

CLINICAL PRACTICE GUIDELINES

To All Registered Emergency Care Providers

This document serves to inform all emergency care providers that the below Clinical Practice Guidelines (CPGs) and related capabilities and medications have been adopted by the Professional Board for Emergency Care (PBEC) for use and implementation by all registered emergency care providers.

It is the responsibility of all registered persons to a.) familiarise themselves and b.) undergo learning/training activities related to the contents of the document. In addition to familiarisation, it is important that as far as possible, and where relevant, the related clinical practice guideline is used during all clinical encounters. Where not applicable, all reasonable, locally contextual standards of care apply to clinical encounters. The deadline for the adoption of the revised list of capabilities and medications by registered persons is the 31st of December 2018. It is, however, acknowledged that the learning/training activities required to perform procedures and administer medications not currently on the scope of practice, will extend beyond this deadline.

Emergency care providers are directed to the revised list of capabilities and medications which are attached as an Annexure to the guidelines. The revised list of capabilities and medications (read together with the requirements linked to the performance and/or administration of such skills/medications) are applicable as per the above-mentioned deadline date. It must, however, be noted that the medications not currently on the scope of practice await final regulatory approval. Further communication will follow in relation to the approval of these medications. Emergency care providers acting outside of the revised list of capabilities (and mandatory training to perform such procedures) will be considered to be acting outside of the relevant scope of practice.

Abbreviations

ACS	- Acute Coronary Syndromes
AEA	- Ambulance Emergency Assistant
AFEM	- The African Federation for Emergency Medicine
AHA	- American Heart Association
ALS	- Advanced Life Support
ANT	- Ambulance Emergency Technician
BAA	- Basic Ambulance Assistant
BEMC	- Bachelor's in Emergency Medical Care
BLS	- Basic Life Support
CCA	- Critical Care Assistant
CEBHC	- Centre for Evidence-based Health Care
COPD	- Chronic Obstructive Pulmonary Disease
CPG	- Clinical Practice Guideline
CPR	- Cardiopulmonary Resuscitation
EC	- Emergency Care
ECSSA	- Emergency Care Society of South Africa
ECA	- Emergency Care Assistant
ECP	- Emergency Care Practitioner
ECT	- Emergency Care Technician
EM	- Emergency Medicine
EMSSA	- Emergency Medicine Society of South Africa
ENSSA	- Emergency Nurses Society of South Africa
Epinephrine	- Adrenaline
HPCSA	- Health Professions Council of South Africa
ICU	- Intensive Care Unit
ILCOR	- International Liaison Committee on Resuscitation
ILS	- Intermediate Life Support
IM	- Intramuscular, Intramuscularly
IMD	- Invasive Meningococcal Disease
IO	- Intraosseous, Intraosseously
IV	- Intravenous, Intravenously
ND EMC	- National Diploma in Emergency Medical Care
NICU	- Neonatal Intensive Care Unit
NIV, NPPV	- Positive Pressure Non-Invasive Ventilation
NSTEMI	- Non-ST-Elevation Myocardial Infarction
PaCO ₂	- Partial Pressure of Carbon Dioxide
PBEC	- Professional Board for Emergency Care
PR	- Per Rectum
STEMI	- ST-Elevation Myocardial Infarction
SVT	- Supraventricular Tachycardia
TCA	- Tricyclic Antidepressant
VF	- Ventricular Fibrillation
VT	- Ventricular Tachycardia

Recommendations

Usage

The following depicts the purpose of the various text boxes:

Practice point: Aims to guide clinicians in how to perform the recommendation in practice.

Implementation point: Clarifies the context of a recommendation.

Cross reference: Identifies other useful recommendations/sections.

Definitions:

Clinical advice: seeking consultation with providers of an individual an individual registered as an Emergency Care Practitioner, Emergency Medicine Physician or appropriate healthcare professional (specialist).

1. Obstetrics & Gynaecology

There were no evidence-based clinical practice guidelines addressing obstetric issues from a purely pre-hospital emergency services perspective. Despite this, there were many high-quality recommendations from in hospital and other types of health facilities (e.g. midwife run delivery units) which are directly applicable to pre-hospital management of obstetrics. The delivery and birth process will ideally not occur in the pre-hospital environment, but every practitioner needs to be able to manage a delivery and to intervene where necessary within the limits of their scope of practice.

1.1 Normal Delivery

A normal birth is defined by the WHO as: "spontaneous in onset, low-risk at the start of labour and remaining so throughout labour and delivery. The infant is born spontaneously in the vertex position between 37 and 42 completed weeks of pregnancy. After birth mother and infant are in good condition" (World Health Organization, 1996). The role of the EMS practitioner is to provide comfort and support for the mother and newborn, and to monitor and assist where necessary, while transferring to the appropriate health facility. However, an apparently low-risk normal delivery can complicate without warning at any stage, so the definition is often applied retrospectively.

Healthcare professionals and other staff caring for women in labour should establish an empathetic relationship with women in labour and ask them about their expectations and needs, so that they can support and guide them, being aware at all times of the importance of their attitude, the tone of voice used, the words used and the manner in which care is provided (Australian Resuscitation Council, 2011).

The first stage of labour begins from the onset of labour (onset of regular labour pains) until the second stage of labour. During the first stage (lasting, on average, 5-8 hours) mothers require reassurance, comfort and support, hydration and appropriate pain relief where necessary. The second stage of labour is usually faster, commencing when the cervix is fully dilated, and the foetus is expelled. The initial passive phase precedes the active phase, where there are expulsive contractions, maternal pushing, and the foetus becomes visible. During the active phase, mothers should be encouraged to push, and the foetus supported as it emerges.

In the presence of foetal distress, it may be appropriate to expedite delivery by encouraging the mother to push earlier than the recommended active phase at the end of the second stage of labour.

Foetal distress during labour is suspected when the foetal heart rate is abnormally high or low. It should be managed as follows pre-hospital:

- Explain the problem to the woman.
- Place the woman in the left lateral position.
- Stop oxytocin infusion if applicable.
- Give oxygen by face mask at 6 L/min for 20-30 minutes.
- Start an intravenous (IV) infusion of Ringer's lactate to run at 240 mL/hour for 1-2 hours, unless the woman is hypertensive or has cardiac disease.
- Consider transferring the patient to a facility with the capability to perform a caesarean section.

The third stage starts immediately after delivery of the baby and ends with delivery of the placenta. This would normally occur spontaneously within 30 minutes (Australian Resuscitation Council, 2011).

The active method of managing the third stage is recommended, to prevent excessive bleeding: (National Department of Health, Republic of South Africa, 2015)

- Immediately after delivery of the baby, ensure by abdominal palpation that there is no previously undiagnosed second twin, even if antenatal ultrasound found a singleton pregnancy.
- If there is no second twin, immediately give oxytocin 10 units intramuscularly (IM).
- Await uterine contraction for 2-3 minutes then feel for uterine contraction every 30 seconds.
- Do not massage or squeeze the uterus with the placenta still inside.
- When the uterus is felt to contract, put steady tension on the umbilical cord with the right hand, while pushing the uterus upwards with the left hand.
- Deliver the placenta by applying continuous gentle traction on the umbilical cord.

The fourth stage is defined as the first hour after delivery of the placenta. The woman is at risk for postpartum haemorrhage and must be observed (National Department of Health, Republic of South Africa, 2015).

1.1.1 Women in labour should be treated with the utmost respect and should be fully informed and involved in decision-making. To facilitate this, healthcare professionals and other staff caring for them should establish an empathetic relationship with women in labour and ask them about their expectations and needs, so that they can support and guide them, being aware at all times of the importance of their attitude, the tone of voice used, the words used and the manner in which care is provided. (Australian Resuscitation Council, 2011)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.1.2 Women should be encouraged and helped to adopt any position they find comfortable during the first stage and to be mobile if they wish, following a check of motor and proprioceptive block.^{adapted}

1.1.3 Spontaneous pushing is recommended. If there is no pushing sensation, pushing should not be directed until the passive phase of the second stage of labour has ended. (Australian Resuscitation Council, 2011)*

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.1.4 The perineum should be actively protected using controlled deflection of the foetal head, asking the woman not to push. (Australian Resuscitation Council, 2011)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high-quality clinical trials.

1.1.5 The duration of the third stage of labour is considered to be delayed if it is not complete within 30 minutes after birth of the neonate with active management, or within 60 minutes with a spontaneous third stage. (Australian Resuscitation Council, 2011)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.1.6 Active management of delivery is recommended. (Australian Resuscitation Council, 2011) *

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.1.7 Oxytocin should be used routinely in the third stage of labour. (Australian Resuscitation Council, 2011)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.1.8 The mother's expectations for pain relief during labour should be met as far as is possible. (Australian Resuscitation Council, 2011)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high-quality clinical trials.

1.1.9 Inhaling nitrous oxide is recommended during labour as a pain relief method; women should be informed that its analgesic effect is moderate and that it can cause nausea and vomiting, somnolence and altered memories. (Australian Resuscitation Council, 2011)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high-quality clinical trials.

1.1.10 If parenteral opioids are chosen as analgesia, patients should be informed that they have a limited analgesic effect and can cause nausea and vomiting. (Australian Resuscitation Council, 2011)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.1.11 Anti-emetics should be considered when IV or IM opioids are used.^{adapted}

1.2 Newborn Care

- For a foetus in distress requiring resuscitation, there should be immediate cord clamping to facilitate optimal resuscitation.
- Otherwise, delayed cord clamping would usually be advocated – ie. clamp the umbilical cord after the second minute or after it stops pulsing (Australian Resuscitation Council, 2011).
- Assess the baby's Apgar score at 1 minute (National Department of Health, Republic of South Africa, 2015).
- To keep the baby warm, he or she should be covered and dried with a blanket or towel that has previously been warmed, whilst maintaining skin-to-skin contact with the mother (Australian Resuscitation Council, 2011).
- The mother and baby should not be separated for the first hour or until the first feed has been given. During this period the midwife should remain vigilant and periodically observe, interfering as little as possible in the relationship between the mother and neonate, checking the neonate's vital signs (colour, respiratory movements, tone and if necessary heart rate) (Australian Resuscitation Council, 2011).

1.2.1 **Delayed clamping of the umbilical cord is recommended.** (Australian Resuscitation Council, 2011)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.2.2 **Women should have skin-to-skin contact with their babies immediately after birth.** (Australian Resuscitation Council, 2011)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.2.3 **Breastfeeding should be encouraged as soon as possible after birth, preferably within the first hour.** (Australian Resuscitation Council, 2011)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.2.4 **Systematic oropharyngeal and nasopharyngeal aspiration are not recommended for neonates.** (Australian Resuscitation Council, 2011)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

1.3 Abnormal Delivery

1.3.1 Shoulder Dystocia

In shoulder dystocia, delivery of the baby's head is not followed by delivery of the rest of the body because the shoulders are too broad and become stuck in the pelvis. This usually happens with large babies (>3.5 kg) (National Department of Health, Republic of South Africa, 2015). There can be significant perinatal morbidity and mortality associated with the condition, even when it is managed appropriately. Maternal morbidity is increased, particularly the incidence

of postpartum haemorrhage (11%) as well as third and fourth-degree perineal tears (3.8%). Brachial plexus injury (BPI) is one of the most important foetal complications of shoulder dystocia, complicating 2.3% to 16% of such deliveries (Royal College of Obstetricians and Gynaecologists, 2012).

Timely management of shoulder dystocia requires prompt recognition. The attendant health carer should routinely observe for:

- difficulty with delivery of the face and chin
- the head remaining tightly applied to the vulva or even retracting (turtle-neck sign)
- failure of restitution of the foetal head
- failure of the shoulders to descend

Routine traction in an axial direction (traction in line with the foetal spine i.e. without lateral deviation) can be used to diagnose shoulder dystocia but any other traction should be avoided (Royal College of Obstetricians and Gynaecologists, 2012).

Management, once shoulder dystocia is diagnosed, should include:

- Call for additional help
- No use of fundal pressure
- McRoberts' manoeuvre is simple, rapid and effective as first line intervention
- Suprapubic pressure should be used to improve the effectiveness of the McRoberts' manoeuvre (Royal College of Obstetricians and Gynaecologists, 2012)

Successful delivery using McRoberts' manoeuvre will be aided by lying the woman flat and removing any pillows from under her back. With one assistant on either side, the woman's legs should be hyperflexed. Routine traction (the same degree of traction applied during a normal delivery) in an axial direction should then be applied to the foetal head to assess whether the shoulders have been released. Suprapubic pressure should ideally be applied by an assistant from the side of the foetal back in a downward and lateral direction just above the maternal symphysis pubis. This reduces the foetal bisacromial diameter by pushing the posterior aspect of the anterior shoulder towards the foetal chest (Royal College of Obstetricians and Gynaecologists, 2012).

If unsuccessful, deliver the posterior arm by locating the posterior shoulder in the vagina and sweeping the arm in front of the baby's chest. Once the posterior arm is delivered, delivery of the anterior shoulder should not be very difficult. Posterior arm delivery may be easier if the woman turns to a knee-elbow position (all-fours position).

1.3.1.1 **Managing shoulder dystocia according to an appropriate algorithm has been associated with improved perinatal outcomes.** adapted

1.3.1.2 Maternal pushing should be discouraged, as this may exacerbate impaction of the shoulders. (Royal College of Obstetricians and Gynaecologists, 2012)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.1.3 Fundal pressure should not be used during the management of shoulder dystocia. It is associated with a high neonatal complication rate and may result in uterine rupture. (Royal College of Obstetricians and Gynaecologists, 2012)¹

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.1.4 The McRoberts' manoeuvre is flexion and abduction of the maternal hips, positioning the maternal thighs on her abdomen. It straightens the lumbosacral angle, rotates the maternal pelvis towards the mother's head and increases the relative anterior-posterior diameter of the pelvis. The McRoberts' manoeuvre is an effective intervention, with reported success rates as high as 90%. It has a low rate of complication and is one of the least invasive manoeuvres, and therefore, if possible, should be employed first. (Royal College of Obstetricians and Gynaecologists, 2012) *

Evidence from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship or evidence extrapolated from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship.

1.3.2 Breech Presentation & Delivery

A breech presentation refers to the buttock, feet or knees presenting first during a vaginal delivery. This is a high risk delivery for the mother and foetus unless managed appropriately, ideally in hospital.

- Avoid pre-hospital breech delivery in primigravid patients wherever possible.
- Vaginal breech delivery must be personally supervised by the most experienced person available (National Department of Health, Republic of South Africa, 2015).
- There is uncertainty around the optimal techniques for delivery of a breech foetus. Practitioners should be aware of the various techniques and use their judgement and experience to facilitate the delivery. Breech extraction refers to the policy of routinely expediting vaginal breech delivery by extraction of the baby within a single uterine contraction, but this is not well supported by evidence.

Technique of delivery: (National Department of Health, Republic of South Africa, 2015)

- Put the mother in lithotomy position.
- Encourage spontaneous breech delivery and only assist in keeping the foetal back facing upwards.
- For extended knees, assist by flexing at the knees and gently delivering each leg.
- After delivery of the trunk, allow the breech to hang, pull the cord down and cover the delivered parts with a cloth.
- As the scapulae appear, be ready to assist with delivery of the arms.
- Deliver the arms if necessary by running your fingers from the foetal back over the shoulder and sweeping the arms down in front of the chest, and then out.
- The neck will deliver up to the nape.
- Deliver the head by laying the foetus over the right forearm (if the provider's right hand is dominant) and inserting the right middle finger into the baby's mouth, with the index and ring fingers supporting the cheek, to flex the head.
- Simultaneously, the left hand exerts suprapubic pressure to flex the head (Wigand-Martin method) or pushes directly onto the occiput to assist flexion (Mauriceau-Smellie-Veit method).
- Ease the baby out, with gentle traction, and continuous flexion as described.
- Should the foetal back face downwards after delivery of the arms, the head may be trapped. The best chance of delivery is to swing the foetus anteriorly over the maternal abdomen to flex the head.

1.3.2.1 Diagnosis of breech presentation for the first time during labour should not be a contraindication for vaginal breech birth. (Royal College of Obstetricians and Gynaecologists, 2006) *

Evidence from expert from expert committee reports or opinions and/or clinical experiences of respected authorities.

1.3.2.2 Women should be advised that, as most experience with vaginal breech birth is in the dorsal or lithotomy position, that this position is advised. (Royal College of Obstetricians and Gynaecologists, 2006)

Evidence from expert from expert committee reports or opinions and/or clinical experiences of respected authorities.

1.3.2.3 Breech extraction should not be used routinely. (Royal College of Obstetricians and Gynaecologists, 2006)

Evidence from expert from expert committee reports or opinions and/or clinical experiences of respected authorities.

1.3.2.4 Delayed delivery of the arms should be delivered by sweeping them across the baby's face and downwards or by the Lovset manoeuvre (rotation of the baby to facilitate delivery of the arms). (Royal College of Obstetricians and Gynaecologists, 2006)

Evidence from expert from expert committee reports or opinions and/or clinical experiences of respected authorities.

1.3.2.5 Delayed engagement in the pelvis of the aftercoming head: manage by: Suprapubic pressure by an assistant should be used to assist flexion of the head; The Mauriceau-Smellie-Veit manoeuvre should be considered, if necessary, displacing the head upwards and rotating to the oblique diameter to facilitate engagement. (Royal College of Obstetricians and Gynaecologists, 2006)

Evidence from expert from expert committee reports or opinions and/or clinical experiences of respected authorities.

1.3.2.6 The aftercoming head may be delivered with forceps, the Mariceau-Smellie-Veit manoeuvre or the Burns-Marshall method. (Royal College of Obstetricians and Gynaecologists, 2006)

Evidence from expert from expert committee reports or opinions and/or clinical experiences of respected authorities.

1.3.3 Cord Prolapse

Cord presentation is the presence of the umbilical cord between the foetal presenting part and the cervix, with or without intact membranes. The principal causes of asphyxia in this context are thought to be cord compression and umbilical arterial vasospasm preventing venous and arterial blood flow to and from the foetus (Royal College of Obstetricians and Gynaecologists, 2014).

Cord compression can be further reduced by the mother adopting the knee–chest or left lateral (preferably with head down and pillow under the left hip) position (Royal College of Obstetricians and Gynaecologists, 2014). Despite the many procedures followed, there is uncertainty about any one process over another. Elevation of the presenting part during transfer may prevent cord compression. There are concerns that manipulation of the cord or exposure to air may cause reactive vasoconstriction and foetal hypoxic acidosis. Some authorities advise that swabs soaked in warm saline be wrapped around the cord, but this is of unproven benefit (Royal College of Obstetricians and Gynaecologists, 2014). A practitioner competent in the resuscitation of the newborn should attend all births that follow cord prolapse (Royal College of Obstetricians and Gynaecologists, 2014). During emergency ambulance transfer, the knee–chest position is potentially unsafe and the exaggerated Sims position (left lateral with pillow under hip) should be used (Royal College of Obstetricians and Gynaecologists, 2014).

