 Consider bypass to a centre that can provide extracorporeal rewarming and telephone to discuss the case. If the transport is to be undertaken, consider mechanical chest compressions or interval compressions during transfer (these patients are 'dormant' and may not benefit from prolonged, continuous compressions).

5.11 Hyperthermia

5.11.1 Hyperthermia occurs when the body's ability to thermo-regulate fails and core temperature exceeds that normally maintained by homeostatic mechanisms. Either the body's metabolic heat production or environmental heat load exceeds the body's normal heat loss capacity, or heat loss is impaired.

5.11.2 When managing the hyperthermic patient in cardiac arrest follow standard procedures for basic and advanced life support and cool the patient rapidly to a temperature of 39°C.

5.11.3 Prognosis is poor when compared to normothermic cardiac arrests. High body temperature is capable of producing irreversible brain damage and the risk of unfavourable neurological outcome increases for each degree of body temperature above 37^{o}C.

5.12 Drowning

5.12.1 Drowning is defined as a process resulting in primary respiratory impairment from submersion/immersion in a liquid medium and is the third leading cause of accidental death in Europe.

5.12.2 Hypoxia is the most common cause of arrest in drowning but hypothermia or arrhythmia should also be considered.

5.12.3 Ensure personal safety and safety of other rescuers. Establish whether the patient was alone or if there may be other patients. Request additional resources are requested as required.

5.12.4 Palpation of the pulse as the sole indicator to confirm the presence or absence of cardiac arrest is unreliable. Use an ECG and waveform capnography $ETCO_2$ monitoring to confirm cardiac arrest.

5.12.5 Treat with normal BLS/ALS protocols, prioritising airway management and reversible causes. There is no difference in the management of salt and fresh water drowning:

- Administer high flow oxygen.
- Consider head and neck injuries which may be present if the patient dived into shallow water.
- The patient's heart may be extremely slow and external cardiac chest compressions may be required.
- Consider early tracheal intubation, as high pressure may be required for ventilation because of poor compliance resulting from pulmonary oedema.

5.12.6 Regurgitation of stomach contents is common following resuscitation from drowning and should be managed in the same way as for any cardiac arrest. In most drowning incidents patients will aspirate small amounts of water, and this is absorbed into the central circulation. Do not use abdominal thrusts or tip the patient head down to remove water from the lungs or stomach as this risks further airway contamination.

5.12.7 During prolonged immersion, patients may become hypovolaemic due to hydrostatic pressure of the water on the body. Administer IV fluids to correct hypovolaemia if indicated.

5.12.8 If submersion occurs in cold water (less than 5°C), hypothermia may develop rapidly and provides some protection against hypoxia. If hypothermia is considered to be the cause, manage as per Section 5.11.

5.13 Opiate Overdose

5.13.1 Cardiac arrest following opiate overdose (OD) is usually secondary to a respiratory arrest and is therefore associated with severe brain hypoxia, meaning prognosis is often poor. If cardiac arrest occurs, follow standard resuscitation guidelines whilst incorporating the following recommendations.

5.13.2 Administering naloxone is unlikely to cause harm and can be given where opiate OD is likely, according to JRCALC guidance. Administer incrementally until the patient is breathing adequately and is able to protect their own airway but remains in a 'groggy' state for conveyance (refer to naloxone medicine protocol).

5.13.3 Cases of suspected opiate overdose should normally be conveyed to hospital, but clinical judgement and early senior clinical advice should be considered where the senior clinician on scene believes the resuscitation attempt to be futile.

5.14 Rhythm Affecting Drugs

5.14.1 Consider the effect that rhythm affecting prescription drugs (e.g. beta blockers) and non-opiate recreational drugs may be having on cardiac output before terminating a resuscitation attempt.

5.15 Asthma

5.15.1 Cardiac arrest in the asthmatic is often a terminal event after a period of hypoxaemia, and has been linked to:

- Severe bronchospasm and mucous plugging leading to asphyxia.
- Cardiac arrhythmias due to hypoxia, stimulant drug or electrolyte abnormalities.
- Dynamic hyperinflation where a gradual build up of pressure occurs which reduces venous return and blood pressure.
- Tension pneumothorax (often bilateral).

5.15.2 Consideration of reversible causes (the 4H's and 4T's) will help identify these causes of cardiac arrest. Management of cardiac arrest in asthma patients should follow standard protocols whilst incorporating the following recommendations:

- Ventilation may be difficult because of increased airway resistance,
- If dynamic hyperinflation is suspected during CPR, manual compression of the chest wall and/or a period of planned apneoa achieved by disconnecting the BVM and catheter mount from the tracheal tube, may relieve gas trapping.
- Consider the use of the T-piece to support nebulisation as detailed within Clinical Guideline (CG22) T-piece Nebulisation. Use caution due to the risk of barotrauma due to overinflating the chest.
- There is a significant risk of gastric inflation and hypoventilation of the lungs when ventilating a severe asthmatic, therefore consider intubating early where required.
- Look for evidence of reversible causes, specifically tension pneumothorax and bilateral pneumothoraces.
- Decompress suspected pneumothoraces and consider enhanced/critical care support to perform finger thorocostomy.

5.16 Anaphylaxis

5.16.1 Anaphylaxis is a severe, life threatening allergic reaction of rapid onset, which results in a generalised or systemic hypersensitivity reaction. All allergic reactions should be managed according to Clinical Guideline (CG04) Allergic Reactions. Should cardiac arrest occur, manage the patient with the following considerations:

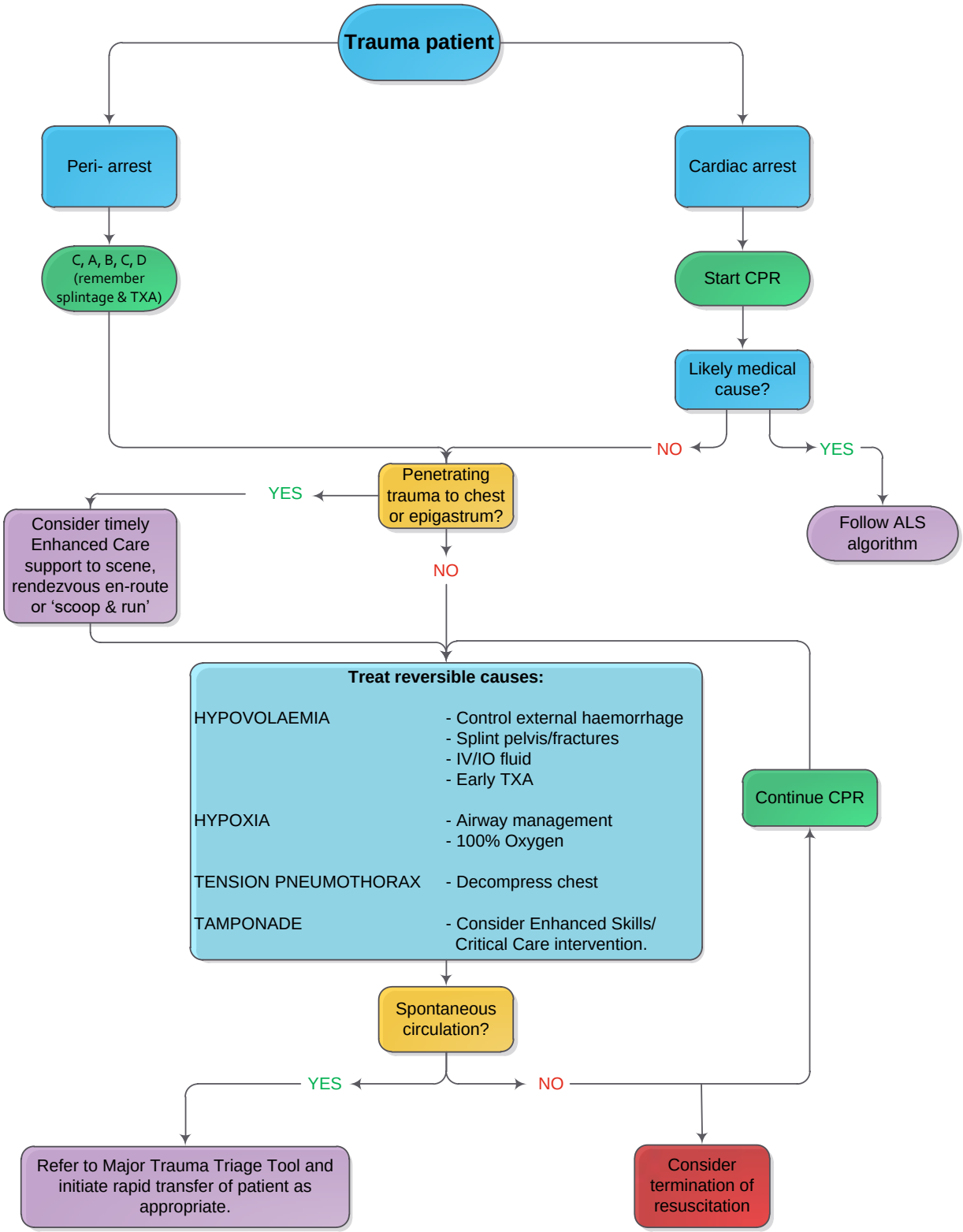
- Consider the use of steroids, antihistamines (if not already administered) and large amounts of fluids.
- Prolonged resuscitation may be required.
- In patients with angioedema and severe anaphylaxis, airway compromise may occur rapidly. Warning signs are swelling of the tongue and lips, hoarseness and oropharyngeal swelling. Consider early intubation for patients in cardiac arrest, as a delay may make later attempts extremely difficult.
- Supraglottic airway devices are likely to be difficult to insert as airway swelling progresses.
- A needle cricothyroidectomy or surgical airway (if available) may be required if intubation is not possible. Consider early enhanced/critical care support.

6. Trauma

6.1 Establishing the cause of cardiac arrest may not be straightforward. A primary medical arrest can occur prior to a patient suffering a traumatic insult. Such patients may initially appear to have had a traumatic cardiac arrest but have minimal, if any, injuries. Primary medical cardiac arrests resulting in falls from height or whilst driving are examples that can typically result in rescuers suspecting cardiac arrest of traumatic origin.

6.2 Pay close attention to a witness history and perform an accurate scene assessment to establish the course of events and mechanism of injury. If there is a possibility that the patient has had a primary medical cardiac arrest, follow standard BLS and ALS guidelines. Consider early Enhanced Care support and follow the traumatic arrest algorithm in Figure 2.

6.3 *Figure 2 - Trauma Arrest Algorithm*



Adapted from UKRC guidelines 2015

6.4 Blunt Trauma

6.4.1 Survival from traumatic cardiac arrest is directly correlated with the duration of CPR and the time spent pre-hospital; prolonged CPR is associated with a poor outcome.

6.4.2 In the pre-hospital setting, advanced life support and exclusion of reversible causes using the 4H's and 4T's or the 'HOTT' approach should take precedence:

- **H**ypovolemia - Control external hemorrhage, pelvic binder, long bone splinting and give fluids/blood (where carried), early administration of TXA.
- **O**xygenation - Including airway management.
- **T**ension pneumothorax - Bilateral decompression, finger thoracostomy and/or chest tubes (where trained)
- **T**amponade - Early thoracotomy, (consider early enhanced/critical care or rapid conveyance to closest TU/MTC).

6.4.2 Chest compressions should not prevent reversible causes from being addressed. Trust clinicians are supported to de-emphasise CPR in order to perform interventions to address reversible causes where the arrest is as a result of blunt trauma.

6.4.3 Ensure reversible causes are addressed before administering Adrenaline.

6.4.4 Resuscitation should be commenced, irrespective of whether the cardiac arrest was witnessed, unless the patient meets the criteria for not commencing resuscitation detailed in Section 3.

6.4.5 Undertake only essential lifesaving interventions on scene, if the patient has signs of life, rapidly transfer to hospital or arrange rendezvous with enhanced/critical care support. Do not delay for spinal immobilisation.

6.4.6 Effective airway management using a stepwise approach is essential to maintain oxygenation of the severely compromised trauma patient. In low cardiac output conditions, positive pressure ventilation may cause further circulatory depression or even cardiac arrest by impeding venous return to the heart. Monitor ventilation with continuous waveform capnography and adjust rate to achieve normocarbia.

6.4.7 In the presence of uncontrolled haemorrhage, administer Tranexamic acid early and in accordance with the Trust PGD.

6.4.8 Excessive fluid will increase bleeding. Give intravenous fluids until ROSC is achieved, up to a maximum of 2 litres.

6.4.9 Consider whether patient can be conveyed for early blood or blood product intervention, or, whether this can be brought to scene or to a rendezvous point in a timely manner by Enhanced Care assets.

6.4.10 In blunt trauma cases, where ALS (including attempts to address reversible causes up to level of skill set) is being delivered, clinical judgement may be applied as to whether Enhanced Care assets may be accessed or the patient can be conveyed to a TU/MTC in a timely manner. Refer to section 3.5.

6.5 Penetrating Trauma

6.5.1 In penetrating traumatic cardiac arrest, patients should be transferred rapidly to hospital because surgical intervention is often needed to treat the cause of the arrest. A 'scoop and run' policy is appropriate but crew safety should be a consideration where there are prolonged journey times in a moving vehicle.