1.3.3.1 Cord prolapse should be suspected when there is an abnormal foetal heart rate pattern, especially if such changes commence soon after membrane rupture, either spontaneous or artificial. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.3.2 There are insufficient data to evaluate manual replacement of the prolapsed cord above the presenting part to allow continuation of labour. This practice is not recommended. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.3.3 To prevent vasospasm, there should be minimal handling of loops of cord lying outside the vagina. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.3.4 To prevent cord compression, it is recommended that the presenting part be elevated either manually or by filling the urinary bladder. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.3.5 All women with cord prolapse should be advised to be transferred to the nearest consultant-led unit for birth, unless an immediate vaginal examination by a competent professional reveal that a spontaneous vaginal birth is imminent. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.3.6 The presenting part should be elevated during transfer either manually or by using bladder distension. It is recommended that practitioners carry a Foley catheter for this purpose and equipment for fluid infusion. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.3.7 Caesarean section is the recommended mode of delivery in cases of cord prolapse when vaginal birth is not imminent in order to prevent hypoxic acidosis. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high quality clinical trials.

1.3.3.8 Vaginal birth, in most cases operative, can be attempted at full dilatation if it is anticipated that birth would be accomplished quickly and safely, using standard techniques and taking care to avoid impingement of the cord when possible. (Royal College of Obstetricians and Gynaecologists, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

1.3.4 Premature Labour & Delivery

“Preterm babies are prone to serious illness or death during the neonatal period. Without appropriate treatment, those who survive are at increased risk of lifelong disability and poor quality of life. Complications of prematurity are the single largest cause of neonatal death and the second leading cause of deaths among children under the age of 5 years. Global efforts to

further reduce child mortality demand urgent action to address preterm birth" (World Health Organization, 2015a). This is defined as the onset of labour after the gestation of ≥ 24 weeks and before 37 weeks of pregnancy (National Department of Health, Republic of South Africa, 2015).

South African Maternity guidelines recommend active resuscitation and transfer to appropriate facility of babies with birth weight $< 900\text{g}$. Pre-hospital tocolysis has been raised as a contentious point and existing evidence is thin, especially around pre-hospital use of tocolytics.

Following discussion with receiving clinicians, pre-hospital tocolysis with a single dose of the short acting calcium channel blocker nifedipine (Adalat®) (National Department of Health, Republic of South Africa, 2015) can be administered for preterm labour patients (26-33 weeks/EFW 800-1999g). This is most appropriate for long distance transfers in which the following conditions are met:

- Gestational age assessment can be accurately undertaken
- Preterm birth is considered imminent
- There is no clinical evidence of maternal infection
- Adequate childbirth care is available (including the capacity to recognise and safely manage preterm labour and birth)
- The preterm newborn can receive adequate care if needed (including resuscitation, thermal care, feeding support, infection treatment and safe oxygen use)

A recommended dosage of 30 mg should be administered orally (nifedipine should not be chewed or taken sublingually). Contraindications include all cardiac diseases, hypotension and hypertensive diseases.

General Management

1.3.4.1 Kangaroo mother care is recommended for the routine care of newborns weighing 2000 g or less at birth and should be initiated in health-care facilities as soon as the newborns are clinically stable. (World Health Organization, 2015a)

Strong recommendation; moderate-quality evidence.

1.3.4.2 Unstable newborns weighing 2000 g or less at birth, or stable newborns weighing less than 2000 g who cannot be given Kangaroo mother care, should be cared for in a thermoneutral environment either under radiant warmers or in incubators. (World Health Organization, 2015a) *

Strong recommendation; very low-quality evidence.

1.3.4.3 There is insufficient evidence on the effectiveness of plastic bags/wraps in providing thermal care for preterm newborns immediately after birth. However, during stabilization and transfer of preterm newborns to specialized neonatal care wards, wrapping in plastic bags/wraps may be considered as an alternative to prevent hypothermia. (World Health Organization, 2015a)

Conditional recommendation; low-quality evidence.

1.3.4.4 Continuous positive airway pressure therapy is recommended for the treatment of preterm newborns with respiratory distress syndrome. (World Health Organization, 2015a) *

Strong recommendation; low-quality evidence.

- 1.3.4.5 During ventilation of preterm babies born at or before 32 weeks of gestation, it is recommended to start oxygen therapy with 30% oxygen or air (if blended oxygen is not available), rather than with 100% oxygen.** (World Health Organization, 2015a) *

Strong recommendation; very low-quality evidence.

- 1.3.4.6 Maternal transfer to prevent the need for premature neonatal transfer reduces preterm neonatal morbidity and mortality. Very low birth weight infants (less than 1,500 grams) inborn to Level III perinatal centres have lower mortality, reduced incidence of Grade III and Grade IV intraventricular haemorrhage, and lower sensorineural disability rates than outborn infants.** (World Health Organization, 2015a)

Low Quality Evidence.

- 1.3.4.7 Tocolytic treatments (acute and maintenance treatments) are not recommended for women at risk of imminent preterm birth for the purpose of improving newborn outcomes.**

(World Health Organization, 2015a) *

Low Quality Evidence.

Antenatal Steroids

Although administration of steroids in preterm labour will usually be a hospital based decision and practice, for long distance transfers, with agreement from referring/receiving practitioners it may be appropriate pre-hospital. "Give steroids (preferably betamethasone 12 mg IM, or dexamethasone 4 mg/1ampoule)" (National Department of Health, Republic of South Africa, 2015).

- 1.3.4.8 Antenatal corticosteroid therapy is recommended for women at risk of preterm birth from 24 weeks to 34 weeks of gestation when the following conditions are met: gestational age assessment can be accurately undertaken; preterm birth is considered imminent; there is no clinical evidence of maternal infection; adequate childbirth care is available (including the capacity to recognize and safely manage preterm labour and birth); the preterm newborn can receive adequate care if needed (including resuscitation, thermal care, feeding support, infection treatment and safe oxygen use).** (World Health Organization, 2015a)

*

Strong recommendation; moderate-quality evidence for newborn outcomes and low quality evidence for maternal outcomes.

- 1.3.4.9 Either IM dexamethasone or IM betamethasone (total 24 mg in divided doses) is recommended as the antenatal corticosteroid of choice when preterm birth is imminent.**

(World Health Organization, 2015a)

Strong recommendation; low-quality evidence.

1.4 Antenatal Haemorrhage

- 1.4.1 No deviation from current practice can be recommended at this time.**

1.4 Post Partum Haemorrhage

“Postpartum Haemorrhage (PPH) is commonly defined as a blood loss of 500 ml or more within 24 hours after birth. PPH is the leading cause of maternal mortality in low-income countries and the primary cause of nearly one quarter of all maternal deaths globally. Most deaths resulting from PPH occur during the first 24 hours after birth: the majority of these could be avoided through the use of prophylactic uterotonics during the third stage of labour and by timely and appropriate management. Improving health care for women during childbirth in order to prevent and treat PPH is an essential step towards the achievement of the Millennium Development Goals” (World Health Organization, 2015b).

1.4.1 Prevention of PPH

Early active management of the third stage of labour can prevent subsequent catastrophic PPH and is essential for all deliveries managed by EMS practitioners.

- “Active management of the third stage of labour involves interventions to assist in expulsion of the placenta with the intention to prevent or decrease blood loss. Interventions include use of uterotonics, clamping of the umbilical cord, and controlled traction of the cord. In contrast, with expectant, or physiological, management, spontaneous delivery of the placenta is allowed, with subsequent intervention, if necessary, that involves uterine massage and use of uterotonics” (Leduc, Senjkas and Lalonde, 2009).
- “All women giving birth should be offered uterotonics during the third stage of labour to prevent PPH and IM/IV oxytocin (10 IU) is recommended as the uterotonic drug of choice” (World Health Organization, 2015b).
- There is insufficient evidence to recommend one oxytocin route over another for the prevention of PPH (World Health Organization, 2015b).
- In South Africa, administration of IM oxytocin after delivery of the baby (rather than after delivery of shoulder) is acceptable practice (particularly where there are limited staff to administer).
- Continuous massage is not advocated to prevent PPH, but is part of the management of uncontrolled PPH with an atonic uterus. “Continuous uterine massage is not recommended as an intervention to prevent PPH for women who have received prophylactic oxytocin, because the massage may cause maternal discomfort, require a dedicated health professional, and may not lead to a reduction of blood loss” (World Health Organization, 2015b).
- Close observation of vital signs, uterine contraction and bleeding in the fourth stage of labour is vital (National Department of Health, Republic of South Africa, 2015).

1.4.1.1 Active management of the third stage of labour reduces the risk of PPH and should be offered and recommended to all women. (Leduc, Senjkas and Lalonde, 2009)

Good evidence to recommend the clinical preventive action; Evidence obtained from at least one properly randomized controlled trial.

1.4.1.2 The use of uterotonics for the prevention of PPH during the third stage of labour is recommended for all births. (World Health Organization, 2015b)

Strong recommendation, moderate-quality evidence.

1.4.1.3 Oxytocin (10 IU), administered IM, is the preferred medication and route for the prevention of PPH in low-risk vaginal deliveries. Care providers should administer this medication after delivery of the anterior shoulder. (Leduc, Senjkas and Lalonde, 2009) *

Good evidence to recommend the clinical preventive action; Evidence obtained from at least one properly randomized controlled trial.

1.4.1.4 IV infusion of oxytocin (20 to 40 IU in 1000 mL, 150 mL per hour) is an acceptable alternative for active management of third stage labour. (Leduc, Senjkas and Lalonde, 2009)

Fair evidence to recommend the clinical preventive action; Evidence obtained from at least one properly randomized controlled trial.

1.4.1.5 In settings where oxytocin is unavailable, the use of other injectable uterotonics (ergometrine) or oral misoprostol (600 µg) is recommended. *adapted*

1.4.1.6 In settings where skilled birth attendants are not present and Oxytocin (10 IU), is unavailable, the administration of misoprostol (600 µg PO) by community health care workers and lay health workers is recommended for the prevention of PPH. (World Health Organization, 2015b)

Strong recommendation, moderate quality evidence.

1.4.1.7 Sustained uterine massage is not recommended as an intervention to prevent PPH in women who have received prophylactic oxytocin. (World Health Organization, 2015b) *

Weak recommendation, low-quality evidence.

1.4.1.8 Postpartum abdominal uterine tonus assessment for early identification of uterine atony is recommended for all women. (World Health Organization, 2015b)

Strong recommendation, very-low-quality evidence.

1.4.2 Cord Clamping & Placental Management

Placental delivery is essential to allow the uterus to contract and thus reduce blood loss in the third stage of labour. This process is completed within 5 minutes in 50% of deliveries and by 15 minutes in 90%. Failure of the placenta to be delivered in such a timely manner is a well-known risk factor of PPH (Leduc, Senjkas and Lalonde, 2009).

1.4.2.1 Late cord clamping (performed at 1 to 3 minutes after birth) is recommended for all term births while initiating simultaneous essential newborn care. *adapted*

- 1.4.2.2 Early cord clamping (<1 minute after birth) is not recommended unless the neonate is asphyxiated and needs to be moved immediately for resuscitation.** (World Health Organization, 2015b)

Strong recommendation, moderate-quality evidence.

- 1.4.2.3 There is no evidence that, in an uncomplicated delivery without bleeding, interventions to accelerate delivery of the placenta before the traditional 30 to 45 minutes will reduce the risk of PPH.** (Leduc, Senjkas and Lalonde, 2009) *

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from well-designed cohort (prospective or retrospective) or case-control studies.

- 1.4.2.4 Placental cord drainage cannot be recommended as a routine practice since the evidence for a reduction in the duration of the third stage of labour is limited to women who did not receive oxytocin as part of the management of the third stage. There is no evidence that this intervention prevents PPH.** (Leduc, Senjkas and Lalonde, 2009)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from well-designed cohort (prospective or retrospective) or case-control studies.

- 1.4.2.5 If the placenta is not expelled spontaneously, the use of IV/IM oxytocin (10 IU) in combination with controlled cord traction is recommended.** (World Health Organization, 2015b) *

Weak recommendation, very-low-quality evidence.

“If the third stage of labour lasts more than 30 minutes, continuous cord traction (CCT) and IV/IM oxytocin (10 IU) **(second dose)** should be used to manage the retained placenta. If the placenta is retained and bleeding occurs, the manual removal of the placenta should be expedited” (World Health Organization, 2015b).

1.4.3 Initial Management of PPH

All women with PPH must be transferred from a community health centre to hospital. Community health centre midwives and doctors should take whatever emergency steps they can, as listed below, to arrest bleeding and achieve fluid resuscitation. Patients with PPH must, wherever possible, be adequately stabilised before transfer from community health centre to hospital (National Department of Health, Republic of South Africa, 2015).

A previously established plan of action is of great value when preventive measures have failed. This plan should include aggressive fluid resuscitation and control of bleeding (Leduc, Senjkas and Lalonde, 2009). In SA, available uterotonic drugs include oxytocin (syntocinon), ergometrine, syntometrine (combination syntocinon and ergometrine) and misoprostol.

- Research has shown that care providers poorly estimate blood loss and consistently underestimate the loss of a large volume of blood. Clinical signs and symptoms of shock are useful bedside indicators of ongoing blood loss and will assist clinicians in management (Leduc, Senjkas and Lalonde, 2009).
- The initial goal of management is to determine the cause of blood loss while instituting resuscitative measures. Evaluation of uterine tone and a complete inspection of the lower genital tract are required. The goal of resuscitative measures is to maintain hemodynamic stability and oxygen perfusion of the tissues. An IV infusion of crystalloid solution should be instituted, using large-bore tubing, along with oxygen supplementation. The "ABCs" should be observed and vital signs, oxygen saturation, and urinary output monitored (Leduc, Senjkas and Lalonde, 2009).
- IV Oxytocin is the first line uterotonic for the treatment of PPH, even when already administered as prophylaxis as part of AMTSL.
- There is no added benefit to offering misoprostol simultaneously to women receiving oxytocin for the treatment of PPH (i.e. adjunct misoprostol). If given as an alternative to oxytocin, 400 µg is an acceptable sublingual misoprostol dose for the treatment of PPH (World Health Organization, 2015b).
- There are various methods to reduce PPH by direct pressure on the uterus; many are not appropriate to the pre-hospital environment. Uterine tamponade as described (1.4.4.1) is likely the easiest procedure.
- Evidence for the recommendation of tranexamic acid was extrapolated from the literature on surgery and trauma, which shows tranexamic acid to be a safe option for the treatment of trauma-related bleeding (World Health Organization, 2015b).
- Uterine massage as a therapeutic measure is defined as the rubbing of the uterus achieved through the manual massaging of the abdomen. This is typically sustained until the bleeding stops or the uterus contracts. Uterine massage should be started once PPH has been diagnosed (World Health Organization, 2015b).

1.4.3.1 For blood loss estimation, clinicians should use clinical markers (signs and symptoms) rather than a visual estimation. (Leduc, Senjkas and Lalonde, 2009) *

Fair evidence to recommend the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

1.4.3.2 Management of ongoing PPH requires a multidisciplinary approach that involves maintaining hemodynamic stability while simultaneously identifying and treating the cause of blood loss. (Leduc, Senjkas and Lalonde, 2009)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

1.4.3.3 Uterine tamponade (The quickest method of tamponade is with bimanual compression of the uterus. One hand is placed over the uterus externally; the other is placed in the vagina to apply pressure on the lower segment. Consistent compression with the 2 hands results in external compression of the uterus to reduce blood flow. This can be continued until further measures are taken or assistance arrives.) can be an efficient and effective intervention to temporarily control active PPH due to uterine atony that has not responded to medical therapy. (Leduc, Senjkas and Lalonde, 2009)

There is insufficient evidence (in quantity or quality) to make a recommendation; however, other factors may influence decision-making; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

1.4.3.4 IV oxytocin alone is the recommended uterotonic drug for the treatment of PPH. (World Health Organization, 2015b) *

Strong recommendation, moderate-quality evidence.

1.4.3.5 If IV oxytocin is unavailable, or if the bleeding does not respond to oxytocin, the use of IV ergometrine, oxytocin-ergometrine fixed dose, or a prostaglandin drug (including sublingual misoprostol, 800 µg) is recommended. (World Health Organization, 2015b) *

Strong recommendation, low-quality evidence.

1.4.3.6 The use of isotonic crystalloids is recommended in preference to the use of colloids for the initial IV fluid resuscitation of women with PPH. (World Health Organization, 2015b) *

Strong recommendation, low-quality evidence

1.4.3.7 The use of tranexamic acid is recommended for the treatment of PPH if oxytocin and other uterotonics fail to stop bleeding or if it is thought that the bleeding may be partly due to trauma. (World Health Organization, 2015b)

Weak recommendation, moderate-quality evidence

1.4.3.8 Uterine massage is recommended for the treatment of PPH. (World Health Organization, 2015b)

Strong recommendation, very low- quality evidence.

1.4.4 Second Line Management of PPH

- External aortic compression has long been recommended as a potential life-saving technique, and mechanical compression of the aorta, if successful, slows blood loss. A high value is placed on this procedure as a temporising measure in the treatment of PPH (World Health Organization, 2015b).
- External aortic compression is performed by applying firm and sustained pressure to the aorta above the level of the umbilicus while awaiting help (National Department of Health, Republic of South Africa, 2015).
- Research evaluating the potential benefits and harms of non-pneumatic anti-shock garments is ongoing. Based on the evidence available, non-pneumatic anti-shock garments should be regarded as a temporising measure while transfer is awaited (World Health Organization, 2015b).

Balloon Tamponade may be initiated by referring clinicians for continuation during transfer, but is not within EMS practitioners scope to initiate. It should be noted that the application of these interventions requires training and that maternal discomfort and complications associated with these procedures have been reported. In the pre-hospital context, these are last resorts for women in extremis en route to definitive care.

1.4.4.1 If women do not respond to treatment using uterotonics, or if uterotonics are unavailable, the use of intrauterine balloon tamponade is recommended for the treatment of PPH due to uterine atony. (World Health Organization, 2015b)

Weak recommendation, very-low-quality evidence.

1.4.4.2 The use of bimanual uterine compression is recommended as a temporizing measure until appropriate care is available for the treatment of PPH due to uterine atony after vaginal delivery. (World Health Organization, 2015b)

Weak recommendation, very-low-quality evidence.

1.4.4.3 The use of external aortic compression for the treatment of PPH due to uterine atony after vaginal birth is recommended as a temporizing measure until appropriate care is available. (World Health Organization, 2015b)

Weak recommendation, very-low-quality evidence.

1.4.4.4 The use of non-pneumatic anti-shock garments is recommended as a temporizing measure until appropriate care is available. (World Health Organization, 2015b)*

Weak recommendation, low-quality evidence.

1.5 Hypertension & Eclampsia in Pregnancy

"Hypertensive disorders are one of the most common direct causes of maternal mortality and are responsible for significant perinatal and maternal morbidity. These disorders include chronic hypertension, pre-eclampsia, and eclampsia. Early detection and timely intervention is essential to prevent maternal and perinatal complications. Early detection and treatment of the hypertension until foetal viability and timely delivery will result in reducing death and morbidity from complications associated with pre-eclampsia" (National Department of Health, Republic of South Africa, 2015).

1.5.1 Hypertension

SA guidelines suggest that if there is acute severe hypertension (blood pressure is >160 mm systolic or >110 mm diastolic), give nifedipine 10 mg orally to swallow (not buccally, sublingually or bitten). Repeat blood pressure measurement every half hour. If the blood pressure is still >160 mm systolic or >110 mm diastolic 30 minutes after nifedipine, a second dose of nifedipine can be given (National Department of Health, Republic of South Africa, 2015).

Nifedipine should not be given sublingually to a woman with hypertension. Profound hypotension can occur with concomitant use of nifedipine and parenteral magnesium sulphate and therefore nifedipine should be prescribed with caution in women with severe pre-eclampsia (Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland, 2011).

Pre-hospital practitioners are constrained by the available drugs for treating hypertension in the pre-hospital context, and would normally rely on the referring and receiving practitioners to guide and initiate antihypertensive treatment. When faced with a critically hypertensive pregnant patient, practitioners should be guided by their resources, context and experience in judiciously reducing blood pressure while carefully monitoring the patient.

1.5.1.1 **Treat women with severe hypertension who are in critical care during pregnancy or after birth immediately with one of the following: labetalol (oral or IV); hydralazine (IV); nifedipine (oral).** (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

This recommendation applies to critical care transfers.

1.5.1.2 **In women with severe hypertension who are in critical care, monitor their response to treatment: to ensure that their blood pressure falls; to identify adverse effects for both the woman and the foetus; to modify treatment according to response.** (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

1.5.1.3 **In women with severe hypertension who are in critical care, aim to keep systolic blood pressure below 150 mmHg and diastolic blood pressure between 80 and 100 mmHg.** (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

1.5.1.4 **The choice and route of administration of an antihypertensive drug for severe hypertension during pregnancy, in preference to others, should be based primarily on the prescribing clinician's experience with that particular drug, its cost and local availability.** (Lipman et al., 2014)

Weak recommendation; Very low quality of evidence.

1.5.2 Preeclampsia & Eclamptic Seizures Management

Definitions:

- Severe hypertension diastolic blood pressure 110mmHg or greater, systolic blood pressure 160 mmHg or greater (National Institute for Health and Care Excellence, 2010a).
- Pre-eclampsia is new hypertension presenting after 20 weeks with significant proteinuria. Severe pre-eclampsia is pre-eclampsia with severe hypertension and/or with symptoms, and/or biochemical and/or haematological impairment (National Institute for Health and Care Excellence, 2010a).
- Imminent eclampsia describes symptoms and signs that characterise severe pre-eclamptic women, i.e. severe persistent headache, visual disturbances, epigastric pain, hyper-reflexia, clonus, dizziness and fainting, or vomiting (National Department of Health, Republic of South Africa, 2015).
- Eclampsia is a generalised tonic-clonic seizures after 20 weeks of pregnancy and within 7 days after delivery, associated with hypertension and proteinuria.

Magnesium sulphate is recommended for the prevention of eclampsia in women with severe pre-eclampsia in preference to other anticonvulsants.

Ensure that the patient is accompanied by an experienced nurse or well-trained paramedic to ensure that the magnesium sulphate regimen is continued, that the patient is kept on her side and that complete records accompanies the patient and are handed over to the receiving health professional (National Department of Health, Republic of South Africa, 2015).

Motor paralysis, absent tendon reflexes, respiratory depression and cardiac arrhythmia (increased conduction time) can all occur with magnesium administration but will be at a minimum if magnesium is administered slowly and the woman is closely monitored (Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland, 2011).

For severe pre-eclampsia, imminent eclampsia, or eclampsia, initiate a magnesium sulphate loading dose: Dilute 4 ampoules (4 g) in 200 mL Ringer's lactate and infuse over 20 minutes.

For maintenance treatment (If transfer will take longer than 4 hours), also give 5 g magnesium sulphate deep IM in each buttock (a total dose of 14 g. Alternatively, if infusion pumps are available, put 4 grams in 200 mL fluid and infuse at 50 mL/hour (instead of the IM doses) for maintenance.

For quick transfer (specialist centre close by), the 4 g IV loading dose is sufficient (National Department of Health, Republic of South Africa, 2015).

1.5.2.1 If a woman in a critical care setting who has severe hypertension or severe preeclampsia has or previously had an eclamptic fit, give IV or IM magnesium sulphate. adapted

This recommendation applies to critical care transfers.

1.5.2.2 Consider giving IV magnesium sulphate to women with severe preeclampsia who are in a critical care setting if birth is planned within 24 hours. (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

1.5.2.3 If considering magnesium sulphate treatment, use the following as features of severe preeclampsia: (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

- **severe hypertension and proteinuria or mild or moderate hypertension and proteinuria with one or more of the following: symptoms of severe headache**
- **problems with vision, such as blurring or flashing before the eyes; severe pain just below the ribs or vomiting; papilloedema; signs of clonus (≥ 3 beats)**
- **Liver tenderness**
- **HELLP syndrome; platelet count falling to below 100×10^9 per litre**
- **Abnormal liver enzymes (ALT or AST rising to above 70 iu/litre).**

1.5.2.4 The full IV or IM magnesium sulphate regimens are recommended for the prevention and treatment of eclampsia. (World Health Organization, 2011)

Strong recommendation; moderate quality of evidence.

1.5.2.5 Use the Collaborative Eclampsia Trial regimen for administration of magnesium sulphate: loading dose of 4 g should be given IV over 5 minutes, followed by an infusion of 1 g/hour maintained for 24 hours (recurrent seizures should be treated with a further dose of 2–4 g given over 5 minutes). (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

1.5.2.6 Do not use diazepam, phenytoin or lytic cocktail as an alternative to magnesium sulphate in women with eclampsia. (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

1.5.2.7 Choose mode of birth for women with severe hypertension, severe preeclampsia or eclampsia according to the clinical circumstances and the woman's preference. (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

1.5.3 Fluid Management in Pre-Eclamptic and Eclamptic Patients

The fluid balance in hypertensive episodes in pregnancy is critical. Although volume replacement may be required, there is a high risk of overload and pulmonary oedema (Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland, 2011).

- 1.5.3.1 Consider using up to 500 ml crystalloid fluid before or at the same time as the first dose of IV hydralazine in the antenatal period.** (Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland, 2011) *

Grading embedded in recommendation.

- 1.5.3.2 Do not use volume expansion in women with severe pre-eclampsia unless hydralazine is the antenatal antihypertensive.** (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation

- 1.5.3.3 In women with severe pre-eclampsia, limit maintenance fluids to 80 ml/hour unless there are other ongoing fluid losses (for example, haemorrhage).** (National Institute for Health and Care Excellence, 2010a)

Grading embedded in recommendation.

Clinicians should be cautious with fluid administration due to the risk of pulmonary oedema. A 200 mL bolus is typically administered.

1.6 Trauma in Pregnancy

"The management of a pregnant trauma patient warrants consideration of several issues specific to pregnancy, such as alterations in maternal physiology and anatomy, exposure to radiation and other possible teratogens, the need to assess foetal well-being, and conditions that are unique to pregnancy and are related to trauma (Rh isoimmunization, placental abruption, and preterm labour). Optimisation of outcome in severe trauma cases mandates a multidisciplinary team approach involving trauma surgeons, emergency medicine physicians, obstetricians, neonatologists, nursing staff, and technicians" (Jain et al., 2015).

The pregnant patient has a greater risk for airway management problems and difficult intubation than the non-pregnant patient. An early intubation should be considered whenever airway problems are anticipated (Jain et al., 2015).

- 1.6.1 Every female of reproductive age with significant injuries should be considered pregnant until proven otherwise by a definitive pregnancy test or ultrasound scan.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

- 1.6.2 A nasogastric tube should be inserted in a semiconscious or unconscious injured pregnant woman to prevent aspiration of acidic gastric content.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

- 1.6.3 Oxygen supplementation should be given to maintain maternal oxygen saturation > 95% to ensure adequate foetal oxygenation.** (Jain et al., 2015)

Fair evidence to recommend the clinical preventive action; Evidence from well-designed controlled trials without randomization.

- 1.6.4 Two large bore (14 to 16 gauge) IV lines should be placed in a seriously injured pregnant woman.** (Jain et al., 2015)
Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.
- 1.6.5 Because of their adverse effect on uteroplacental perfusion, vasopressors in pregnant women should be used only for intractable hypotension that is unresponsive to fluid resuscitation.** (Jain et al., 2015)
Fair evidence to recommend the clinical preventive action; Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments.
- 1.6.6 After mid-pregnancy, the gravid uterus should be moved off the inferior vena cava to increase venous return and cardiac output in the acutely injured pregnant woman. This may be achieved by manual displacement of the uterus or left lateral tilt. Care should be taken to secure the spinal cord when using left lateral tilt.** (Jain et al., 2015)
Fair evidence to recommend the clinical preventive action; Evidence from well-designed controlled trials without randomization.
- 1.6.7 To avoid rhesus D (Rh) alloimmunization in Rh-negative mothers, O-negative blood should be transfused when needed until cross-matched blood becomes available.** (Jain et al., 2015)
Good evidence to recommend the clinical preventive action; Evidence obtained from at least one properly randomized controlled trial.
- 1.6.8 The abdominal portion of military anti-shock trousers should not be inflated on a pregnant woman because this may reduce placental perfusion.** (Jain et al., 2015) *
Fair evidence to recommend the clinical preventive action; Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments.
- 1.6.9 Transfer or transport to a maternity facility (triage of a labour and delivery unit) is advocated when injuries are neither life nor limb-threatening and the foetus is viable (\geq 23 weeks), and to the emergency centre when the foetus is under 23 weeks' gestational age or considered to be non-viable. When the injury is major, the patient should be transferred or transported to the emergency centre, regardless of gestational age.** *adapted*
Fair evidence to recommend the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.
- 1.6.10 When the severity of injury is undetermined or when the gestational age is uncertain, the patient should be evaluated in the emergency centre to rule out major injuries.** *adapted*

1.7 Cardiac Arrest in Pregnancy

See also Sections 1.1.3, BLS CPR: Pregnancy and 11.3.4, Special Circumstances in Cardiac Arrest: Pregnancy.

"Maternal cardiac arrest during pregnancy challenges health care teams with the simultaneous care of two critically ill patients, mother and unborn baby. These challenges are superimposed upon a general lack of experience in maternal resuscitative measures by obstetric health care teams because cardiac arrest in pregnancy is estimated to occur in < 1:20,000 women" (Lipman et al., 2014).

Although most features of resuscitating a pregnant woman are similar to standard adult resuscitation, several aspects and considerations are uniquely different. The most obvious difference is that there are two patients, the mother and the foetus (Jeejeebhoy et al., 2015). Recent data show that the rate of survival to hospital discharge after maternal cardiac arrest may be as high as 59%, far higher than most arrest populations, further justifying appropriate training and preparation for such events despite their rarity (Jeejeebhoy et al., 2015).

1.7.1 General Recommendations for Arrest in Pregnancy

Pre-hospital providers should not be expected to perform a peri-mortem caesarean delivery; however, transporting the mother in cardiac arrest to a location where peri-mortem caesarean delivery can be performed in a timely manner is essential. Foetal cardiac activity may be slow but present after many minutes of maternal pulselessness. As a result, foetal survival can occur in cases when maternal vital signs are lost before arrival in the emergency centre and when CPR fails to restore maternal pulses (Jeejeebhoy et al., 2015).

- Preparation for cardiac arrest: Educate providers about the management of cardiac arrest in pregnancy.
- Preparation for peri-mortem caesarean delivery: Identify contact details or appropriate code calls to mobilise the entire maternal cardiac arrest response team, and ensure the availability of equipment for caesarean delivery and resuscitation of the neonate.
- Preparation for management of obstetric complications: Stock drugs and equipment commonly available in obstetric units, including oxytocin and prostaglandin F2a.
- Decisions involving the resuscitation status of the neonate: Decisions about foetal viability should be made in collaboration with the obstetrician, neonatologist, and family. The decision depends on the gestational age and, to a significant degree, the neonatal facilities available. This information should be clearly documented (Jeejeebhoy et al., 2015).

1.7.1.1 If resources are available, EMS response to a maternal cardiac arrest should include the appropriate complement of staff to ensure that BLS and ACLS actions can be performed, including chest compressions, left uterine displacement, defibrillation when indicated, and management of the difficult airway. (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.1.2 If available, transport should be directed toward a centre that is prepared to perform peri-mortem caesarean section, but transport should not be prolonged by >10 minutes to reach a centre with more capabilities. (Jeejeebhoy et al., 2015) *

Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.1.3 EMS and the receiving emergency centre must establish optimal communication and an action plan for the transport of a maternal cardiac arrest patient. The emergency centre should be able to rapidly mobilize the maternal cardiac arrest team, and specialized equipment should be available from the time the patient arrives in the emergency centre.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

Management decisions made during a maternal cardiac arrest may require estimation of gestational age. Classically accepted rule-of-thumb landmarks may also be used: Gestational age is 12 weeks if the uterus is palpable at above the pubic symphysis, 20 weeks if the uterus is palpable at the level of the umbilicus, and 36 weeks if the uterus is palpable at the level of the xiphisternum (Jeejeebhoy et al., 2015).

Rapid response to instability in the pregnant patient is essential for the prevention of cardiac arrest. Maternal haemodynamics must be optimised; hypoxaemia must be treated; and IV access must be established (Jeejeebhoy et al., 2015).

- 1.7.1.4 Code team members with responsibility for pregnant women should be familiar with the physiological changes of pregnancy that affect resuscitation technique and potential complications.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.1.5 When appropriate, the patient should be placed in a full left lateral decubitus position to relieve aortocaval compression.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.1.6 When appropriate, administration of 100% oxygen by face mask to treat or prevent hypoxemia is recommended.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.1.7 IV access should be established above the diaphragm to ensure that the intravenously administered therapy is not obstructed by the gravid uterus.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.1.8 Precipitating factors should be investigated and treated.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.1.9 Because an immediate caesarean delivery may be the best way to optimize the condition of the mother and foetus, this operation should optimally occur at the site of the arrest. A pregnant patient with in-hospital cardiac arrest should not be transported for caesarean delivery. Management should occur at the site of the arrest. Transport to a facility that can perform a caesarean delivery may be required when indicated**

(e.g., for out-of-hospital cardiac arrest or cardiac arrest that occurs in a hospital not capable of caesarean delivery). (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.2 CPR in the Pregnant Patient

Left uterine displacement: Manual left uterine displacement has been shown to be superior to lateral tilt. The benefits of manual left uterine displacement over tilt include easier access for both airway management and defibrillation. While manual left uterine displacement is performed, the patient can remain supine and receive usual resuscitative measures, including high quality chest compressions without hindrance. Manual left uterine displacement can be performed from the left of the patient, where the uterus is cupped and lifted up and leftward off the maternal vessels, or from the right of the patient, where the uterus is pushed upward and leftward off the maternal vessels. The rescuer must be careful not to inadvertently push down, which would increase the amount of inferior vena cava compression and negatively affect maternal haemodynamics (Jeejeebhoy et al., 2015).

1.7.2.1 Chest compressions should be performed at a rate of at least 100 per minute at a depth of at least 2 in (5 cm), allowing full recoil before the next compression, with minimal interruptions, and at a compression-ventilation ratio of 30:2. (Jeejeebhoy et al., 2015)

Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

1.7.2.2 Interruptions should be minimized and limited to 10 seconds except for specific interventions such as insertion of an advanced airway or use of a defibrillator. (Jeejeebhoy et al., 2015)

Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

1.7.2.3 The patient should be placed supine for chest compressions. (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.2.4 There is no literature examining the use of mechanical chest compressions in pregnancy, and this is not advised at this time. Continuous manual left uterine displacement should be performed on all pregnant women who are in cardiac arrest in which the uterus is palpated at or above the umbilicus to relieve aortocaval compression during resuscitation. (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.2.5 If the uterus is difficult to assess (e.g., in the morbidly obese), attempts should be made to perform manual left uterine displacement if technically feasible. (Jeejeebhoy et al., 2015)

Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.2.6 **The rescuer should place the heel of 1 hand on the centre (middle) of the victim's chest (the lower half of the sternum) and the heel of the other hand on top of the first so that the hands overlap and are parallel.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.7 **The time when pulselessness was confirmed should be documented.** (Jeejeebhoy et al., 2015)
Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.8 **High quality CPR should be paired with uterine displacement, and a firm backboard should be used.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.9 **Rapid automated defibrillation should be provided whenever it is indicated as appropriate by rhythm analysis.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.10 **Appropriate BLS airway management should be initiated.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.11 **A member of the first responder team should perform bag-mask ventilation with 100% oxygen flowing to the bag at a rate of at least 15 L/ min.** (Jeejeebhoy et al., 2015)
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.12 **Two-handed bag-mask ventilation is preferred.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.2.13 **Hypoxemia should always be considered as a cause of cardiac arrest. Oxygen reserves are lower, and the metabolic demands are higher in the pregnant patient compared with the non-pregnant patient; thus, early ventilatory support may be necessary.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.3 Defibrillation During Pregnancy

Application of defibrillation and cardioversion shocks to the maternal chest would be expected to pass minimal energy to the foetus and is considered safe in all stages of pregnancy. When indicated, defibrillation should be performed in the pregnant patient without hesitation or delay (Jeejeebhoy et al., 2015).

- 1.7.3.1 **The same currently recommended defibrillation protocol should be used in the pregnant patient as in the non-pregnant patient. There is no modification of the recommended application of electric shock during pregnancy.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.3.2 **The patient should be defibrillated with biphasic shock energy of 120 to 200 J with subsequent escalation of energy output if the first shock is not effective and the device allows this option.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from single RCTs or pseudo-RCTs)
- 1.7.3.3 **Compressions should be resumed immediately delivery of the electric shock.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.3.4 **For settings where staff have no ECG rhythm recognition skills or where defibrillators are used infrequently such as in an obstetric unit, the use of an automated external defibrillator may be considered.** (Jeejeebhoy et al., 2015)
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.3.5 **Anterolateral defibrillator pad placement is recommended as a reasonable default.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.3.6 **The lateral pad/paddle should be placed under the breast tissue, an important consideration in the pregnant patient.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.3.7 **The use of adhesive shock electrodes is recommended to allow consistent electrode placement.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

1.7.4 Airway Management in Pregnancy

- Hypoxaemia develops more rapidly in the pregnant patient compared with the non-pregnant patient; therefore, rapid, high quality, and effective airway and breathing interventions are essential (Jeejeebhoy et al., 2015).
- Airway management should always be considered more difficult in the pregnant patient; therefore, appropriate airway algorithms for pregnancy should be instituted. For first responders with minimal airway experience, bag-mask ventilation with 100% oxygen is the most rapid non-invasive strategy to initiate ventilation (Jeejeebhoy et al., 2015).
- The glottis in pregnancy is often smaller because of oedema; therefore, starting with a smaller ETT may increase the likelihood of successful intubation. Face mask ventilation between laryngoscopic attempts may preserve oxygenation; any difficulty in ventilation indicates the need to avoid further laryngoscopy and to select alternative methods of airway management. Supraglottic airway placement is the preferred rescue strategy to facilitate ventilation after failed intubation (Jeejeebhoy et al., 2015).
- Pregnant women and those who are immediately postpartum are at increased risk of regurgitation and aspiration of stomach contents. Despite these concerns, chest compressions, oxygenation, and relief of aortocaval compression are a higher priority than techniques to limit the risk of regurgitation (e.g., cricoid pressure, rapid intubation) when caring for the obstetric victim of cardiopulmonary arrest (Jeejeebhoy et al., 2015).
- Continuous capnography should be used if available to assess correct placement of the ETT, the quality of chest compressions, and ROSC (Jeejeebhoy et al., 2015).