6.5.2 Address airway, defibrillation if indicated and splintage and consider performing all further interventions en-route. Administer Tranexamic acid early in accordance with the Trust PGD.

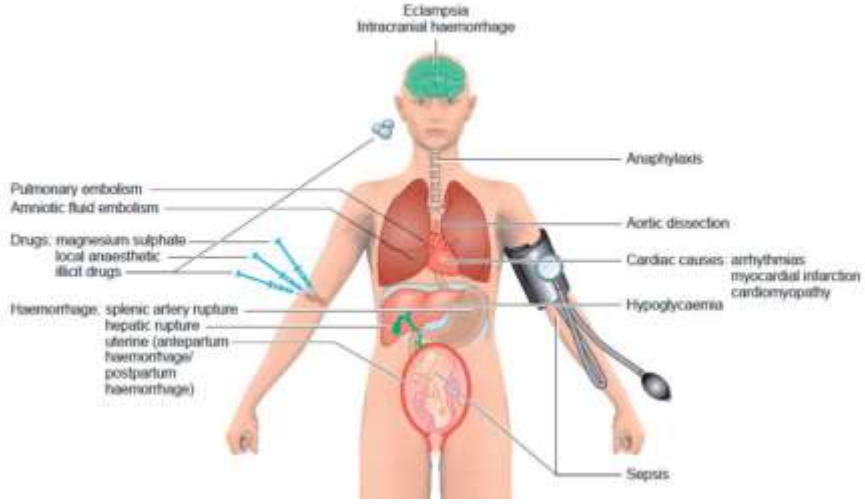
6.5.3 Give intravenous fluids until ROSC is achieved, up to a maximum of 2 litres. In the presence of uncontrolled haemorrhage, excessive fluid will increase bleeding.

7 Maternal Basic and Advanced Life support

7.1 Less than 9 in every 100,000 women die in pregnancy or childbirth and the overall maternal mortality rate in the UK continues to fall. Between 2012–2014, deaths from 'indirect' causes remain the largest group of deaths; these are deaths from conditions not directly due to pregnancy but existing conditions which are exacerbated by pregnancy, for example patients with heart problems.

7.2 Consideration of complications associated with maternity should be made during or up to six weeks (42 days) after the end of pregnancy (whether the pregnancy ended by termination, miscarriage, birth, or was an ectopic pregnancy) through causes associated with, or exacerbated by, pregnancy (Figure 3)

7.3 Figure 3 - Complications Associated with Pregnancy



7.4 It is important to recognise that there are two patients. Resuscitation of the mother is the primary concern and may provide effective resuscitation of the foetus.

7.5 The approach to resuscitating a pregnant woman is the same as that of any adult in cardiac arrest. However, from 20 weeks gestation onwards, the weight of the gravid uterus can cause 30% of the cardiac output to be sequestered into the lower limbs when a patient lying supine. Immediately manually displace the uterus to the maternal left side.

7.6 CPR should not be terminated in the pre-hospital setting on a pregnant patient as the foetus may have a chance of survival.

7.7 A scoop and run approach is appropriate- convey to nearest ED with obstetrics unit on site. Address airway and defibrillation if indicated and consider performing all further interventions en-route. Consider early enhanced/critical care support.

7.8 Modifications for Cardiac Arrest in Pregnancy

7.8.1 Start resuscitation according to standard ALS guidelines with manual displacement of the uterus to the maternal left, in order to minimise inferior vena caval compression. Manual displacement can be applied from either the maternal left or right side with the assistant ensuring the uterus is displaced toward the maternal left (Figure 4). The previously taught technique of using a tilted rescue board has been shown not to achieve sufficient left lateral tilt.

7.8.2 Figure 4 - Manual Uterine Displacement during Maternal Resuscitation

Reproduced from JRCALC 2017

7.8.3 The hand position for chest compressions may need to be slightly higher (2-3 cm) on the sternum for patients with advanced pregnancy (e.g. over 28 weeks).

7.8.4 Ventilation with a bag-valve-mask may lead to regurgitation and aspiration. A supraglottic airway may reduce the risk of gastric aspiration and make ventilation of the lungs easier. Where intubation is required as part of a step-wise approach to airway management, consider using a tracheal tube 0.5-1.0 mm smaller than usual, as the trachea can be narrowed by oedema and swelling.

7.8.5 Defibrillation energy levels are as recommended for standard defibrillation. If large breasts make it difficult to place an apical defibrillator electrode, use an anteroposterior or bi-axillary electrode position.

7.8.6 Establish IV or IO access as soon as possible, preferably at a level above the diaphragm.

7.8.7 At 20 weeks, the uterine fundus will be below the umbilicus.

7.8.8 If there is no response to CPR with ALS, undertake a time critical transfer to the nearest ED with an obstetric unit attached. Place a pre-alert as soon as possible to enable the ED, to organise a maternity team.

7.8.9 Remember eclampsia/pre-eclampsia.

8 Paediatric Basic/Advanced Life Support

8.1 Age definitions:

- An infant is under one year old.
- A child is between one year and puberty.

8.2 Paediatric life support applies to infants and children up to the age of puberty (excluding newborn) and should be performed in accordance with Resuscitation Council Guidelines 2015 (Appendix C and D).

8.3 Children are likely to have severe underlying illness or injury that can only be managed adequately in hospital and it is therefore particularly important not to delay on scene.

8.4 As most cardiorespiratory arrests in children are due to respiratory insufficiency, paediatric resuscitation priorities focus on re-oxygenating the child.

8.5 In the event of a life-threatening episode for any child, consideration must be given to the need for clinical assessment of other siblings in the property if the cause of illness is unknown. In the event of a life-threatening episode for any child, consideration must be given to safeguarding concerns for other siblings.

8.6 Initial Assessment

8.6.1 The initial assessment includes:

- Check response.
- Open and check the airway.
- Check for the presence of breathing.
- If breathing agonal or not present deliver 5 ventilations.
- Re-check breathing and circulation together.
- If unsure about the presence of a pulse or the pulse rate is less than 60 beats per minute start compressions.

8.6.2 Evidence suggests that pulse palpation for 10 seconds is unreliable for determining the presence or absence of an effective circulation. This means that palpation of the pulse cannot be the sole determinant of the need for chest compressions. Clinicians need to determine the presence or absence of 'signs of life', such as response to stimuli, normal breathing (rather than abnormal gasps) or spontaneous movement. **If the clinician is unsure whether there is a pulse, assume there is no pulse.**

8.7 Paediatric Airway and Ventilation

8.7.1 Use a stepwise approach to airway management:

- Place your hand on the forehead and gently tilt the head back. At the same time, with your fingertip(s) under the point of the child's chin, lift the chin. Do not push on the soft tissues under the chin as this may block the airway.
- If you still have difficulty in opening the airway, try the jaw thrust method- place the first two fingers of each hand behind each side of the child's mandible (jaw bone) and push the jaw forward.
- Both methods may be easier if the child is turned carefully onto their back. Consider a folded towel under the child's shoulders/upper back to obtain neutral alignment. When there is a risk of back or neck injury, establish a clear upper airway by using jaw thrust or chin lift alone, in combination with manual in-line stabilisation of the head and neck by an assistant (if available).
- If life-threatening airway obstruction persists despite effective application of jaw thrust or chin lift, add head tilt a small amount at a time until the airway is open. Establishing a patent airway takes priority over concerns about a potential back or neck injury.
- Visually inspect the oropharynx. Do not perform a blind finger sweep.
- The Trust does not support staff in intubating children under 12 of age, but does support laryngoscopy to assist in the removal of any upper airway foreign body obstruction.
- Give five rescue breaths and observe for signs of life (coughing or gasping)

8.8 Paediatric Chest Compressions

8.8.1 Avoid compressing the upper abdomen by locating the xiphisternum (i.e. find the angle where the lowest ribs join in the midline) and compressing the sternum one finger's breadth above this point.

8.8.2 Studies have shown that chest compressions are frequently too shallow. Depth of compression should be at least one third of the anterior-posterior diameter of the chest. The mean one-third compression depth is 4cm for infants, 5cm for children.

8.8.3 Compression rate is 100 - 120 per minute. Compression rate refers to the speed at which compressions are given, not the total number delivered in each minute.

8.9 Compression: Ventilation Ratios

8.9.1 First responders and non-frontline staff who learn only single-rescuer techniques, should use a ratio of 30 compressions to 2 ventilations (two fingers for infants, heel of one hand for children).

8.9.2 Solo responder ambulance clinicians should use 15:2, unless not achieving an adequate number of compressions because of difficulty in the transition between ventilation and compression, when they should revert to 30:2. Two or more ambulance clinicians carrying out paediatric resuscitation should use a ratio of 15 compressions to 2 ventilations and use the encircling technique for infants.

8.9.3 Place both thumbs flat side by side on the lower half of the sternum with the tips pointing towards the infant's head. Spread the rest of both hands with the fingers together to encircle the lower part of the infant's rib cage with the tips of the fingers supporting the infant's back. Press down on the lower sternum with the two thumbs to depress it at least 1/3 of the depth of the infant's chest.

8.10 Paediatric Drugs

8.10.1 If venous access is not readily attainable, give early consideration to intraosseous access in line with Clinical Guideline (CG13) Intraosseous Access.

8.10.2 In the case of a shockable rhythm, adrenaline 10 mcg/kg (0.1ml/kg of 1:10,000) should be administered once chest compressions have been restarted after the delivery of the 3rd shock. Repeat adrenaline every 3-5 minutes.

8.10.3 For non-shockable rhythms administer adrenaline as soon as IV/IO access is achieved and repeat every 3-5 minutes whilst the patient remains in cardiac arrest.

8.10.4 Amiodarone (5mg/kg) should be administered after the third shock (post adrenaline) in refractory VF/VT. This may be repeated once more (5mg/kg), after the 5th shock if still in a shockable rhythm.

8.10.5 Fluids should be administered according to JRCALC guidance.

9. Newborn Resuscitation

9.1 The Trust defines 'Newborn' as time from birth, until normal physiology has been established. A reasonable timescale for this would be within the first 2 hours following delivery. Newborn basic life support should be performed in accordance with Resuscitation Council UK (2015) Guidelines (See Appendix E).

9.2 Pre-term Delivery

9.2.1 Prematurity is defined as less than 36 weeks gestation. Premature infants are more likely to need help with ventilation.

9.2.2 Spontaneous breathing will be inadequate for babies born at less than 32 weeks gestation. Additionally they are likely to be deficient in surfactant (surfactant reduces alveolar surface tension and keeps the lung alveoli open during expiration). Surfactant replacement and/or ventilatory support may be required therefore immediate hospital transfer should be undertaken even if apparently well. A higher inflation pressure with bag and mask ventilation may therefore be required in pre term infants to open up their lungs.

9.2.3 Pre-term babies are at particular risk of hypothermia, hypoglycaemia and a higher risk of infection. Pre-term infants less than 32 weeks gestation are also at risk of intracranial bleeds.

9.2.4 Where attending a birth at 20-24 weeks or where gestation is unknown, and there are signs of life, support as appropriate. Where gestation is known to be less than 20 weeks, and where there are no signs of life, resuscitation is likely to be futile and this should be considered by the clinician and discussed with the mother.

9.3 Assessment of the Newborn

9.3.1 A healthy baby will be born blue but will have a good tone, cry within a few seconds of delivery, have a good heart rate (normally 120–150 per minute), and become pink within the first 90 seconds.

9.3.2 A less healthy baby will be born blue, will have less good tone, may have a slow heart rate (less than 100 per minute) and may not establish adequate breathing by 90–120 seconds.

9.3.3 An ill (very hypoxic) baby will be born pale and floppy, not breathing and with a very slow heart rate.

9.3.4 Assess colour, tone, breathing and heart rate.

9.3.5 Assess heart rate by listening with a stethoscope (feeling for a peripheral pulse is not reliable). In noisy or very cold environments, palpating the pulse at the umbilical cord may be an alternative and may save unwrapping the baby (this is only reliable when the pulse is greater than 100 bpm).

9.3.6 Attach a pulse oximeter to the **right** hand or wrist to obtain an accurate reading of the preductal saturation.

9.3.7 Ensure the condition of the baby prior to resuscitation is documented using the APGAR score.

9.4 Temperature Control

9.4.1 Babies are born small and wet. They get cold very easily, especially if they remain wet and in a draught. It is important that the baby does not get cold at this stage.

9.4.2 Full term babies must be dried, wet towels removed and the baby covered with dry towels. Heat loss is most significant from the baby's head, either cover with a hat or form a towel/blanket to cover the head. Close windows and doors to prevent draught and ensure heating is on in if in the ambulance.

9.4.3 Pre-term babies may be placed, without drying, into a food grade plastic bag but this must **not** be considered to be active warming of the baby and blanketing and heating must still be used.

9.5 Cord Management

9.5.1 For uncompromised babies, a delay in cord clamping of at least 1 minute is recommended. For compromised babies, resuscitative measures take priority.

9.5.2 To divide the cord, apply two cord clamps securely 3cm apart and about 15cm from the umbilicus. Cut the cord between the clamps.