1.7.4.1 Endotracheal intubation should be performed by an experienced laryngoscopist:

(Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- **Starting with an endotracheal tube (ETT) with a 6.0- to 7.0-mm inner diameter is recommended**
- **Optimally no more than 2 laryngoscopy attempts should be made**
- **Supraglottic airway placement is the preferred rescue strategy for failed intubation.**
- **If attempts at airway control fail and mask ventilation is not possible, current guidelines for emergency invasive airway access should be followed (call for help, obtain equipment).**
- **Prolonged intubation attempts should be avoided to prevent deoxygenation, prolonged interruption in chest compressions, airway trauma, and bleeding.**

- 1.7.4.2 Cricoid pressure is not routinely recommended.** (Jeejeebhoy et al., 2015)
Recommendation should not be performed; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.4.3 Continuous waveform capnography, in addition to clinical assessment, is recommended as the most reliable method of confirming and monitoring correct placement of the ETT and is reasonable to consider in intubated patients to monitor CPR quality, to optimize chest compressions, and to detect ROSC.** (Jeejeebhoy et al., 2015)
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.4.4 Findings consistent with adequate chest compressions or ROSC include a rising Petco₂ level or levels >10 mm Hg.** (Jeejeebhoy et al., 2015)
Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.4.5 Interruptions in chest compressions should be minimized during advanced airway placement.** (Jeejeebhoy et al., 2015)
Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.5 Arrhythmia Management in Pregnancy

Medical therapy during cardiac arrest is no different in the pregnant patient than in the non-pregnant patient (Jeejeebhoy et al., 2015).

- 1.7.5.1 For refractory (shock-resistant) ventricular fibrillation and tachycardia, amiodarone 300 mg rapid infusion should be administered with 150-mg doses repeated as needed.** (Jeejeebhoy et al., 2015)
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.5.2 Medication doses do not require alteration to accommodate the physiological changes of pregnancy. Although there are changes in the volume of distribution and clearance of medication during pregnancy, there are very few data to guide changes in current recommendations.** (Jeejeebhoy et al., 2015)*
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.5.3 In the setting of cardiac arrest, no medication should be withheld because of concerns about foetal teratogenicity.** (Jeejeebhoy et al., 2015)
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.
- 1.7.5.4 Physiological changes in pregnancy may affect the pharmacology of medications, but there is no scientific evidence to guide a change in current recommendations. Therefore, the usual drugs and doses are recommended during ACLS.** (Jeejeebhoy et al., 2015)
Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.5.5 Administering 1 mg adrenaline IV/IO every 3 to 5 minutes during adult cardiac arrest should be considered. In view of the effects of vasopressin on the uterus and because both agents are considered equivalent, adrenaline should be the preferred agent.** (Jeejeebhoy et al., 2015)

Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.5.6 It is recommended that current ACLS drugs at recommended doses be used without modifications.** (Jeejeebhoy et al., 2015)

Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

1.7.6 Foetal Assessment and Monitoring During Maternal Resuscitation

During active CPR, the focus should remain on maternal resuscitation and restoration of maternal pulse and blood pressure with adequate oxygenation. During this time, evaluation of the foetal heart will not be helpful and carries the risk of inhibiting or delaying maternal resuscitation and monitoring. Should the mother achieve ROSC and her condition be stabilized, then foetal heart surveillance may be instituted when deemed appropriate (Jeejeebhoy et al., 2015).

- 1.7.6.1 Foetal assessment should not be performed during resuscitation.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.7.7 Delivery During Maternal Arrest

There is uncertainty around the evidence defining the timing of a peri-mortem caesarean delivery. Although, historically, it was suggested that the peri-mortem caesarean delivery be performed within 5 minutes of cardiac arrest, there are studies documenting both maternal and foetal survival after 5 minutes and performing a peri-mortem caesarean delivery within a 10-15-minute interval may still be reasonable, although survival seems to decrease (Jeejeebhoy et al., 2015).

The role of EMS will be to make rapid decisions and transport a pregnant patient in peri-arrest or arrest to an appropriate nearest facility with the capacity to perform a peri-mortem caesarean delivery. In addition, EMS needs to notify the receiving facility in such a case that this is a possibility to prepare for.

- 1.7.7.1 During cardiac arrest, if the pregnant woman (with a fundus height at or above the umbilicus) has not achieved ROSC with usual resuscitation measures with manual uterine displacement, it is advisable to prepare to evacuate the uterus while resuscitation continues.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.7.2 Decisions on the optimal timing of a peri-mortem caesarean delivery for both the infant and mother are complex and require consideration of factors such as the cause of the arrest, maternal pathology and cardiac function, foetal gestational age, and resources (i.e. may be delayed until qualified staff is available to perform this procedure). Shorter arrest-to-delivery time is associated with better outcome.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from single RCTs or pseudo-RCTs.

1.7.8 Post-Arrest Care

It is essential that a multidisciplinary team continue care in the post-arrest period. As with all post-arrest patients, the pregnant patient who is successfully resuscitated will require thorough assessment, monitoring, and treatment as complications arise (Jeejeebhoy et al., 2015)

- 1.7.8.1 If the patient is still pregnant, she should be placed in the full left lateral decubitus position, provided that this does not interfere with additional management issues such as monitoring, airway control, and IV access. If the patient is not in full left lateral tilt, manual left uterine displacement should be maintained continuously.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

- 1.7.8.2 The cause of the arrest should continue to be considered and treated accordingly.** (Jeejeebhoy et al., 2015)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

1.8 Gynaecological Issues

1.8.5 Non-Pregnant PV Bleeding

- 1.8.5.1 No deviation from current practice can be recommended at this time.**

1.8.6 PV Discharge

- 1.8.6.1 No deviation from current practice can be recommended at this time.**

2. Seizures

2.1 Paediatric Seizures

Paediatric and adult seizures are managed in essentially the same way, with the focus on identification, injury prevention, rapid termination and prevention of ongoing seizures; ongoing attention must be paid to reversal of the cause of the seizure. Important differences in children relate to febrile seizures (covered in section 3: Fever & Sepsis) and easily correctable causes such as hypoglycaemia.

2.1.1 Children with convulsive status epilepticus in the pre-hospital setting should have glucometry performed to assess for hypoglycaemia. *adapted*

2.1.2 We suggest that children with pre-hospital seizures should have blood glucose checked from a capillary source; a venous check would be a less preferred alternative to assess for hypoglycaemia. (Shah et al., 2014) *

Weak recommendation; low quality evidence

Glucometers appropriate for use in children are required. Capillary blood is preferred, venous blood sampling is a possible alternative in shocked children, but this should not be used routinely.

2.1.3 We recommend that children with pre-hospital hypoglycaemia (glucose <60 mg/dL or <3 mmol/L) should be treated with either IV dextrose or IM glucagon. (Shah et al., 2014)

Strong recommendation; low quality evidence

Glucose should be 10% dilution; oral or buccal dextrose should be used if IV glucose or IM glucagon is not available or appropriate. Glucagon should be used with caution in situations of malnutrition.

2.1.4 We suggest that patients found to be hypoglycaemic in the setting of a pre-hospital seizure should be transported to an emergency centre, regardless of whether they return to baseline mental status after treatment. (Shah et al., 2014)

Weak recommendation; low quality evidence

2.1.5 We recommend that for children who are postictal upon arrival of EMS personnel in the pre-hospital setting, IV placement is not necessary if transport time is short, since alternative routes for administration of anticonvulsants should be utilized. If transport time is expected to be long, either precautionary IV or interosseous (IO) needle placement may be considered as it may be useful for other aspects of patient care. (Shah et al., 2014)

Strong Recommendation, Low quality evidence

2.1.6 We suggest that pre-hospital seizure management in children does not require IV placement to minimize seizure recurrence or adverse events. (Shah et al., 2014)*

Strong recommendation; low quality evidence

IV placement is not a necessity as many of the agents can be given via nasal and IM routes, which are as effective as the IV route. If delay to transport is unavoidable or transport time is long IV placement may be appropriate after first line agent administration.

- 2.1.7 We recommend that pre-hospital protocols for seizure management in children utilize alternative (non-IV) routes of drug administration as first-line therapy for treating children with status epilepticus.** (Shah et al., 2014)

Strong recommendation, moderate quality evidence

- 2.1.8 We recommend buccal midazolam over PR (per rectal) diazepam for pre-hospital seizure cessation and control.** (Shah et al., 2014) *

Strong recommendation; low quality evidence

- 2.1.9 We suggest IM midazolam over PR diazepam for pre-hospital seizure cessation and control.** (Shah et al., 2014) *

Weak recommendation; very low quality evidence

IM lorazepam is suggested as a possible alternative option.

- 2.1.10 We suggest intranasal (IN) midazolam over PR diazepam for pre-hospital seizure cessation and control.** (Shah et al., 2014) *

Weak recommendation; very low quality evidence

- 2.1.11 We suggest IV diazepam, midazolam, or lorazepam as equivalent therapeutic options when IV benzodiazepines are administered.** (Shah et al., 2014) *

Weak recommendation

- 2.1.12 We suggest a dose of 0.05–0.1 mg/kg for IV diazepam (rate unknown).** (Shah et al., 2014) *

Strong recommendation; low quality evidence

- 2.1.13 We suggest a dose of 0.05–0.1 mg/kg over 15–30 seconds for IV lorazepam.** (Shah et al., 2014) *

Weak recommendation; low quality evidence

- 2.1.14 We suggest a dose of 0.1 mg/kg for IV midazolam (rate unknown).** (Shah et al., 2014) *

Weak recommendation; very low quality evidence

2.2 Adult Seizures

- 2.2.1 Status epilepticus should be defined as 5 min or more of continuous clinical or recurrent seizure activity without recovery between seizures.** ^{adapted}

- 2.2.2 Status epilepticus should be classified as either convulsive status epilepticus (convulsions that are associated with rhythmic jerking of the extremities) or non-convulsive status epilepticus.** ^{adapted}

2.2.3 Refractory status epilepticus should be defined as status epilepticus that does not respond to the standard treatment regimens, such as an initial benzodiazepine followed by another antiepileptic drug. (Brophy et al., 2012)
Strong recommendation, moderate quality evidence

2.2.4 The aetiology of status epilepticus should be diagnosed and treated as soon as possible. (Brophy et al., 2012) *
Strong recommendation, high quality evidence

This may not always be possible in the pre-hospital setting, however common cause of seizures such a head injury, hypoxia and hypoglycaemia to mention only a few examples should be considered.

2.2.5 The treatment of convulsive status epilepticus should occur rapidly and continue sequentially until clinical seizures are halted. (Brophy et al., 2012)
Strong recommendation, high quality evidence

2.2.6 Benzodiazepines should be given as emergent initial therapy. (Brophy et al., 2012)
Strong recommendation, high quality evidence

2.2.7 Lorazepam is the drug of choice for IV administration. (Brophy et al., 2012)
Strong recommendation, high quality evidence

2.2.8 Midazolam is the drug of choice for IM administration. (Brophy et al., 2012) *
Strong recommendation, moderate quality evidence

Consider IN option for administration of midazolam as an alternative.

2.2.9 Rectal diazepam can be given when there is no IV access and IM administration of midazolam is contraindicated. (Brophy et al., 2012)
Strong recommendation, moderate quality evidence

2.2.10 In general, convulsive status epilepticus, the preferred treatment pathway is IV administration of 0.1 mg/kg lorazepam. (Lindsay et al., 2010)
Evidence from at least one systematic review of RCTs or individual RCTs

2.2.11 Depending on the patient's general medical condition, the clinician may decide to start treatment at a lower dose of 4 mg and repeat this dose if SE is not terminated within 10 min. (Lindsay et al., 2010) *
Evidence from at least one convincing prospective matched-group cohort study or overwhelming controlled trials

Consider initial dosage of lorazepam in status epilepticus in context of clinical presentation of the patient.

2.2.12 In the setting of refractory generalised convulsive and subtle SE, it is suggested that an infusion of anaesthetic doses of midazolam and airway management is initiated due to the progressive risk of brain and systemic damage. Effective initial IV doses of midazolam

are a 0.2 mg/kg bolus, followed by continuous infusion at rates of 0.05 to 0.4 mg/kg/h.^{adapted}

This recommendation refers to the context of refractory status epilepticus.

3. Fever & Sepsis

3.1 Dangerous Fever in Children

Feverish illness in young children usually indicates an underlying infection and is a cause of concern for parents and carers. Despite advances in healthcare, infections remain a leading cause of death in children under the age of 5 years. Fever in young children can be a diagnostic challenge for healthcare professionals because it is often difficult to identify the cause. In most cases, the illness is due to a self-limiting viral infection. However, fever may also be the presenting feature of serious bacterial infections such as meningitis and pneumonia. A significant number of children have no obvious cause of fever despite careful assessment. These children with fever without apparent source are of particular concern to healthcare professionals because it is especially difficult to distinguish between simple viral illnesses and life-threatening bacterial infections in this group.

Services may choose to implement a tool for evaluation and management of the febrile child, such as the UK "traffic light" system. It must be noted that no tools of this nature were identified to be directly applicable to the SA population.

3.1.1 Assessment of the Febrile Child

3.1.1.1 Do not routinely use the oral and rectal routes to measure the body temperature of children aged 0–5 years. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

There are concerns that some young children will bite the thermometer, and others find the technique uncomfortable or even painful. Rectal thermometers are unacceptable for routine use, as other safer options exist.

3.1.1.2 In infants under the age of 4 weeks, measure body temperature with an electronic thermometer in the axilla. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.3 In children aged 4 weeks to 5 years, measure body temperature by one of the following methods: (National Institute for Health and Care Excellence, 2013) *

Grading embedded in recommendation.

- **electronic thermometer in the axilla**
- **chemical dot thermometer in the axilla**

- **infra-red tympanic thermometer**

3.1.1.4 Forehead chemical thermometers are unreliable and should not be used by healthcare professionals. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.5 Reported parental perception of a fever should be considered valid and taken seriously by healthcare professionals. (National Institute for Health and Care Excellence, 2013) *

Grading embedded in recommendation.

Subjective detection of fever by parents and carers has been relatively well studied. Although there had been no direct comparisons, the sensitivity and specificity of detecting fever by palpation were comparable with those reported for axillary and tympanic thermometers.

3.1.1.6 First, healthcare professionals should identify any immediately life-threatening features, including compromise of the airway, breathing or circulation, and decreased level of consciousness. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

Recognise that children with any of the following symptoms or signs are in a high-risk group for serious illness: pale/mottled/ashen/blue skin, lips or tongue, no response to social cues, appearing ill to a healthcare professional, does not wake or if roused does not stay awake, weak, high-pitched or continuous cry grunting, respiratory rate greater than 60 breaths per minute, moderate or severe chest indrawing, reduced skin turgor, bulging fontanelle. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.7 Recognise that children with any of the following symptoms or signs are in at least an intermediate-risk group for serious illness: pallor of skin, lips or tongue reported by parent or carer, not responding normally to social cues, no smile, wakes only with prolonged stimulation, decreased activity, nasal flaring, dry mucous membranes, poor feeding in infants, reduced urine output, rigors. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.8 Recognise that children who have all of the following features, and none of the high- or intermediate-risk features, are in a low-risk group for serious illness: normal colour of skin, lips and tongue responds normally to social cues, content/smiles stay awake or awakens quickly strong normal cry or not crying normal skin and eyes, moist mucous membranes. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.9 Measure and record temperature, heart rate, respiratory rate and capillary refill time as part of the routine assessment of a child with fever. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.10 Recognise that a capillary refill time of 3 seconds or longer is a risk marker for serious illness. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.11 Measure the blood pressure of children with fever if the heart rate or capillary refill time is abnormal and the facilities to measure blood pressure are available. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.12 In children older than 6 months do not use body temperature alone to identify those with serious illness. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.13 Recognise that children younger than 3 months with a temperature of 38°C or higher are in a high-risk group for serious illness. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.14 Recognise that children aged 3–6 months with a temperature of 39°C or higher are in at least an intermediate-risk group for serious illness. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.1.15 Recognise that children with tachycardia are in at least an intermediate-risk group for serious illness. ^{adapted}

Services should recommend a chart that clearly defines paediatric tachycardia, such as the Advanced Paediatric Life Support criteria.

3.1.1.16 Assess children with fever for signs of dehydration and shock. Look for: prolonged capillary refill time, abnormal skin turgor, abnormal respiratory pattern, weak pulse, cool extremities. ^{adapted}

Grading embedded in recommendation

3.1.2 Patient Pathway

“Feverish illness in children is a normal and common event although it can cause significant anxiety for some parents and carers. Parents may seek support from healthcare services but in most cases the parents can be reassured that the child is best cared for at home. They may need support and advice to do this confidently. The overwhelming majority of children will recover quickly and without problems. However, in a few cases the child's condition may worsen or fail to improve. Parents need information on when and how to seek further advice” (National Institute for Health and Care Excellence, 2013).

3.1.2.1 Advise parents or carers looking after a feverish child at home: to offer the child regular fluids (where a baby or child is breastfed the most appropriate fluid is breast milk), how to detect signs of dehydration by looking for the following features (sunken fontanelle, dry mouth, sunken eyes, absence of tears, poor overall appearance), to encourage their child to drink more fluids and consider seeking further advice if they detect signs of dehydration, how to identify a non-blanching rash, to check their child during the night, to keep their child away from nursery or school while the child's fever persists but to notify the school or nursery of the illness. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

This is NOT on scene discharge; practitioners should not discourage or refuse transport if parents request to do so.

See also Section 15.1, On-Scene Discharge Practices

- 3.1.2.2 Following contact with a healthcare professional, parents and carers who are looking after their feverish child at home should seek further advice if: the child has a fit, the child develops a non-blanching rash, the parent or carer feels that the child is less well than when they previously sought advice, the parent or carer is more worried than when they previously sought advice, the fever lasts longer than 5 days, the parent or carer is distressed, or concerned that they are unable to look after their child.** (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

Practitioners should not discourage or refuse transport if parents request to do so.