9.6 Airway and Ventilation

9.6.1 Assess colour, tone, breathing and heart rate before taking the following approach:

- Consider the use of a folded towel or similar behind the baby's shoulders to obtain neutral alignment (Figure 5).
- Until birth the lungs have been filled with fluid; aeration of the lungs in these circumstances is likely to require sustained application of pressure with a BVM for two to three seconds. These are known as inflation breaths.
- Give five inflation breaths and reassess.
- If no chest rise or increase in heart rate, provide five further inflation breaths and reassess.
- If no chest rise or increase in heart rate, use the two person BVM technique and reassess.

- If no chest rise or increase in heart rate, reassess the airway and apply gentle suction if required.
- Consider the use of an advanced airway e.g. OP or SGA and re-assess.
- For term infants air should be used for resuscitation at birth.
- If, despite effective ventilation, oxygenation remains unacceptable, use of a higher concentration of oxygen should be considered.
- Pre-term babies (less than 32 weeks gestation) may not reach the same arterial blood oxygen saturations in air as those achieved by term babies, therefore oxygen should be given judiciously.
- Thick meconium must be suctioned from the airway if the patient is unresponsive. Suction should be avoided in the conscious new born, due to the risk of vagal stimulation.

9.6.2 Figure 5 - Positioning of Newborn to Achieve Neutral Alignment

Reproduced from JRCALC 2017

9.7 Chest Compressions

9.7.1 Almost all babies needing help at birth will respond to successful lung inflation with an increase in heart rate followed quickly by normal breathing. However, in some cases chest compressions are necessary.

9.7.2 Chest compression should be started only when you are sure that the lungs have been aerated successfully.

9.7.3 In babies, the most efficient method of delivering chest compression is to grip the chest in both hands in such a way that the two thumbs can press on the lower third of the sternum, just below an imaginary line joining the nipples with the fingers over the spine at the back. If this method is not achievable, then the two finger method should be used in the lower third of the sternum. The ratio of compressions to inflations in newborn resuscitation is 3:1.

9.8 Newborn Drugs

9.8.1 The administration of drugs is not supported for newborn resuscitation.

9.8.2 Newborn blood glucose readings will often normally be low, and therefore it is unlikely that the administration of glucose will be required. Treat hypoglycaemia for full term babies if the blood sugar is less than 2.2mmol/l, or less than 1.7 for pre-term.

10 Post ROSC Management

10.1 Successful ROSC is the first important step towards the end goal of complete recovery and discharge from hospital without neurological impairment. The following guidance applies to all patients who achieve ROSC.

10.2 Post-cardiac-arrest syndrome, which comprises post-cardiac-arrest brain injury, post-cardiac-arrest myocardial dysfunction, the systemic ischaemia/reperfusion response, and persistence of the precipitating pathology, often complicates the post-resuscitation phase. The severity of the syndrome will vary with the duration and cause of the cardiac arrest. The pre-hospital care of ROSC patients will contribute to the effective management of post cardiac arrest syndrome.

10.3 Once ROSC is achieved, ambulance clinicians should remain on scene to ensure patient stability before attempting removal, unless an intervention only available at hospital is required (e.g. intervention for suspected cardiac tamponade), or it is unsafe to remain on-scene.

10.4 The recurrence rate of a shockable rhythm is at its highest during this time. During this stabilisation period, the following should be considered:

- Ensure adequate airway and ventilations.
- Assist ventilations where required.
- Record a full set of observations (HR, RR, BP, SPO_2, $ETCO_2$, Temperature, blood glucose, GCS, 12-lead ECG) and ensure ABCDs are effectively managed throughout.
- Titrate oxygen flow to achieve an SpO2 of between 94-98%. Following a traumatic arrest, administer 100% oxygen.
- Monitor $ETCO_2$ using waveform capnography and aim to ventilate to achieve normocarbia (4.0-5.7 kPa).

- Continue to consider and address reversible causes of the initial arrest (the 4H's and 4T's).
- If present, treat arrhythmias.
- Treat bradycardia with Atropine according to JRCALC guidance.
- Manage blood glucose and maintain between 4.0mmol/l and 10mmol/l.
- A 12-lead ECG must be recorded and screenshot taken on ePCR. If 12 lead ECG shows ST elevation in two or more anatomically contiguous leads (≥2mm in chest leads or ≥1mm in limb leads) and the history of cardiac arrest suggests a cardiac cause, convey to a hospital with PPCI capabilities. Contact the PPCI centre and discuss whether they will accept the patient. If PPCI centre will not accept patient, record decision on the ePCR and convey the patient to an ED.
- If patient experiences a seizure which lasts more than 2-3 minutes or is recurrent and is unlikely to be due to hypoxia, administer IV diazemuls (or rectal diazepam in absence of IV/IO access). When administered IV, give slowly being mindful of the potential side effects of respiratory depression and hypotension. This is an additional Trust indication to standard JRCALC guidelines.
- Following ROSC, patients may be cerebrally irritated and combative. Exclude hypoglycaemia and hypoxaemia as potential causes.
- These patients may benefit from formal anaesthetic management, but incremental doses of IV diazepam or midazolam may be indicated and may be administered by Enhanced/Critical Care support only.

10.5 Post ROSC Blood Pressure Management

10.5.1 If hypotensive (systolic less than 90mmHg / absent radial pulse) administer a fluid bolus of 250mls normal saline (administer JRCALC dose for paediatrics).

10.5.2 Patients who remain hypotensive following fluid administration may be administered 100mcg (1ml) doses of 1:100,000 adrenaline until the systolic blood pressure is 90mmHg or higher, if they meet **all** of the following requirements:

- Aged 18 years of age or over.
- Hypotensive despite fluid administration.
- Pulse rate under 100 beats per minute.

10.5.3 The 1:100.000 adrenaline is prepared in the following way:

- **Step 1:** Draw 1ml (100mcg) of adrenaline 1:10,000 in to a 10ml syringe using a 3 way tap.

- **Step 2:** Dilute this with 9ml of normal saline to give 10ml of adrenaline 1:100,000 (10mcg/ml).

- **Step 3:** Label the syringe as shown ready for use.

- Patients may have repeated boluses of 10mcg adrenaline until they sustain a blood pressure greater than 90mmHg or higher.

10.6 Post Cardiac Arrest Temperature Management

10.6.1 Following resuscitation, many patients with a return of spontaneous circulation (ROSC) have a poor neurological outcome due to hypoxic-ischemic brain injury. Mild hypothermia decreases metabolic demand, suppresses inflammation, stabilises cell membranes and reduces the release of toxic chemicals. The application of active cooling using cold packs or cold saline is no longer recommended.

10.6.2 Post cardiac arrest temperature management using passive cooling must be applied to patients who fulfil **all** of the following inclusion criteria:

- Return of spontaneous circulation following cardiac arrest.
- Aged 1 year or over.
- GCS 9 or below.
- Temperature over 36°C.