- 3.1.2.3 Children whose symptoms or combination of symptoms and signs suggest an immediately life-threatening illness should be referred immediately for emergency medical care by the most appropriate means of transport.** (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.3 Management of the Febrile Child

Fever is a normal physiological response to infection and a number of other conditions. Although it is a normal response, some people, including many doctors, nurses and parents, believe that fever should be treated to reduce temperature. This is usually either because of concerns about the damaging effect of fever or because it is thought to be a distressing symptom. However, opinions differ about this, with others believing that fever should be allowed to run its course.

If it is thought necessary to reduce fever, there are a number of interventions that are or have been used, either alone or in combination. Pharmacological treatments differ fundamentally from physical treatments, as they aim to lower the hypothalamic set-point rather than simply cool the body. If it is thought necessary to reduce fever, the safest, most clinically and cost-effective treatments and those most acceptable to the child should be used (National Institute for Health and Care Excellence, 2013).

- 3.1.3.1 Oxygen should be given to children with fever who have signs of shock or oxygen saturation (SpO₂) of less than 92% when breathing air. Treatment with oxygen should also be considered for children with an SpO₂ of greater than 92%, as clinically indicated.** (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

- 3.1.3.2 Children with fever and shock presenting to an advanced life support provider should be given an immediate IV fluid bolus of 10-20 mL/kg; the initial fluid should normally be 0.9%**

sodium chloride and actively monitored and given further fluid boluses (10-20 mL/kg) as necessary. ^{adapted}

Grading embedded in recommendation.

Ringer's lactate is also an acceptable fluid alternative.

3.1.3.3 Antipyretic agents do not prevent febrile convulsions and should not be used specifically for this purpose. (National Institute for Health and Care Excellence, 2013)

3.1.3.4 Tepid sponging is not recommended for the treatment of fever. (National Institute for Health and Care Excellence, 2013) *

Grading embedded in recommendation.

Physical treatments such as tepid sponging cool the part of the body being sponged but do not reduce the levels of prostaglandins and, so, the temperature of the whole body is not reduced. Clinical judgement should be used when using tepid sponging.

3.1.3.5 Children with fever should not be underdressed or over-wrapped. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.3.6 Consider using either paracetamol or ibuprofen in children with fever who appear distressed. (National Institute for Health and Care Excellence, 2013) *

Grading embedded in recommendation.

Ibuprofen should not be used in suspected renal dysfunction patients.

3.1.3.7 Do not use antipyretic agents with the sole aim of reducing body temperature in children with fever. (National Institute for Health and Care Excellence, 2013)

Grading embedded in recommendation.

3.1.3.8 When using paracetamol or ibuprofen in children with fever: continue only as long as the child appears distressed, consider changing to the other agent if the child's distress is not alleviated, do not give both agents simultaneously, only consider alternating these agents if the distress persists or recurs before the next dose is due. (National Institute for Health and Care Excellence, 2013) *

Grading embedded in recommendation.

Ibuprofen should not be used in suspected renal dysfunction patients.

3.2 Paediatric Invasive Meningococcal Disease

Meningococcal infection causes infrequent outbreaks but is highly contagious to direct contacts. It can cause a severe meningitis or septicaemia with an extremely rapid onset and deterioration.

3.2.1 Pre-hospital Management of invasive meningococcal disease

3.2.1.1 Patients with suspected invasive meningococcal disease will be sent to hospital urgently.

(Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.) *Recommended practice based on clinical experience and consensus.*

3.2.1.2 When suspecting invasive meningococcal disease, IV antibiotics (ceftriaxone 50 mg/kg IV or IM) should be administered as soon as possible, both in primary care and at a higher level, but the urgent transfer to hospital should not be delayed.

(Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.) *

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

3.2.1.3 In patients with suspected or confirmed meningococcal sepsis, resuscitation should be started immediately, if possible, prior to initiating patient transport or during transport.

(Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.)

Recommended practice based on clinical experience and consensus.

3.2.1.4 If there are signs of shock, give immediately 20 mL/kg of 0.9% sodium chloride in 5 to 10 minutes. Give the fluid IV or via an interosseous route and reassess the patient immediately.

(Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.) *

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

Ringer's lactate may be used as a fluid alternative.

3.2.1.5 In self-ventilating children with suspected bacterial meningitis or confirmed meningococcal septicaemia, and signs of respiratory distress, the use of a facial mask is recommended to provide 15 litres of oxygen through a mask with reservoir. If there is a threat of loss of airway patency, airway opening manoeuvres should be applied; positive pressure ventilation through a mask ventilation bag and finally isolation of the airway.

(Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.)*

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

The flow rate should be sufficient to keep reservoir bag inflated.

- 3.2.1.6 **Administration of an initial fluid bolus of 20 mL/kg to infants and children with shock is reasonable, including those with conditions such as severe sepsis. If the signs of shock still persist after the first 40-60 mL/kg of fluid bolus, call for advice/support, consider intubation and ventilation and vasoactive drugs where practical and expedite transfer to expert paediatric facility.** (Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.)

Recommended practice based on clinical experience and consensus.

Pre-hospital providers involved in the care of suspected or subsequently proven IMD are at risk of infection. Universal precautions are mandatory, but additional barrier protection is advised when caring for these patients and post-exposure prophylaxis may be warranted.

3.2.2 Respiratory Support in Paediatric Patients with Invasive Meningococcal Disease

- 3.2.2.1 **It must be noted that children and young people with suspected or confirmed bacterial meningitis or meningococcal septicaemia are very ill and at grave risk of sudden deterioration during intubation. Anticipate high risk intubation conditions such as aspiration, pulmonary oedema or worsening shock during intubation. Prepare so that the following elements are available before intubation: facilities to administer fluid boluses, appropriate vasoactive drugs; and access to a health care professional experienced in the management of critically ill paediatric patients.** (Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.) *

Recommended practice based on clinical experience and consensus.

Adrenaline is the first choice as a vasoactive drug.

- 3.2.2.2 **Tracheal intubation and mechanical ventilation should be undertaken for the following indications:** (Working Group of the Clinical Practice Guideline on the Management of Invasive Meningococcal Disease, n.d.)

Recommended practice based on clinical experience and consensus.

- **Threatened (for example, loss of gag reflex), or actual loss of airway patency**
- **The need for any form of assisted ventilation**
- **Increased work of breathing**
- **Hypoventilation or apnoea**
- **Features of respiratory failure, including:**
 - **Irregular respiration (for example, Cheyne–Stokes breathing),**
 - **Hypoxia (partial pressure of arterial oxygen [PaO₂] less than 97.5 mmHg)
Decreased oxygen saturations in air by pulseoximetry (O₂ saturation <92%)**
- **Hypercapnia (Partial pressure of carbon dioxide in arterial blood (PaCO₂) greater than 45 mmHg)**
- **Continuing shock following infusion of a total of 40 mL/kg of resuscitation fluid**
- **Signs of raised intracranial pressure**
- **Impaired mental status: Reduced or fluctuating level of consciousness (Glasgow Coma Scale score less than 9 or a drop of 3 or more) or Moribund state**

- Control of intractable seizures
- Need for stabilisation and management to allow brain imaging or transfer to the paediatric intensive care unit (ICU) of another hospital

3.3 Septic Shock in Children

3.3.1 Initial Resuscitation

3.3.1.1 The committee suggests starting with oxygen administered by face mask or, if needed and available, high-flow nasal cannula oxygen or nasopharyngeal continuous positive airway pressure (CPAP) for respiratory distress and hypoxemia. (Dellinger et al., 2012)

Weak recommendation; Evidence from well-done observational studies with control RCTs.

3.3.1.2 Peripheral IV access or IO access can be used for fluid resuscitation and inotrope infusion when a central line is not available. If mechanical ventilation is required, then cardiovascular instability during intubation is less likely after appropriate cardiovascular resuscitation. (Dellinger et al., 2012)

Weak recommendation; Evidence from well-done observational studies with control RCTs.

3.3.1.3 The committee suggests that the initial therapeutic endpoints of resuscitation of septic shock be: capillary refill of ≤ 2 seconds, normal blood pressure for age, normal pulses with no differential between peripheral and central pulses, warm extremities, urine output > 1 mL/kg/hr, and normal mental status. (Dellinger et al., 2012)

Strength of recommendation unknown, level of evidence unknown.

3.3.1.4 The committee recommends evaluating for and reversing pneumothorax, pericardial tamponade, or endocrine emergencies in patients with refractory shock. (Dellinger et al., 2012)

Strong recommendation; Evidence from well-done observational studies with control RCTs.

3.3.1.5 The committee suggests controlling hyperglycaemia using a similar target as in adults (≤ 180 mg/dL or 10 mmol/L). Glucose infusion should accompany insulin therapy in newborns and children. (Dellinger et al., 2012)

Weak recommendation; Evidence from well-done observational studies with control RCTs.

3.3.1.6 The committee recommends a conservative fluid strategy for patients with established sepsis-induced ARDS who do not have evidence of tissue hypoperfusion. (Dellinger et al., 2012)

Strong recommendation; Evidence from well-done observational studies with control RCTs.

3.3.1.7 In the absence of specific indications such as bronchospasm, the committee recommends against the use of $\beta 2$ -agonists for treatment of patients with sepsis induced ARDS. (Dellinger et al., 2012)

Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.

3.3.2 Fluid Resuscitation

3.3.2.1 In settings with access to inotropes and mechanical ventilation, the committee suggests that initial resuscitation of hypovolemic shock begin with infusion of isotonic crystalloids, with boluses of up to 20 mL/kg for crystalloids over 5 to 10 minutes. These should be titrated to reversing hypotension, increasing urine output, and attaining normal capillary

refill, peripheral pulses and level of consciousness without inducing hepatomegaly or rales. If hepatomegaly or rales develop, inotropic support should be implemented, not fluid resuscitation. In children with severe haemolytic anaemia (severe malaria or sickle cell crises) who are not hypotensive, blood transfusion is considered superior to crystalloid or albumin bolusing. (Dellinger et al., 2012)

Weak recommendation; Evidence from well-done observational studies with control RCTs.

3.3.3 Mechanical Ventilation

3.3.3.1 The committee suggests providing lung-protective strategies during mechanical ventilation. (Dellinger et al., 2012)

Weak recommendation; Evidence from well-done observational studies with control RCTs.

3.3.3.2 The committee recommends use of sedation with a sedation goal in critically ill mechanically ventilated patients with sepsis. (Dellinger et al., 2012)

Evidence from downgraded controlled studies or expert opinion based on other evidence.

3.3.4 Fluid Management and Advanced Life Support in Paediatric Septic Shock

Emphasis is placed on the use of individualised patient evaluation before the administration of IV fluid boluses, including physical examination by a clinician and frequent reassessment to determine the appropriate volume of fluid resuscitation (van der Jagt et al., 2015).

The use of etomidate for intubation in septic shock is controversial. Consider other agents, but a single dose of etomidate may be a safe option.

Specific infection-related shock states appear to behave differently with respect to fluid bolus therapy. Evidence was not considered to be specific to a particular setting, after determining that "resource-limited setting" is difficult to define and can vary greatly even within individual health systems and small geographic regions. It appears that in some specific patient populations, where critical care resources including inotropic and mechanical ventilator support were limited, bolus fluid therapy resulted in higher mortality (van der Jagt et al., 2015).

3.3.4.1 Administration of an initial fluid bolus of 10- 20 mL/kg to infants and children with shock is reasonable, including those with conditions such as severe sepsis, severe malaria and Dengue. ^{adapted}

3.3.4.2 When caring for children with severe febrile illness (such as those included in the FEAST trial) in settings with limited access to critical care resources (i.e. mechanical ventilation and inotropic support), administration of bolus IV fluids should be undertaken with extreme caution because it may be harmful. (van der Jagt et al., 2015)

Recommendation may be considered, Evidence from randomised studies.

- 3.3.4.3 Providers should reassess the patient after every fluid bolus.** (van der Jagt et al., 2015)
Recommendation should be performed, Evidence from consensus opinion.
- 3.3.4.4 Either isotonic crystalloids or colloids can be effective as the initial fluid choice for resuscitation.** (Kleinman et al., 2010)
Recommendation is reasonable to perform, Evidence from randomised studies.
- 3.3.4.5 Early assisted ventilation may be considered as part of a protocol-driven strategy for septic shock.** (Kleinman et al., 2010)
Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.
- 3.3.4.6 Etomidate has been shown to facilitate endotracheal intubation in infants and children with minimal hemodynamic effect, but do not use it routinely in paediatric patients with evidence of septic shock.** (Kleinman et al., 2010) *
Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.
- 3.3.4.7 Adrenal suppression is seen after administration of etomidate in children and adults. In children and adults with septic shock, etomidate administration is associated with a higher mortality rate.** (Kleinman et al., 2010)
Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

3.4 Sepsis and Meningitis in Adults

3.4.1 Hemodynamic Support & Adjunctive Therapy

- 3.4.1.1 The committee recommends crystalloids be used as the initial fluid of choice in the resuscitation of severe sepsis and septic shock.** (Dellinger et al., 2012)
Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.
- 3.4.1.2 The committee recommends against the use of hydroxyethyl starches (HES) for fluid resuscitation of severe sepsis and septic shock.** (Dellinger et al., 2012)
Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.
- 3.4.1.3 We suggest that crystalloids are used for resuscitation in patients with sepsis rather than albumin.** (Perner et al., 2015)
Weak recommendation, low quality of evidence.
- 3.4.1.4 We suggest that crystalloids are used for resuscitation in patients with sepsis rather than gelatin.** (Perner et al., 2015)
Weak recommendation, very low quality of evidence.
- 3.4.1.5 The committee suggests adrenaline to maintain adequate blood pressure.** ^{adapted}

3.4.2 Mechanical Ventilation in Adults with Sepsis

Hypercapnia is contraindicated in patients with suspected high intracranial pressure (Dellinger et al., 2012).

3.4.2.1 The committee recommends that clinicians target a tidal volume of 6 mL/kg predicted body weight in patients with sepsis induced acute respiratory distress syndrome (ARDS). (Dellinger et al., 2012)

Strong recommendation; Evidence from RCTs.

3.4.2.2 The committee recommends that plateau pressures be measured in patients with ARDS and that the initial upper limit goal for plateau pressures in a passively inflated lung be ≤ 30 cm H₂O. (Dellinger et al., 2012)

Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.

3.4.2.3 The committee recommends that positive end-expiratory pressure (PEEP) be applied to avoid alveolar collapse at end expiration (atelectotrauma). (Dellinger et al., 2012)

Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.

3.4.2.4 The committee suggests strategies based on higher rather than lower levels of PEEP for patients with sepsis-induced moderate to severe ARDS. (Dellinger et al., 2012) *weak*

recommendation; Evidence from well-done observational studies with control RCTs.

3.4.2.5 The committee suggests recruitment manoeuvres in sepsis patients with severe refractory hypoxemia due to ARDS. (Dellinger et al., 2012) *

Weak recommendation; Evidence from well-done observational studies with control RCTs.

3.4.2.6 The committee recommends that mechanically ventilated sepsis patients be maintained with the head of the bed elevated between 30 and 45 degrees to limit aspiration risk and to prevent the development of ventilator associated pneumonia. (Dellinger et al., 2012)

Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.

3.4.2.7 The committee suggests that positive pressure non-invasive mask ventilation (PPNIV) be used in that minority of sepsis-induced ARDS patients in whom the benefits of PPNIV have been carefully considered and are thought to outweigh the risks. (Dellinger et al., 2012)

Weak recommendation; Evidence from downgraded RCTs or upgraded observational studies.

3.4.3 Sedation & Analgesia in Sepsis

3.4.3.1 The committee recommends that either continuous or intermittent sedation be minimised in mechanically ventilated sepsis patients, targeting specific titration endpoints. (Dellinger et al., 2012)

Strong recommendation; Evidence from downgraded RCTs or upgraded observational studies.

3.4.3.2 The committee recommends that neuromuscular blocking agents be avoided if possible in the septic patient without ARDS due to the risk of prolonged neuromuscular blockade following discontinuation. If neuromuscular blocking agents must be maintained, either intermittent bolus as required or continuous infusion with train-of-four monitoring of the depth of blockade should be used. (Dellinger et al., 2012)

Strong recommendation; Evidence from well-done observational studies with control RCTs.

4. Paediatric Gastroenteritis

Infective gastroenteritis in young children is characterised by the sudden onset of diarrhoea, with or without vomiting. Most cases are due to an enteric virus, but some are caused by bacterial or protozoal infections. The illness usually resolves without treatment within days; however, symptoms are unpleasant and affect both the child and family or carers. Severe diarrhoea can quickly cause dehydration, which may be life threatening (National Institute for Health and Care Excellence, 2009).

4.1 Identification

4.1.1 Suspect gastroenteritis if there is a sudden change in stool consistency to loose or watery stools, and/or a sudden onset of vomiting. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

4.1.2 Be aware that in children with gastroenteritis: diarrhoea usually lasts for 5–7 days, and in most it stops within 2 weeks; vomiting usually lasts for 1–2 days, and in most it stops within 3 days. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

4.1.3 Consider any of the following as possible indicators of diagnoses other than gastroenteritis: fever: temperature of 38°C or higher in children younger than 3 months; temperature of 39°C or higher in children aged 3 months or older; shortness of breath or tachypnoea; altered conscious state; neck stiffness; bulging fontanelle in infants; non-blanching rash; blood and/or mucus in stool; bilious (green) vomit; severe or localised abdominal pain; abdominal distension or rebound tenderness. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

Grading embedded in recommendation.

4.2 Assessing dehydration and shock

It is very important that practitioners have a clear understanding of the difference between shock and dehydration. They often present together, but either can occur independently. The presentations can be only subtly different, yet the management is entirely different - different fluids given at different rates. There are many tools for assessing dehydration and shock in the paediatric population. For operationalisation of these recommendations, a table outlining the signs and symptoms of dehydration may be implemented.

- 4.2.1 During remote or face-to-face assessment ask whether the child: appears unwell, has altered responsiveness, for example is irritable or lethargic, has decreased urine output, has pale or mottled skin, or has cold extremities.** (National Institute for Health and Care Excellence, 2009)
Grading embedded in recommendation.
- 4.2.2 It is recommended that the history and physical examination be the primary basis for the diagnosis of acute gastroenteritis (AGE).** (Cincinnati Children's Hospital Medical Center, 2011)
Grading embedded in recommendation.
- 4.2.3 Recognise that the following are at increased risk of dehydration: children younger than 1 year, particularly those younger than 6 months; infants who were of low birth weight; children who have passed more than five diarrhoeal stools in the previous 24 hours; children who have vomited more than twice in the previous 24 hours; children who have not been offered or have not been able to tolerate supplementary fluids before presentation; infants who have stopped breastfeeding during the illness; or children with signs of malnutrition.** (National Institute for Health and Care Excellence, 2009)
Grading embedded in recommendation.
- 4.2.4 It is recommended that clinical assessment be initially performed for the presence and degree of dehydration (none, some or severe) using a validated Clinical Dehydration Scale, valid for children under age 5 years.** (National Institute for Health and Care Excellence, 2009)
Evidence from systematic review, meta-analysis, or meta-synthesis of multiple studies.
- 4.2.5 For acute bloody diarrhoea (dysentery) in children, the main principles of the therapeutic approach are: Treatment of dehydration and rapid transport to appropriate hospital.**
adapted

4.3 Fluid Management and Oral Rehydration

Oral rehydration therapy is replacement of fluids and electrolytes, such as sodium, potassium, and chloride necessary for normal physiological functions and is effective in 95% of cases of mild to moderate dehydration. Oral rehydration therapy is less invasive, less expensive, is associated with less morbidity and can be dispensed outside of the hospital setting, while being as effective as IV treatment (Medical Services Commission, 2010).