10.6.3 Apply passive cooling to prevent hyperthermia and achieve a target temperature of under 36°C:

- Remove insulating clothing from patient.
- Turn rear ambulance compartment heating off.
- Turn rear compartment air conditioning on (where available).

10.6.4 Due to the practicalities of removing clothing, it is recommended that passive cooling is commenced once the patient is loaded into the ambulance. Cooling may be commenced earlier at the clinician's discretion.

10.6.5 A blanket or sheet should be applied whilst unloading the patient at hospital to maintain modesty but must be removed at the earliest opportunity.

11 Documentation

11.1 In line with Trust Policy, a Patient Clinical Record must be completed and annotated appropriately. The Cardiac Arrest section must be completed for all patients where resuscitation has been commenced. The Confirmation of Death section must be completed for all cases where death is confirmed.

11.2 The PCR must clearly identify the clinician who completed each airway manoeuvre, delivered defibrillation and administered each medicine. Where applied, it must also document the time that passive cooling commenced.

11.3 Any deviation from this guideline must be recorded, with any potential or actual adverse event reported through the incident reporting system.

12 References

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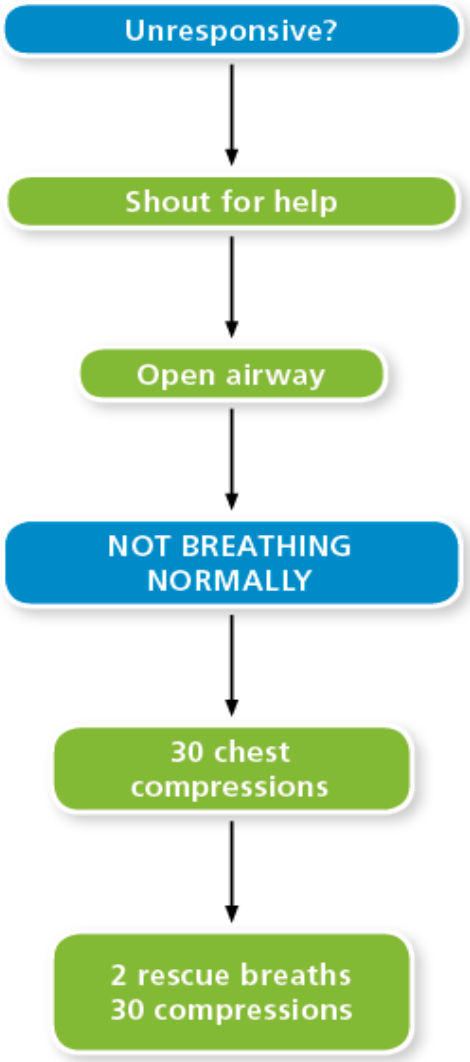
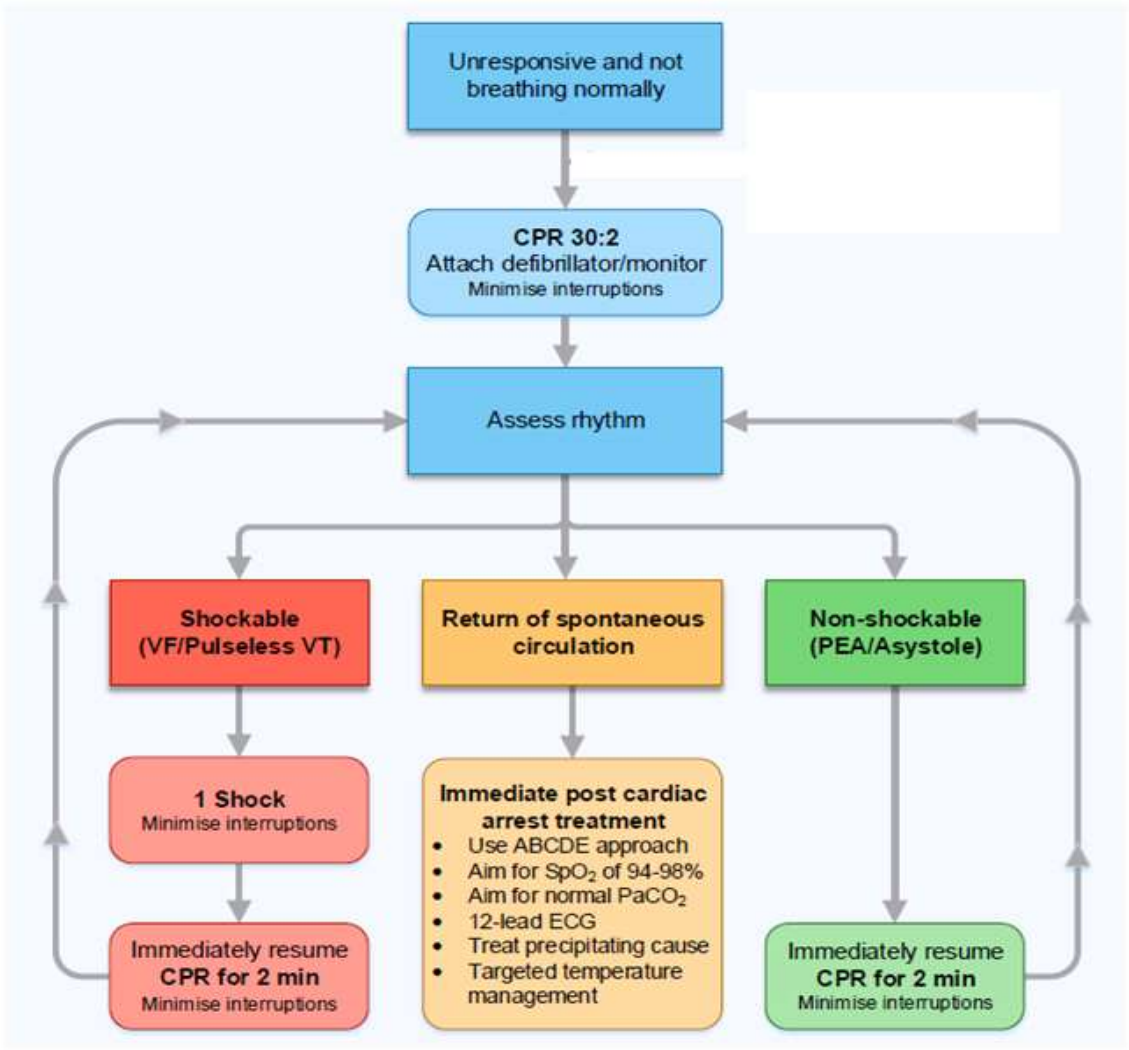
Appendix A - Adult Basic Life Support



Adapted from the Resuscitation Council (UK) algorithm 2015.

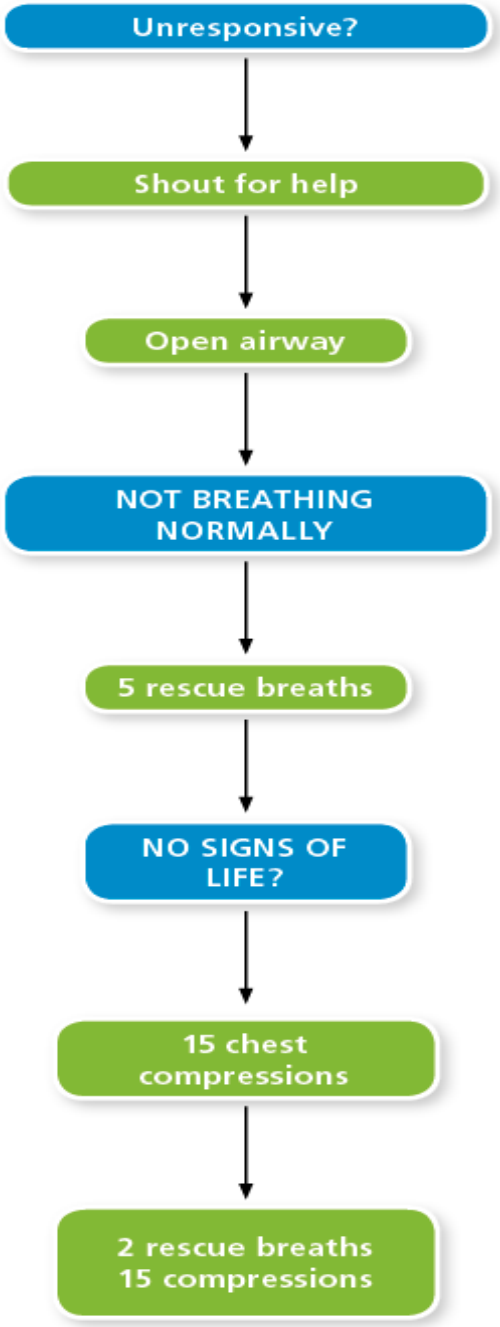
Appendix B - Adult Advanced Life Support



1. Amiodarone (300mg) should be administered after the third shock (post adrenaline) in refractory VF/VT, with a further 150mg dose given if the patient remains in VF/VT after the 5th shock.

Adapted from the Resuscitation Council (UK) algorithm 2015.

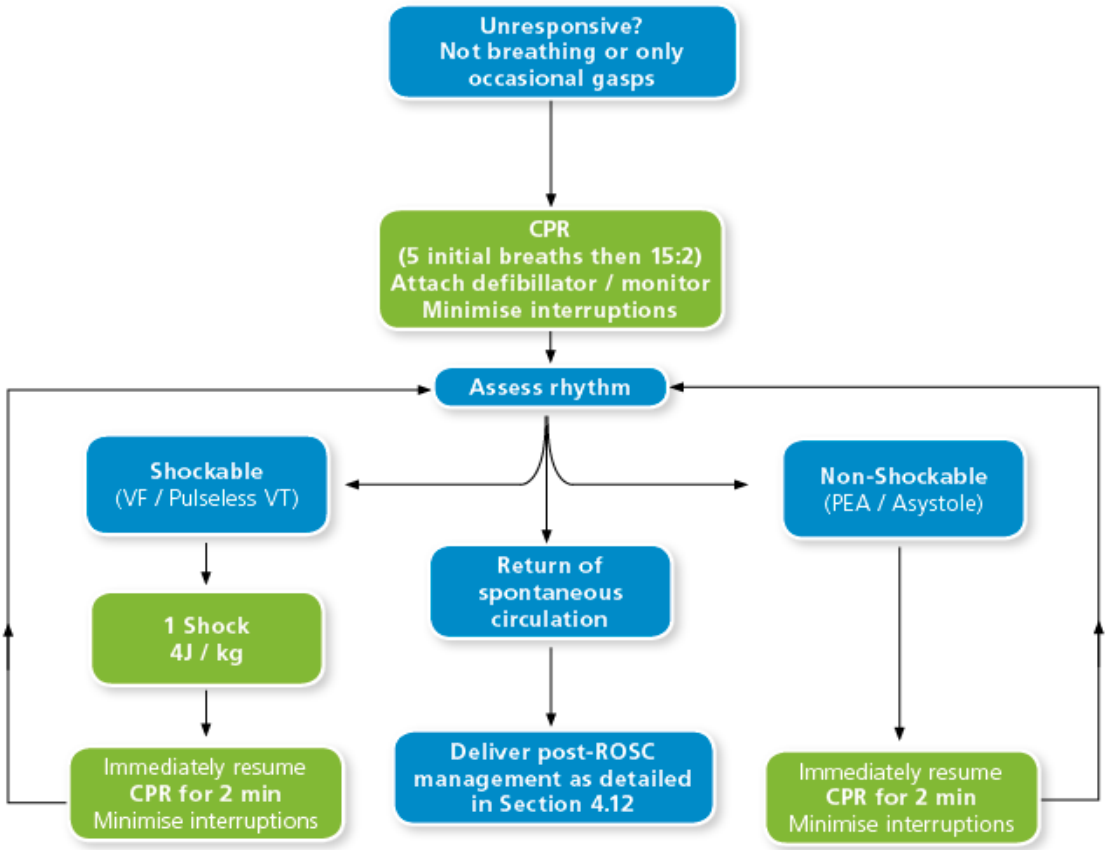
Appendix C - Paediatric Basic Life Support



Solo responder ambulance clinicians should use 15:2, unless not achieving an adequate number of compressions because of difficulty in the transition between ventilation and compression, when they should revert to 30:2. Two or more ambulance clinicians carrying out paediatric resuscitation should use a ratio of 15 compressions to 2 ventilations and use the encircling technique for infants.

Adapted from the Resuscitation Council (UK) algorithm 2015

Appendix D- Paediatric Advanced Life Support



During CPR

- Ensure high-quality CPR: rate, depth, recoil;
- Plan actions before interrupting CPR;
- Give oxygen;
- Vascular access (intravenous, intraosseous);
- Give adrenaline every 3-5 min;
- Consider advanced airway and capnography;
- Continuous chest compressions when advanced airway in place;
- Correct reversible causes.