Oral Rehydration Solution (ORS) is either reconstituted from a commercial formulation or can be mixed by the caregivers/ practitioners using the well-established formula of ORS: Give the child a drink made with 6 level teaspoons of sugar and 1/2 level teaspoon of salt dissolved in 1 litre of clean water.

Although initiation and administration of oral rehydration for children with acute gastro-enteritis will seldom be the primary responsibility of EMS practitioners, it is important that they have the insight to encourage clients to start or continue with oral rehydration during transfer.

- 4.3.1 Acute gastroenteritis is one of the most common causes of dehydration affecting infants and children. Oral rehydration therapy is replacement of fluids and electrolytes, such as sodium, potassium, and chloride necessary for normal physiological functions and is effective in 95% of cases of mild to moderate dehydration. Oral rehydration therapy is less invasive, less expensive, is associated with less morbidity, and can be dispensed outside of the hospital setting, while being as effective as IV treatment.** (Medical Services Commission, 2010)
Strength of recommendation unknown, level of evidence unknown.
- 4.3.2 In children with gastroenteritis but without clinical dehydration: continue breastfeeding and other milk feeds; encourage fluid intake; discourage the drinking of fruit juices and carbonated drinks, especially in those at increased risk of dehydration; offer ORS solution as supplemental fluid to those at increased risk of dehydration.** (National Institute for Health and Care Excellence, 2009)
Grading embedded in recommendation.
- 4.3.3 Use ORS solution to rehydrate children, including those with hypernatraemia, unless IV fluid therapy is indicated.** (National Institute for Health and Care Excellence, 2009)
Grading embedded in recommendation.
- 4.3.4 In children with clinical dehydration, including hypernatraemic dehydration: use low-osmolarity ORS solution (240–250 mOsm/l)[5] for oral rehydration therapy; give 50 mL/kg for fluid deficit replacement over 4 hours as well as maintenance fluid; give the ORS solution frequently and in small amounts.** (National Institute for Health and Care Excellence, 2009) *
Grading embedded in recommendation.
- 4.3.5 In children with clinical dehydration, also consider supplementation with their usual fluids (including milk feeds or water, but not fruit juices or carbonated drinks) if they refuse to take sufficient quantities of ORS solution and do not have red flag symptoms or signs.** (National Institute for Health and Care Excellence, 2009) *
Grading embedded in recommendation.
- 4.3.6 In children with clinical dehydration consider giving the ORS solution via a nasogastric tube if they are unable to drink it or if they vomit persistently.** (National Institute for Health and Care Excellence, 2009)
Grading embedded in recommendation.
- 4.3.7 In children with clinical dehydration monitor the response to oral rehydration therapy by regular clinical assessment.** (National Institute for Health and Care Excellence, 2009)
Grading embedded in recommendation.

4.4 Management of Shock in Gastro-Enteritis

Management of shock follows the same principles as treating shock from other causes in children: rapid bolus of crystalloids and reassess regularly. Be aware that malnourished children should receive fluid replacement more slowly - give only 10 ml/kg bolus of fluid and reassess carefully before further bolus of fluid. Any crystalloid fluid such as Ringer's lactate or plasmalyte are reasonable alternatives if sodium chloride is not available.

- 4.4.1 Use IV fluid therapy if: shock is suspected or confirmed; a child with red flag symptoms or signs shows clinical evidence of deterioration despite oral rehydration therapy; or a child persistently vomits the ORS solution, given orally or via a nasogastric tube.** (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

- 4.4.2 Treat suspected or confirmed shock with a rapid IV infusion of 20 mL/kg of 0.9% sodium chloride solution.** (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

- 4.4.3 If a child remains shocked after the first rapid IV infusion: immediately give another rapid IV infusion of 10-20 mL/kg of 0.9% sodium chloride solution and consider possible causes of shock other than dehydration. Reassess for response and signs and symptoms of fluid overload (e.g. feel for liver size).** ^{adapted}

Grading embedded in recommendation.

- 4.4.4 Consult with medical control using local communications protocols if a child remains shocked after the second rapid IV infusion.** ^{adapted}

- 4.4.5 When symptoms and/or signs of shock resolve after rapid IV infusions, start rehydration with IV fluid therapy.** (National Institute for Health and Care Excellence, 2009) *Grading embedded in recommendation.*

4.5 Management of Dehydration in Gastro-Enteritis

The fluid deficit replacement rates above (add 100ml/kg if shocked) are to be used to calculate a 24-hour rehydration schedule and are not hourly replacement rates.

Rehydration management will normally not be initiated by EMS personnel, but rather continued during a transfer once instituted by a referring clinician or started at the receiving institution. The priority is early management and stabilisation of the shocked child, rehydration will normally be corrected slowly over at least 24 hours and converting from IV to oral therapy as soon as possible.

4.5.1 It is dangerous to treat patients with severe diarrheal dehydration using 5% dextrose with 1/4 normal saline, and the risk of death is very high. In diarrheal dehydration, not only water but also a number of electrolytes are lost; the important ones are sodium, potassium, and bicarbonate. (World Gastroenterology Organisation, 2012)

Grading embedded in recommendation.

4.5.2 If IV fluid therapy is required for rehydration (and the child is not hypernatraemic at presentation): use an isotonic solution such as 0.9% sodium chloride, or 0.9% sodium chloride with 5% glucose, for fluid deficit replacement and maintenance. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

4.5.3 For those who required initial rapid IV fluid boluses for suspected or confirmed shock, add 100 mL/kg for fluid deficit replacement to maintenance fluid requirements, and monitor the clinical response. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

4.5.4 For those who were not shocked at presentation, add 50 mL/kg for fluid deficit replacement to maintenance fluid requirements, and monitor the clinical response. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

4.5.5 Attempt early and gradual introduction of oral rehydration therapy during IV fluid therapy. If tolerated, stop IV fluids and complete rehydration with oral rehydration therapy. (National Institute for Health and Care Excellence, 2009)

Grading embedded in recommendation.

4.6 Use of Other Medications

4.6.1 Do not use antidiarrhoeal medications. (National Institute for Health and Care Excellence, 2009)

5. Acute Coronary Syndrome & Similar Conditions

Chest pain and acute dyspnoea are among the most frequent causes of out-of-hospital emergency medical services (EMS) activation. The challenge of the pre-hospital management of chest pain, beyond rapid diagnosis, is the treatment and transfer of patients with major cardiovascular emergencies to adequate centres (Beygui et al., 2015). The required system infrastructure (i.e. local protocols and pathways of care) needs to be in place in order for EMS cardiovascular emergency objectives to be met. Not all recommendations below are readily implementable as local infrastructure must still be developed in South Africa.

The following list of factors association with high risk of bleeding in ACS can be used: (Moscucci et al., 2003)

- Older age (especially >80 years)
- Female gender
- History of renal failure
- History of bleeding
- Low blood pressure
- Treatments associated with higher risk of bleeding:
 - Thrombolytics
 - Glycoprotein 2b3a antagonists
 - Dual antiplatelet therapy
 - Oral anticoagulants
 - Non-steroid anti-inflammatory drugs
- Need for IV inotropics
- Need for vasodilators

In the absence of clear evidence for the benefit of pre-hospital versus in-hospital antithrombotic therapy, a fast transfer with no administration of any antithrombotic medication to a percutaneous coronary intervention (PCI)-capable centre could be the most reasonable decision in patients with active bleeding or at very high risk of bleeding. Caution should be taken in general, based on the risk assessment, not to initiate a treatment pre-hospital which might be administered more safely in the hospital setting after further evaluation. In such situations a rapid and secure transfer in stable conditions to the appropriate facility is the best option (Beygui et al., 2015).

5.1 Patient Pathway

The care of ST-elevation myocardial infarction (STEMI) patients in the pre-hospital setting should be based on regional STEMI networks. Such networks include one or more hospitals and EMS organisations which have a shared protocol for the choice of reperfusion strategy, adjunctive therapy and patient transfer in order to provide consistent treatment to patients. Such protocols

should be formally discussed between all components of the network and be available in writing (Beygui et al., 2015).

Implementation of some of these recommendations are problematic in resource limited settings, especially in South Africa where such systems and local protocols have not been developed. Local, contextually-appropriate implementation strategies will need to be developed according to local services providers' resources and capacity. These recommendations act as best evidence guidance and may not be feasible in all settings. Implementation is thus dependent on local shared protocols and local resources, and stems from this parent CPG.

- 5.1.1 STEMI: Organisation of regional STEMI networks with a shared written protocol for the choice of reperfusion strategy, antithrombotic therapy and patient transfer is strongly recommended.** *adapted*

Such shared protocols must be based on a parent clinical practice guideline guidance; in this case, this guideline document. Successful implementation of an effective pre-hospital STEMI reperfusion network is a national priority and shared STEMI networks and understanding is an essential component in effective STEMI treatment implementation.

- 5.1.2 STEMI: Direct telephone contact between the pre-hospital team and the emergency medical communication centre with ECG teletransmission is recommended for planning reperfusion therapy in borderline cases.** *adapted*

Recommendation dependant on local system infrastructure and processes.

- 5.1.3 Primary PCI: The routine transfer to facilities with 24/7 primary PCI is strongly recommended.** *adapted*

- 5.1.4 Primary PCI: The routine transfer to facilities with onsite surgery is not recommended.** (Beygui et al., 2015)

Grading embedded in recommendation.

The primary PCI strategy requires a transfer to a 24/7 PCI-capable centre. The need for onsite surgery does not appear mandatory because of very low rates of coronary bypass surgery in haemodynamically stable patients. However, unstable patients with cardiogenic shock or suspicion of mechanical complication should, if possible, ideally be transferred to centres with onsite primary PCI and possibility of circulatory assistance implantation in the intensive care unit and onsite cardiac surgery, and if such a transfer destination will not delay revascularisation (Beygui et al., 2015).

- 5.1.5 We recommend that when primary PCI is the planned strategy, that pre-hospital activation of catheterisation laboratory for primary PCI is preferred over no pre-hospital activation.** (Welsford et al., 2015)
Strong recommendation, low-quality evidence.
- 5.1.6 Transfer of unstable patients with cardiogenic shock or suspicion of mechanical complication to centres with onsite PCI and possibility of circulatory assistance implantation in the ICU and optimally onsite cardiac surgery is recommended if such a transfer destination will not delay revascularisation.** (Beygui et al., 2015) *
Grading embedded in recommendation.
- 5.1.7 In the case of stable non-ST-segment elevation ACS, transfer to an emergency centre is recommended for patients with suspected non-ST-segment elevation ACS.** (Beygui et al., 2015)
Grading embedded in recommendation.
- 5.1.8 In the case of non-ST-segment elevation ACS with cardiogenic shock transfer to centres with onsite interventional cardiology, intensive cardiac care and possibility of circulatory support and cardiac surgery is recommended.** (Beygui et al., 2015)
Grading embedded in recommendation.
- 5.1.9 Non-ST-segment elevation ACS: In high-risk patients with haemodynamic instability or signs of heart failure a transfer to emergency centres with possibility of critical care or intensive cardiac care units is recommended. In such patients a transfer to facilities with on-site 24/7 interventional cardiology capability is recommended.** (Beygui et al., 2015)*
Grading embedded in recommendation.
- 5.1.10 Primary PCI: Transfer of unstable patients with cardiogenic shock or suspicion of mechanical complication to centres with onsite PCI and possibility of circulatory assistance implantation in the ICU and optimally onsite cardiac surgery is recommended if such a transfer destination will not delay revascularisation.** (Beygui et al., 2015)
Grading embedded in recommendation.

5.2 Diagnosis & Risk Management

Risk assessment in the pre-hospital setting is of major importance as it greatly influences the management and transfer of patients.

- 5.2.1 The use of clinical findings and ECG for the risk assessment is mandatory.** (Beygui et al., 2015)
Grading embedded in recommendation.
- 5.2.2 It is strongly recommended that 12-lead ECG is recorded within 10 minutes following first medical contact.** ^{adapted}
- 5.2.3 We recommend pre-hospital 12-lead ECG acquisition with hospital notification for adult patients with suspected STEMI.** (Welsford et al., 2015) *
Strong recommendation, low-quality evidence.
- 5.2.4 Specific training in ECG interpretation for all EMS personnel in a position to provide care to STEMI patients is mandatory.** (Beygui et al., 2015) *
Grading embedded in recommendation.

5.2.5 The pre-hospital use of troponin point-of care tests is not recommended in STEMI. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.2.6 Perfect knowledge of contraindications for fibrinolytic therapy is mandatory for all EMS personnel who may provide fibrinolysis. (Beygui et al., 2015)

Grading embedded in recommendation.

5.2.7 The ability to detect a high risk of bleeding based on simple clinical and history data is mandatory for all EMS personnel who may provide fibrinolysis or antithrombotic therapy.

(Beygui et al., 2015)

Grading embedded in recommendation.

Bleeding risk is an important factor to assess in the pre-hospital setting to determine the choice of reperfusion strategy as fibrinolysis is contraindicated in patients at high risk of bleeding (Beygui et al., 2015).

5.2.8 Withholding all antithrombotic medication and rapid transfer to a PCI-capable centre in patients with active bleeding or at very high risk of bleeding is suggested. ^{adapted}

5.3 Pharmacological Management

Primary PCI is widely accepted as the preferred method of reperfusion in STEMI and should be preferred to fibrinolysis if it can be performed in a timely fashion. EMS plays a critical role in the rapid transport and inter-hospital transfer of patients eligible for primary PCI (Beygui et al., 2015). Primary PCI centres in South Africa are scarce and thus if primary PCI is not available pre-hospital reperfusion should be considered within the local EMS context. This must be supported from a shared protocol for the choice of reperfusion strategy, adjunctive therapy and patient transfer in order to provide consistent treatment to patients.

5.3.1 Primary PCI

"The choice between primary PCI and fibrinolysis in the individual patient should be based on the estimated time for PCI (first medical contact to balloon time), the patient's bleeding risk, time since symptom onset, STEMI location and the haemodynamic status of the patient. Direct telephone contact between the pre-hospital team, the emergency medical communication centre and interventional cardiology team, with ECG teletransmission if necessary, may be very useful in planning reperfusion therapy in the safest and most efficient way in borderline cases" (Beygui et al., 2015). If primary PCI can be performed in a timely manner, it is recommended over fibrinolysis; however, if the time to PCI will be prolonged, pre-hospital fibrinolysis is recommended.

Fibrinolysis is also noted to be cost effective in the South African setting. It has been recommended that when fibrinolytic therapy is indicated or chosen as the primary reperfusion strategy, it should be administered within 30 minutes of hospital arrival; however, such target times may not be applicable to the South African setting as first medical contact to needle or balloon time is extensively prolonged compared to high income countries.

5.3.1.1 The assessment of the balance between the benefit and the risk of pre-hospital fibrinolysis >6 h after symptom onset in EMSs that can provide both reperfusion strategies is highly recommended. (Beygui et al., 2015)

Grading embedded in recommendation.

5.3.1.2 In elderly patients (>75 years) presenting >6 h after symptom onset with non-extensive STEMI and who are potential candidates for fibrinolysis, switching to a primary PCI strategy may be considered. (Beygui et al., 2015)

Grading embedded in recommendation.

5.3.1.3 Direct telephone contact between the pre-hospital team and the emergency medical communication centre with ECG teletransmission is recommended for planning reperfusion therapy in borderline cases. ^{adapted}

5.3.1.4 The routine use of nitrates, beta-blockers and oxygen supplementation is not recommended in the pre-hospital setting. (Beygui et al., 2015)

Grading embedded in recommendation.

The use of nitrates and beta-blockers in the pre-hospital setting has not been studied and may be associated with hypotension and heart failure. The routine use of IV beta-blockers as well as routine oxygen supplementation early after myocardial infarction are associated with adverse events (Beygui et al., 2015).

5.3.1.5 Recommended examples of pre-hospital adjunctive therapy are pain control (opioids); anticoagulation (enoxaparine or UFH) and antiplatelet (aspirin and P2Y12/ticagrelor/prasugrel/ clopidogrel). (Beygui et al., 2015)

Grading embedded in recommendation.

5.3.1.6 Pre-hospital use of aspirin is highly recommended prior to primary PCI and suggested for pre-hospital fibrinolysis. ^{adapted}

5.3.1.7 Pre-hospital loading doses of P2Y12 inhibitors in the setting of STEMI are recommended prior to primary PCI. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.3.1.8 Ticagrelor and prasugrel with respect to their contraindications are recommended as first line P2Y12 inhibitors. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.3.1.9 Clopidogrel is recommended when ticagrelor or prasugrel are unavailable or contraindicated prior to primary PCI and is suggested for pre-hospital fibrinolysis. ^{adapted}
Grading embedded in recommendation.

5.3.1.10 Withholding pre-hospital antithrombotic therapy in the presence of high bleeding risk or uncertain STEMI diagnosis is highly recommended. (Beygui et al., 2015)
Grading embedded in recommendation.

5.3.1.11 Opioid use titrated according to pain evaluation is recommended, but caution should be taken to limit the doses as much as possible in light of its potential interaction with oral antiplatelet therapy. (Beygui et al., 2015)
Grading embedded in recommendation.

5.3.1.12 The use of GP2b3a is only recommended in patients at low risk of bleeding. (Beygui et al., 2015)*
Grading embedded in recommendation.

5.3.1.13 The pre-hospital use of enoxaparin as a first line therapy, or UFH if enoxaparin is not available, during the transfer for primary PCI is recommended. (Beygui et al., 2015) *
Grading embedded in recommendation.

5.3.1.14 Bivalirudin is recommended as a first line anticoagulation regimen in the setting of STEMI among patients at high bleeding risk and/or the elderly. (Beygui et al., 2015)*
Grading embedded in recommendation.

This is to be implemented where resources allow and in-hospital and pre-hospital local reperfusion protocols have been implemented (See also 5.1.1). Implementation is dependent on local shared protocol and local resources.

5.3.2 Pre-Hospital Fibrinolysis Strategy

Pre-hospital fibrinolysis may have advantages when there are long transport times. As the transport time shortens, any expected advantage is lost. These advantages need to be weighed against the resources required to implement this and the alternatives available. If PCI is available, time to transport to PCI is a more important determinant of the decision (Welsford et al., 2015).