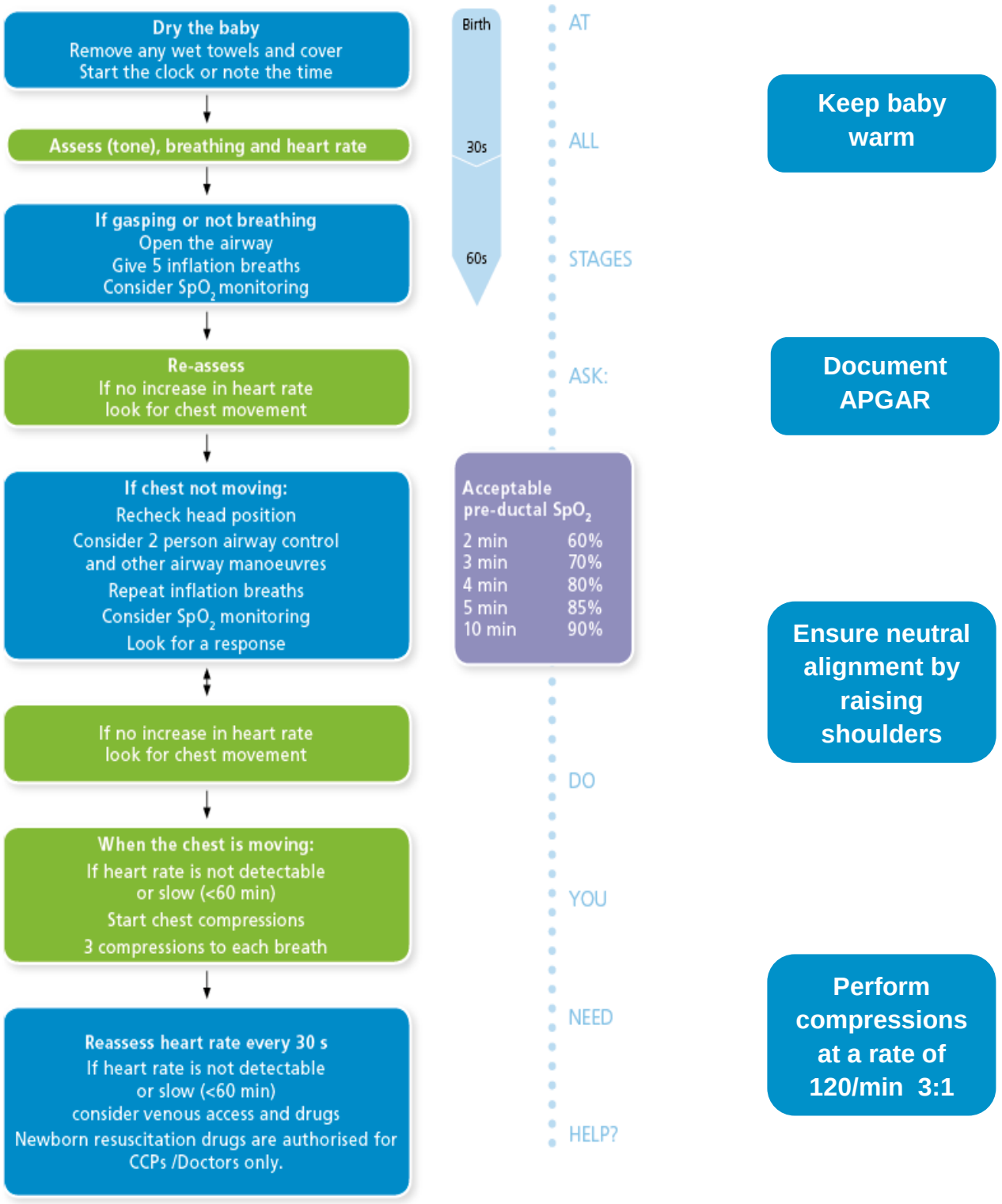
Reversible Causes

- Hypoxia;
- Hypovolaemia;
- Hypo / hyperkalaemia / metabolic;
- Hypothermia.
- Tension pneumothorax;
- Toxins;
- Tamponade - cardiac;
- Thromboembolism.

Amiodarone (5mg/kg) should be administered after the third shock (post adrenaline) in refractory VF/VT. This may be repeated one further time (5mg/kg), after the 5th shock if still in a shockable rhythm

Adapted from the Resuscitation Council (UK) algorithm 2015.

Appendix E - Newborn Advanced Life Support



Adapted from the Resuscitation Council (UK) algorithm 2015

Appendix F - Recognisable Signs of Death

Rigor mortis is post mortem stiffening of the body after death, caused by a loss of Adenosine Triphosphate (ATP) from the body's muscles. After death, cellular respiration in organisms ceases to occur, depleting the body of oxygen used in the making of ATP. ATP is the substance that allows energy to flow to the muscles and enables them to work. Without ATP the muscles become stiff and inflexible.

Rigor mortis occurs throughout the body at the same time but the smaller muscles are affected first, such as those in the face, neck and jaw. Larger muscles are affected later. The sequence may be due to different lactic acid levels among different muscles, which is directly related to the difference in glycogen levels and different types of muscle fibres. It can start to appear from around 1-3 hours and spreads to the larger muscles and internal organs within the next four to six hours. This change is transient, meaning that it develops and then disappears. Rigor mortis is at its peak after 12-24 hours, it then dissipates over the next day or so. When rigor mortis reverses, the body returns back to a flaccid state. The muscles lose their tightness in the reverse of how they gained it; larger muscles which contracted last will lose their stiffness first.

Its onset, peak and dissipation are temperature dependent; cold environmental temperatures can significantly slow the process, whereas very warm temperatures will speed it up.

The onset of rigor mortis is also affected by the individual's age, sex, physical condition and muscular build. Rigor mortis may not be perceivable in infants and children due to their smaller muscle mass. The intensity of rigor also depends on the person's muscular development. The very young, very old and debilitated often have poorly developed rigor.

Rigor mortis may develop very rapidly if the body is acidotic at the time of death, for example somebody who is physically active prior to death, as their muscles will already be lacking ATP stores. In these situations rigor mortis can be almost instantaneous.

Table F1 - Onset of Rigor Mortis

Factors Which Accelerate the Onset/offset of Rigor	**Factors Which Delay the Onset/offset of Rigor**
• Warm temperatures • Strenuous activity • Age and greater muscle mass • Seizure activity • Alkaloid poisoning	• Obese people show rigor later • Cold temperatures • Age and muscle mass – older less muscle mass • Exsanguination – haemorrhage • Asphyxial deaths • Poisoning by arsenic

During this process the body cools (algor mortis) to equilibrate with the surrounding temperature. On average the temperature decreases by 1.5 degrees per hour so is often evident about an hour after death. It is important to remember that this cooling process will be affected by the body's temperature before death; what is normal for the person, any

illness or infection prior to death and any activity or exercise. Environmental considerations and clothing also influence this cooling process; in extremely hot conditions bodies have actually been found to warm up.

Whilst all of these post mortem changes are useful when considering the time of death of a patient, it is also equally important to consider the scene and the environment, which in turn will help in the assessment of any post mortem changes.

Figure F1 - General Time Line of the Recognisable Signs of Death