To be implemented where resources allow, pre-hospital times are long, and in-hospital and pre-hospital local reperfusion protocols have been implemented (See also 5.1.1). Implementation dependent on local shared protocol and local resources

5.3.2.1 Pre-hospital fibrinolysis is highly recommended over in-hospital fibrinolysis. (Beygui et al., 2015) *
Grading embedded in recommendation.

5.3.2.2 Pre-hospital fibrinolysis with immediate transfer to a PCI-capable centre is highly recommended. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.3.2.3 Aspirin administration at the time of fibrinolysis is suggested. adapted

Providers must take into consideration patient allergies and medical history.

5.3.2.4 Clopidogrel (300 mg loading dose in <75 years old and 75 mg dose in ≥ 75 years old) in combination with pre-hospital fibrinolysis is mandatory. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.3.2.5 A weight adjusted dose of tenecteplase as the first line pre-hospital fibrinolytic regimen is recommended with a half dose regimen in > 75 years old. (Beygui et al., 2015) *

Grading embedded in recommendation.

Due to cost restraints, streptokinase may also be appropriate for fibrinolysis in these cases. Its use in the EMS environment is controversial.

5.3.2.6 Anticoagulation is mandatory at the time of pre-hospital fibrinolysis with fibrin specific agents. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.3.2.7 Enoxaparin is highly recommended as the anticoagulant of choice in this setting. (Beygui et al., 2015) *

Grading embedded in recommendation.

5.3.2.8 Bivalirudin and fondaparinux are not recommended in combination with pre-hospital fibrinolysis. (Beygui et al., 2015)

Grading embedded in recommendation.

5.4 Non-ST Elevation ACS

The diagnosis of non-ST-segment elevation ACS in the pre-hospital setting is often challenging in the absence of routine use of biomarkers and imaging modalities. The difficulty is emphasised by the fact that some differential diagnoses such as aortic dissection and pericarditis are contraindications to antithrombotic therapy (Beygui et al., 2015).

5.4.1 Thrombotic and bleeding risk assessment is highly recommended in the setting of non-ST-segment elevation ACS. (Beygui et al., 2015)

Grading embedded in recommendation.

5.4.2 Point of care troponin tests may be considered in the setting of non-ST-segment elevation ACS. (Beygui et al., 2015)*

Grading embedded in recommendation.

To be implemented where resources allow and in-hospital and pre-hospital local reperfusion protocols have been implemented (See also 5.1.1). Implementation dependent on local shared protocol and local resources

5.4.3 In the case of chest pain at first medical contact, sublingual or IV nitrates titrated to blood pressure are recommended. *adapted*

5.4.4 Transfer to the appropriate facility without any 'en route' treatment or aspirin alone is recommended in the absence of need for urgent invasive assessment. *Adapted*

5.4.5 The use of prasugrel in the pre-hospital setting is not recommended. (Beygui et al., 2015)
Grading embedded in recommendation.

5.4.6 A management strategy similar to STEMI is recommended in non-ST-segment elevation ACS patients with cardiogenic shock, life threatening arrhythmias or persistent ischaemia despite initial management, with an antithrombotic regimen including aspirin, ticagrelor or clopidogrel loading dose and anticoagulation by enoxaparin or unfractionated heparin, and immediate invasive strategy. (Beygui et al., 2015)
Grading embedded in recommendation.

5.6 Pericarditis

5.6.1 Patient Pathway

5.6.1.1 Transfer to appropriate units (emergency centres) in facilities where echocardiography and pericardiocentesis are available is recommended. *adapted*

5.6.2 Management

5.6.2.1 It is recommended to consider pericarditis in every patient in whom fibrinolysis is considered for presumed STEMI. (Beygui et al., 2015)
Grading embedded in recommendation.

Pericarditis is one of the common causes of chest pain, sometimes mimicking ACS. The diagnosis is suspected based on the clinical background (e.g. recent symptoms of viral infection), characteristics of the chest pain (modified by posture and breathing), physical findings (pericardial friction rub) and ECG findings (diffuse ST segment elevation without reciprocal ST depression, PR segment depression). Positive diagnosis, usually based on biological signs of inflammation and possible pericardial effusion on echocardiography, cannot be confirmed in the pre-hospital setting (Beygui et al., 2015).

5.6.2.2 Specific management of stable uncomplicated pericarditis during the pre-hospital transportation is not recommended. (Beygui et al., 2015)
Grading embedded in recommendation.

5.6.2.3 Pain relief by major (opioids) analgesics may be considered. ^{adapted}

Stable, uncomplicated pericarditis does not need any specific management during pre-hospital transportation; however, pain relief may be considered as above.

5.7 Tamponade

5.7.1 Assessment & Identification

5.7.1.1 The pre-hospital risk assessment based on the following characteristics is suggested: ^{adapted}

- presence of cardiogenic shock
- haemodynamic instability (heart rate > 130 beats/min or <40, systolic blood pressure <90 mmHg)
- signs of acute right ventricular compression and increased systemic venous pressure (jugular vein distension)
- respiratory distress (respiration rate > 25, blood oxygen saturation <90%)
- low voltage, and/or electrical alternans on the ECG.

5.7.1.2 The pre-hospital use of echocardiography in this setting may be considered if expertise is available and if it does not delay patient transfer. ^(Beygui et al., 2015) *Grading embedded in recommendation.*

5.7.1.3 Rapid transfer of patients with suspicion of tamponade to the nearest centre with the possibility of ultrasound-guided pericardiocentesis and/or cardiac surgery on-site is mandatory. ^(Beygui et al., 2015) *Grading embedded in recommendation.*

5.7.2 Management

5.7.2.1 Ultrasound-guided pericardiocentesis may be considered in the pre-hospital setting if ultrasound devices and medical expertise are available on board. ^(Beygui et al., 2015) *Grading embedded in recommendation.*

5.8 Acute Cardiac Failure

5.8.1 Assessment & Referral

5.8.1.1 All acute heart failure syndrome patients should have the appropriate, goal-directed treatment started as early as possible. In some healthcare settings, this may occur either at home or in the ambulance. ^(Mebazaa et al., 2008) *Strength of recommendation unknown, level of evidence unknown.*

5.8.1.2 Rapidly establish the clinical diagnosis based on the presenting clinical scenario.

(Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.1.3 Quickly arrange for transfer to the nearest hospital, preferably one that has a service of cardiology and cardiac ICU, with or without a cardiac catheterisation laboratory.

(Mebazaa et al., 2008) *

Strength of recommendation unknown, level of evidence unknown.

5.8.1.4 Where possible, establish communication between EMS personnel and the receiving hospital to provide all pertinent and available information, including history, vital signs, and, when available, laboratory and ECG data, especially when patient is critical or deteriorating. ^{adapted}

5.8.1.5 Non-invasive monitoring, including blood oxygen saturation, blood pressure, respiratory rate, and continuous ECG, should be started within minutes of patient contact or in the ambulance if possible. ^{adapted}

Cardiology and critical care resources, and, in particular, cardiac catheterisation resources, are limited in SA. The most appropriate local facility should receive the patient as per local protocols.

5.8.2 Management

5.8.2.1 The organisation of networks between pre-hospital services and hospital departments involved in the management of acute cardiovascular emergencies based on shared protocol is ideal. ^{adapted}

Such shared protocols must be based on a parent clinical practice guideline; in this case, this guideline document.

5.8.2.2 Risk assessment in the pre-hospital setting based on the following characteristics is suggested: (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

- **Presence of cardiogenic shock**
- **haemodynamic instability (heart rate > 130 beats/min or <40, systolic blood pressure <90 mmHg)**
- **respiratory distress (respiration rate > 25, blood oxygen saturation <90%)**
- **ECG findings (ventricular or supraventricular arrhythmia, bradycardia, on-going ischaemia (i.e. STEMI, non-ST-segment elevation ACS))**

5.8.2.3 We recommend supplemental oxygen be considered for patients who are hypoxemic; titrated to an oxygen saturation of 90 - 94%. ^{adapted}

5.8.2.4 Focused echocardiography (FoCUS) pulmonary and cardiac ultrasound may be considered in the pre-hospital setting if competent staff are on board. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

5.8.2.5 Delaying transfer for ultrasound or BNP testing in the pre-hospital setting is not recommended. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

5.8.2.6 In the absence of cardiogenic shock, the recommended treatment is: oxygen with a target saturation >94%; sublingual/IV nitrates titrated according to blood pressure; IV diuretics (furosemide). (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

5.8.2.7 In the case of haemodynamic compromise and respiratory distress the recommended treatment comprises: Non-invasive ventilation (pre-hospital continuous positive airway pressure should be initiated promptly immediately if respiratory distress is detected); Invasive ventilation in the case of unsuccessful or contra-indicated non-invasive ventilation; Inotropic or vasopressor support. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

The recommended inotropic and vasopressor support is adrenaline.

5.8.2.8 Specific management of precipitating or causal factors is suggested: ^{adapted}

- **Electrical cardioversion in the case of ventricular arrhythmia or rapid supraventricular tachycardia associated with haemodynamic and/or neurological compromise is suggested**
- **Antiarrhythmic drugs (amiodarone) in the case of well tolerated ventricular arrhythmia may be considered**
- **IV atropine and/or external pacemaker – if available – may be considered in the case of severe bradycardia**
- **Specific treatment of STEMI or non-ST-segment elevation ACS.**

5.8.2.9 Transfer to an emergency centre is recommended in stable patients who respond rapidly to initial treatment. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

5.8.2.10 Transfer to emergency centres with critical care facilities is highly recommended for unstable patients and/or those who fail to respond to initial treatment. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

5.8.2.11 Transfer to centres with onsite possibility of circulatory assistance may be considered in patients with refractory heart failure and cardiogenic shock. (National Institute for Health and Care Excellence, 2014) *Grading embedded in recommendation.*

5.8.3 Non-Pharmacological Management

5.8.3.1 Patients with hypotension, hypoperfusion or shock: Electrical cardioversion is recommended if an atrial or ventricular arrhythmia is thought to be contributing to the patient's haemodynamic compromise in order to restore sinus rhythm and improve the patient's clinical condition. (Parkhomenko et al., 2012)

General agreement; Evidence from expert consensus and/or small studies, retrospective studies, registries.

5.8.3.2 Electrical cardioversion should be considered in patients when a decision is made to restore sinus rhythm non-urgently ('rhythm control' strategy). This strategy should only be employed in patients with a first episode of AF of <48 h duration (or in patients with no evidence of left atrial appendage thrombus on trans oesophageal echo (TOE)).
adapted

5.8.4 Positive Pressure Non-Invasive Ventilation

5.8.4.1 PPNIV should be used as early as possible in all acute heart failure syndrome patients when dyspnoea, respiratory distress, and/or pulmonary oedema are present to prevent the need for intubation and its subsequent complications and, potentially, to reduce the risk of mortality. (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.4.2 PPNIV will usually not be used when there is a need for emergent intubation due to patient's overall condition or an airway indication. adapted

5.8.4.3 A positive pressure of 5–7.5 cm H₂O and titrating to clinical response is the most appropriate initial therapy when CPAP is used. (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.4.4 Consider use of an open system continuous positive airway pressure where available in the EMS setting. (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown

5.8.4.5 PPNIV (e.g., continuous positive airway pressure [CPAP]) should be considered in dyspnoeic patients with pulmonary oedema and a respiratory rate >20 breaths/min to improve breathlessness and reduce hypercapnia and acidosis. PPNIV can reduce blood pressure and should not generally be used in patients with a systolic blood pressure <85 mmHg (and blood pressure should be monitored regularly when this treatment is used). (Parkhomenko et al., 2012)

Weight of evidence in favour of efficacy; Evidence from single RCTs or large non-randomised studies.

5.8.4.6 If a person has cardiogenic pulmonary oedema with severe dyspnoea and acidaemia consider starting non-invasive ventilation without delay: at acute presentation or as an adjunct to medical therapy if the person's condition has failed to respond. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

In the pre-hospital environment, acidosis will be suspected clinically and supplemented by capnography.

5.8.5 Invasive Ventilation

- 5.8.5.1 **Consider invasive ventilation in people with acute heart failure that, despite treatment, is leading to or is complicated by: respiratory failure or reduced consciousness or physical exhaustion.** (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

Oxygen administration will be the first line therapy in line with above general management. Following oxygen administration, PPNIV may be considered. Although PPNIV does not replace intubation when intubation is indicated, PPNIV may be used as a temporary measure while preparing to intubate, or while assessing the need for invasive ventilation.

5.8.6 Pharmacological Management

- 5.8.6.1 **Do not routinely offer opiates to people with acute heart failure.** (National Institute for Health and Care Excellence, 2014) *

Grading embedded in recommendation.

5.8.7 Diuretics

The use of IV diuretics should be considered as an adjunct for patients in respiratory distress/dyspnoea, and not as routine for all cases. Consider patient comfort and offer urethral catheterization prior to transfer where appropriate. Infusions of diuretics would normally have been started prior to EMS transfer. Note that while diuretics are recommended as first line, they are not first line if Systolic BP is elevated

- 5.8.7.1 **We recommend IV diuretics be given as first line therapy for patients with congestion.** (McKelvie et al., 2013) *

Strong Recommendation, Moderate-Quality Evidence.

- 5.8.7.2 **Offer IV diuretic therapy to people with acute heart failure. Start treatment using either a bolus or infusion strategy.** (National Institute for Health and Care Excellence, 2014) *

Grading embedded in recommendation.

- 5.8.7.3 **Aggressive diuretic monotherapy is not necessary in the majority of patients.** (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

- 5.8.7.4 **Diuretics should only be given when there is evidence of systemic volume overload.** (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

- 5.8.7.5 **Diuretics are not the ideal first-line therapy for most patients with dyspnoea and/or congestion with elevated systolic blood pressure (SBP) (140 mm Hg).** (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.7.6 Diuretics may be helpful in addition to vasodilators (nitrates) in patients with dyspnoea and/or congestion with elevated SBP (140 mm Hg), but they are ineffective as monotherapy. In general, nitrates should be administered first, and volume status and blood pressure should be monitored. Patients who experience a decrease in blood pressure of 30–40 mm Hg after an appropriate dose of nitrate therapy will generally improve symptomatically without diuretic therapy. If volume overload is present, diuretics should be given. The jugular venous pressure should be carefully assessed to determine volume. (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.7.7 Patients receiving diuretics should be re-evaluated in 30 minutes to 1 hr. Therapeutic targets include symptomatic improvement, improvement in physical findings, hemodynamic improvement, oxygen saturation, and diuresis. Gradual diuresis is the goal, not sudden production of large volumes of urine. (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.7.8 For people already taking a diuretic, consider a higher dose of diuretic than that typically prescribed to them. ^{adapted}

5.8.8 Nitrates

Blood pressure needs to be carefully monitored during inotrope therapy.

Implementation dependent on local shared protocol and local resources

5.8.8.1 Do not routinely offer nitrates to people with acute heart failure. (National Institute for Health and Care Excellence, 2014)

Grading embedded in recommendation.

IV nitrates have unclear effectiveness in this patient subgroup and may increase risk of harm in patients with hypotension, in particular in those with aortic stenosis (National Institute for Health and Care Excellence, 2014).

5.8.8.2 An IV infusion of a nitrate should be considered in patients with pulmonary congestion/oedema and a systolic blood pressure >110 mmHg, who do not have severe mitral or aortic stenosis, to reduce pulmonary capillary wedge pressure and systemic vascular resistance. Nitrates may also relieve dyspnoea and congestion. Symptoms and blood pressure should be monitored frequently during administration of IV nitrates. (Parkhomenko et al., 2012) *

Weight of evidence in favour of efficacy; Evidence from single RCTs or large non-randomised studies.

5.8.8.3 If available, it is recommended to administer nitroglycerin spray sublingually before admission (pre-hospital) or in the emergency centre. (Mebazaa et al., 2008)

Strength of recommendation unknown, level of evidence unknown.

5.8.8.4 The initial recommended dose of IV nitroglycerin is 10–20 mcg/min, increased in increments of 5–10 mcg/min every 3–5 minutes as needed. (Mebazaa et al., 2008) *
Strength of recommendation unknown, level of evidence unknown.

5.8.8.5 Slow titration of IV nitrates and frequent blood pressure measurement is recommended to avoid large decreases in SBP. (Mebazaa et al., 2008) *
Strength of recommendation unknown, level of evidence unknown.

5.8.8.6 If IV nitrates are used in specific circumstances, such as for people with concomitant myocardial ischaemia, severe hypertension or regurgitant aortic or mitral valve disease, monitor blood pressure closely in a setting where at least general critical care can be provided. ^{adapted}

IV nitrates should only be used in the context of critical care transports.

5.8.8.7 We recommend the following IV vasodilators, titrated to SBP 100 mm Hg, for relief of dyspnoea in hemodynamically stable patients (SBP 100 mm Hg) : (McKelvie et al., 2013)*

5.8.8.7.1 Nitroglycerin

Strong Recommendation, Moderate- Quality Evidence.

5.8.8.7.2 Nitroprusside

Weak Recommendation, Low-Quality Evidence.

5.8.9 Inotropes

Intra-arterial lines are not to be initiated pre-hospital and are reserved for critical care transfers only.

Critical care (in the form of critical care transfers, pre-hospitally) is for people needing more detailed observation or intervention, including support for a single failing organ system or postoperative care and for those stepping down from higher levels of care (National Institute for Health and Care

5.8.9.1 Do not routinely offer inotropes or vasopressors to people with acute heart failure. (National Institute for Health and Care Excellence, 2014)
Grading embedded in recommendation.

There is unclear evidence of any sustained benefit from the use of vasopressors or inotropes in acute heart failure (National Institute for Health and Care Excellence, 2014).

5.8.9.2 We recommend hemodynamically stable patients do not routinely receive inotropes like dobutamine, dopamine, or milrinone. (McKelvie et al., 2013)
Strong Recommendation, High Quality Evidence.

5.8.9.3 Inotropic agents are NOT recommended unless the patient is hypotensive (systolic blood pressure <85 mmHg), hypoperfused, or shocked because of safety concerns (atrial and ventricular arrhythmias, myocardial ischaemia, and death). (Parkhomenko et al., 2012)

Not useful/effective, and in some cases may be harmful, Evidence from expert consensus and/or small studies, retrospective studies, registries.

5.8.9.4 Patients with Hypotension, Hypoperfusion or Shock: An IV infusion of an inotrope (e.g., adrenaline) should be considered in patients with hypotension (systolic blood pressure <85 mmHg) and/or hypoperfusion to increase cardiac output, increase blood pressure, and improve peripheral perfusion. The ECG should be monitored continuously because inotropic agents can cause arrhythmias and myocardial ischaemia. (Parkhomenko et al., 2012)

Weight of evidence in favour of efficacy; Evidence from expert consensus and/or small studies, retrospective studies, registries.

5.8.9.5 A vasopressor (e.g., adrenaline) may be considered in patients who have cardiogenic shock, despite treatment with an inotrope, to increase blood pressure and vital organ perfusion. The ECG should be monitored as these agents can cause arrhythmias and/or myocardial ischaemia. Intra-arterial blood pressure measurement should be considered. (Parkhomenko et al., 2012)

Efficacy is less well established by evidence/opinion, Evidence from expert consensus and/or small studies, retrospective studies, registries.

5.8.9.6 Consider inotropes or vasopressors in people with acute heart failure with potentially reversible cardiogenic shock during critical care transports. *adapted*

5.8.10 Atrial Fibrillation in Heart Failure

5.8.10.1 We recommend that restoration and maintenance of sinus rhythm not be performed routinely. (McKelvie et al., 2013)

Strong Recommendation, High Quality Evidence.

5.8.10.2 Electrical cardioversion should be considered in unstable patients when a decision is made to restore sinus rhythm urgently ('rhythm control' strategy). This strategy should only be employed in patients with a first episode of AF of <48 h duration. Pharmacological cardioversion with amiodarone is an alternative. *adapted*

6. Behavioural Issues & Mental Health

6.1 Substance Abuse

See Section 11.3, Cardiac Arrest in Special Circumstances

6.1.1 No deviation from current practice can be recommended at this time.

6.2 Aggressive Patients

6.2.1 No deviation from current practice can be recommended at this time.

6.3 Psychosis

6.3.1 No deviation from current practice can be recommended at this time.

6.4 Suicidal & Homicidal Patients

6.4.1 No deviation from current practice can be recommended at this time.

6.5 Depressive States

6.5.1 No deviation from current practice can be recommended at this time.

6.6 Child abuse & Gender-Based Violence

6.6.1 No deviation from current practice can be recommended at this time.

7. Respiratory

7.1 Adult Asthma

Asthma is a common condition which produces a significant workload for general practice, hospital outpatient clinics and inpatient admissions. It is clear that much of this morbidity relates to poor management (British Thoracic Society, 2014).

7.1.1 Assessment

Wheezing is a common physical finding, although the severity of wheezing does not correlate with the degree of airway obstruction. The absence of wheezing may indicate critical airway obstruction, whereas increased wheezing may indicate a positive response to bronchodilator therapy. Oxygen saturation levels may not reflect progressive alveolar hypoventilation, particularly if oxygen is being administered. Note that oxygen saturation may fall initially during therapy because 2-agonists produce both bronchodilation and vasodilation and initially may increase intrapulmonary shunting. Other causes of wheezing are pulmonary oedema, chronic obstructive pulmonary disease (COPD), pneumonia, anaphylaxis, foreign bodies, PE, bronchiectasis, and subglottic mass (Vanden Hoek et al., 2010).

Asthmatic patients need to be assessed using clinical signs and symptoms in addition to peak flow measurements. This helps to classify the severity of the acute asthma attack as shown in the table below.

Signs of a severe asthma attack include some or all of the following (Australian Resuscitation Council, 2014a):

- Gasping for breath (may have little or no wheeze due to little movement of air)
- Severe chest tightness
- Inability to speak more than one or two words per breath
- Feeling distressed and anxious
- Little or no improvement after using "reliever" medication
- 'Sucking in' of the throat and rib muscles, use of shoulder muscles or bracing with arms to help breathing
- Blue discolouration around the lips (can be hard to see if skin colour also changes)
 - Pale and sweaty skin.
 - Symptoms rapidly getting worse or using reliever more than every two hours

Moderate asthma	Increasing symptoms PEF >50–75% best or predicted No features of acute severe asthma	
Acute severe asthma	Any one of: - PEF 33–50% best or predicted - respiratory rate \geq 25/min - heart rate \geq 110/min - inability to complete sentences in one breath	
Life-threatening asthma	Any one of the following in a patient with severe asthma:	
	Clinical signs	Measurements
	Altered conscious level	PEF <33% best or predicted
	Exhaustion	SpO ₂ < 92%
	Arrhythmia	PaO ₂ < 8 kPa
	Hypotension	'normal' PaCO ₂ (4.6–6.0 kPa)
	Cyanosis	
	Silent chest	
Near-fatal asthma	Raised PaCO ₂ and/or requiring mechanical ventilation with raised inflation pressures ⁵⁰⁴⁻⁵⁰⁷	

PaO₂: partial arterial pressure of oxygen

kPa: kiloPascals

PaCO₂: partial arterial pressure of carbon dioxide

Table: Levels of severity of acute asthma attacks in adults (British Thoracic Society, 2014).

7.1.1.1 Refer to hospital any patients with features of acute severe or life-threatening asthma.

(British Thoracic Society, 2014)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

7.1.1.2 Patients with severe asthma should be systematically evaluated, including: confirmation of the diagnosis of asthma, and identification of the mechanism of persisting symptoms and assessment of adherence to therapy. ^{adapted}

7.1.2 Management

- Sit the person comfortably upright. Be calm and reassuring. Do not leave the person alone (Australian Resuscitation Council, 2014a).
- An Important element of early treatment includes removal of or withdrawal from allergens or precipitating irritants in the environment that may be contributing to the exacerbation (National Heart, Lung, and Blood Institute, 2007).
- Many patients with acute severe asthma are hypoxaemic. Supplementary oxygen should be given urgently to hypoxaemic patients, using a face mask, Venturi mask or nasal cannulae with flow rates adjusted as necessary to maintain SpO₂ of 94–98% (British Thoracic Society, 2014).
- Capnography-based hypercapnia, if detected, indicates the development of near-fatal asthma and the need for emergency specialist/anaesthetic intervention (British Thoracic Society, 2014).
- In most cases inhaled beta-2 agonists given in high doses act quickly to relieve bronchospasm with few side effects. Nebulised adrenaline, a non-selective beta-2 agonist, does not have significant benefit over salbutamol (British Thoracic Society, 2014).
- Patients with severe life-threatening asthma require urgent and aggressive treatment with simultaneous administration of oxygen, bronchodilators, and steroids. Healthcare providers must monitor these patients closely for deterioration (Vanden Hoek et al., 2010).
- For those with severe refractory asthma, providers may consider IV magnesium at the standard adult dose of 2 g administered over 20 minutes (Vanden Hoek et al., 2010).
- Adrenaline is an adrenergic agent that can be given subcutaneously to patients with acute severe asthma. The dose of subcutaneous adrenaline (concentration 1:1000) is 0.01 mg/kg, divided into 3 doses of approximately 0.3 mg administered at 20-minute intervals (Vanden Hoek et al., 2010).
- Steroids reduce mortality, relapses, subsequent hospital admission and requirement for β 2 agonist therapy. The earlier they are given in the acute attack, the better the outcome (British Thoracic Society, 2014).
- There are no controlled trials, observational or cohort studies of differing fluid regimes in patients with acute asthma. Some patients require rehydration and correction of electrolyte imbalance. Hypokalaemia can be caused or exacerbated by β 2 agonist and/or steroid treatment and must be corrected (British Thoracic Society, 2014).

Pre-hospital administration of short acting beta agonists reduces airflow obstruction and relieves symptoms. In such settings, EMS providers should have available a nebulizer and/or an inhaler plus spacer/holding chamber for short acting beta agonists administration. If these are not available, subcutaneous adrenaline should be given for severe exacerbations (National Heart, Lung, and Blood Institute, 2007).

Ambulance services should develop pre-hospital protocols for the treatment of acute asthma in children and adults. With medical oversight, these protocols can allow for more frequent administration of several established acute asthma treatments, such as ipratropium bromide and oral systemic corticosteroids. The latter medication is particularly important during prolonged transport times. All pre-hospital providers should receive training in how to respond to the clinical signs and symptoms of severe airway obstruction and imminent respiratory failure (National Heart, Lung, and Blood Institute, 2007).

7.1.2.1 The Expert Panel recommends that EMS providers administer supplemental oxygen and short acting beta agonists to patients who have signs or symptoms of an asthma exacerbation. (National Heart, Lung, and Blood Institute, 2007)

Evidence from RCTs, rich body of data.

7.1.2.2 If oxygen is available, it should be administered at a flow rate of at least at 8 litres per minute through a face mask, by a person trained in its use. (Australian Resuscitation Council, 2014a)

Expert Consensus Opinion.

7.1.2.3 Oxygen should be used to relieve hypoxemia in moderate or severe exacerbations.
adapted

7.1.2.4 Give supplementary oxygen to all hypoxaemic patients with acute severe asthma to maintain an SpO₂ level of 94–98%. Lack of pulse oximetry should not prevent the use of oxygen. (British Thoracic Society, 2014)

Evidence from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship or evidence extrapolated from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship.

7.1.2.5 The first responder should provide assistance with administration of a multi-dose inhaler and, if required, spacer device. adapted

7.1.2.6 No harm is likely to result from giving a “reliever” puffer to someone without asthma. (Australian Resuscitation Council, 2014a)

Expert Consensus Opinion.

7.1.2.7 Use high-dose inhaled β 2 agonists as first line agents in patients with acute asthma and administer as early as possible. Reserve IV β 2 agonists for those patients in whom inhaled therapy cannot be used reliably. (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.1.2.8 In hospital, ambulance and primary care, nebulisers for giving nebulised β 2 agonist bronchodilators should preferably be driven by oxygen. (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.1.2.9 In severe asthma that is poorly responsive to an initial bolus dose of β 2 agonist, consider continuous nebulisation with an appropriate nebuliser. (British Thoracic Society, 2014) *

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.1.2.10 Give steroids in adequate doses in all cases of acute asthma attack. (The earlier they are given in the acute attack the better the outcome.) (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.1.2.11 Add nebulised ipratropium bromide (0.5 mg 4–6 hourly) to β 2 agonist treatment for patients with acute severe or life-threatening asthma or those with a poor initial response to β 2 agonist therapy. (British Thoracic Society, 2014)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high-quality clinical trials.

7.1.2.12 Nebulised magnesium sulphate is not recommended for treatment in adults with acute asthma. (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.1.2.13 Consider giving a single dose of IV magnesium sulphate to patients with acute severe asthma (PEF <50% best or predicted) who have not had a good initial response to inhaled bronchodilator therapy. (British Thoracic Society, 2014)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high quality clinical trials.

7.1.3 Airway & Ventilation

See also Section 11.3.2, Resuscitation in Near-Fatal Asthma

- Non-invasive positive-pressure ventilation (NIPPV) may offer short-term support for patients with acute respiratory failure and may delay or eliminate the need for endotracheal intubation (Vanden Hoek et al., 2010).
- Endotracheal intubation is indicated for patients who present with apnoea, coma, persistent or increasing hypercapnia, exhaustion, severe distress, and depression of mental status. Clinical judgment is necessary to assess the need for immediate endotracheal intubation for these critically ill patients (Vanden Hoek et al., 2010).
- Because even minor manipulation of the airway during intubation can elicit laryngospasm and worsen bronchospasm, the airway should be established by experienced personnel (Schatz et al., 2009).
- Intubation with a rapid sequence of sedation and muscle paralysis is preferred, although some advocate awake intubation because of concern for the potential for apnoea with sedation. Although there might be some concern about sedating a patient who is in respiratory distress, once intubation is planned, there is no contraindication to sedation. Ketamine is one option to consider for pre-intubation sedation (Schatz et al., 2009).
- In addition to ketamine, succinylcholine or a competitive neuromuscular blocking agent can be used for muscle paralysis (Schatz et al., 2009).
- Mechanical ventilation in the asthmatic patient can be difficult and associated risks require careful management. Intubation and positive pressure ventilation can trigger further bronchoconstriction and complications such as breath stacking that result from incomplete expiration, air trapping, and build-up of positive end expiratory pressure (i.e. intrinsic or auto-PEEP) (Vanden Hoek, et al., 2010).
- Initial ventilator settings for the intubated asthmatic patient should be: (Schatz et al., 2009)
 - Controlled mechanical ventilation at 10 breaths/min
 - Tidal volume at 7–8 ml/kg (ideal body weight)
 - Peak inspiratory flow at 60 L/min (constant flow) or 80–90 L/min (decelerating flow)
 - Fraction of inspired oxygen at 1.0

7.1.3.1 Since the effects of auto-PEEP in an asthmatic patient with cardiac arrest are likely quite severe, a ventilation strategy of low respiratory rate and tidal volume is reasonable. (Vanden Hoek, et al., 2010)

Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

7.1.3.2 During arrest a brief disconnection from the bag mask or ventilator may be considered, and compression of the chest wall to relieve air-trapping can be effective. (Vanden Hoek, et al., 2010)

Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

7.1.3.3 For all asthmatic patients with cardiac arrest, and especially for patients in whom ventilation is difficult, the possible diagnosis of a tension pneumothorax should be considered and treated. (Vanden Hoek, et al., 2010)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

7.1.3.4 We make no recommendation about the use of PPNIV in patients who have an exacerbation of asthma, because of insufficient evidence. (Keenan, et al., 2011) *

Strength of recommendation unknown, level of evidence unknown.

7.1.3.5 CPAP We make no recommendation about the use of CPAP in patients who have an exacerbation of asthma, because of a lack of RCTs. (Keenan, et al., 2011) *

Strength of recommendation unknown, level of evidence unknown.

7.1.4 Prevention & Treatment of Complications (Post-Intubation)

- Mild hypoventilation (permissive hypercapnia) reduces the risk of barotrauma. Hypercapnia is typically well tolerated (Vanden Hoek, et al., 2010).
- Four common causes of acute deterioration in any intubated patient are recalled by the mnemonic DOPE (tube Displacement, tube Obstruction, Pneumothorax, Equipment failure). Auto-PEEP is another common cause of deterioration in patients with asthma. If the asthmatic patient's condition deteriorates or if it is difficult to ventilate the patient, check the ventilator for leaks or malfunction; verify endotracheal tube position; eliminate tube obstruction (eliminate any mucous plugs and kinks); evaluate for auto-PEEP; and rule out a pneumothorax (Vanden Hoek, et al., 2010).

7.1.4.1 Hypoxaemia^{adapted}

- **Exclude right mainstem intubation (21-23cm cm at incisors) in an average adult**
- **Exclude pneumothorax and place pleural drain**
- **Exclude tube obstruction (kinking, biting of tube, or plugging)**
- **Exclude pneumonia and another lung disease.**

7.1.4.2 Hypotension (Schatz et al., 2009)

Evidence from consensus judgement.

- **Exclude pneumothorax but first perform a trial of apnoea or hypopnea to decrease intrathoracic pressure unless unequivocal evidence, such as tracheal shift with unilateral breath sounds or subcutaneous emphysema**
- **Consider tension pneumothorax early (This is a clinical diagnosis. If lung examination suggests this complication, proceed with a needle thoracostomy followed by a chest tube thoracostomy)**
- **Administer fluids**
- **Measure auto-PEEP and plateau pressure and apply reduction measures**
- **Exclude other causes, such as myocardial infarction and sepsis.**

7.1.4.2 Cardiac Arrest

- 7.1.4.2.1 A trial of apnoea or hypopnea for no more than 30–60 s with external compressions and volume challenge is therapeutic for lung hyperinflation as a cause of cardiac arrest.** (Schatz et al., 2009)

Evidence from consensus judgement.

- 7.1.4.2.2 Consider tension pneumothorax early (if lung examination suggests this complication, proceed with a needle thoracostomy followed by a careful chest tube thoracostomy).** (Schatz et al., 2009)

Evidence from consensus judgement.

7.2 Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD) is a group of disorders characterised by airway inflammation and airflow limitation that is not fully reversible. COPD should be distinguished from asthma because it is a progressive, disabling disease with increasingly serious complications and exacerbations. The symptoms, signs and physiology of these conditions can overlap with asthma and differentiation can be difficult, particularly in middle-aged smokers presenting with breathlessness and cough. This difficulty is compounded by the fact that the majority of COPD patients exhibit some degree of reversibility with bronchodilators. Patients with severe chronic asthma, chronic bronchiolitis, bronchiectasis and cystic fibrosis may also present with a similar clinical pattern and partially reversible airflow limitation (The Thoracic Society of Australia and New Zealand, 2002).

7.2.1 Assessment of COPD Patient with Exacerbation

Acute exacerbations of COPD are characterised by an increase in respiratory symptoms of cough, wheeze, dyspnoea and/or sputum production (The Thoracic Society of Australia and New Zealand, 2002).

- 7.2.1.1 Early diagnosis and treatment may prevent admission.** (The Thoracic Society of Australia and New Zealand, 2002)

Evidence from nonrandomised trials and observational studies.

- 7.2.1.2 A diagnosis of COPD should be considered in patients over the age of 35 who have a risk factor (generally smoking) and who present with exertional breathlessness, chronic cough, regular sputum production, frequent winter 'bronchitis' or wheeze.** (National Institute for Health and Care Excellence, 2010b)

Grading embedded in recommendation.

Management

- The severity of the airway obstruction sometimes means that the patient has an ineffective cough and is incapable of expectoration (The Thoracic Society of Australia and New Zealand, 2002).
- A minority of patients with longstanding hypercapnia may develop a worsening of their respiratory acidosis if they breathe high levels of inspired oxygen. This may occur within 15 minutes and occurs mainly because of hypoventilation (The Thoracic Society of Australia and New Zealand, 2002).
- Administration of oxygen at an inspired oxygen concentration of 24-28% via a Venturi mask is usually sufficient to improve oxygenation in most patients. Nasal cannulae, although more comfortable, deliver a variable level of enrichment but a flow of 0.5-2.0 L/min is usually sufficient. There is no benefit in trying to obtain SpO₂ levels >92% in these patients (The Thoracic Society of Australia and New Zealand, 2002).

7.2.1.3 Increased breathlessness is a common feature of an exacerbation of COPD. This is usually managed by taking increased doses of short-acting bronchodilators (hand held inhalers or nebulizers (driven by air) as appropriate. (National Institute for Health and Care Excellence, 2010b)

Grading embedded in recommendation.

7.2.1.4 Controlled oxygen (28% or 0.5-2 L/min) is indicated for hypoxaemia. (The Thoracic Society of Australia and New Zealand, 2002)

Evidence from nonrandomised trials and observational studies.

7.2.1.5 The oxygen saturation should be measured in patients with an exacerbation of COPD. If necessary, oxygen should be given to keep the SaO₂ within the individualised target range. ^{adapted}

Grading embedded in recommendation.

7.2.1.6 Inhaled bronchodilators and systemic glucocorticoids are effective treatments for acute exacerbations. (The Thoracic Society of Australia and New Zealand, 2002)

Evidence from RCTs, rich body of data.

7.2.2 Non-Invasive Ventilation

- Ventilatory support, either NIPPV or invasive positive pressure ventilation (IPPV) via an endotracheal tube, should be considered in patients who are unable to ventilate adequately with rising PaCO₂ (The Thoracic Society of Australia and New Zealand, 2002).
- Randomised controlled trials of NIPPV show that fewer patients require intubation, and that there are lower complication rates and reduced mortality (The Thoracic Society of Australia and New Zealand, 2002).
- NIPPV is contraindicated in patients who are unable to protect their airway, are not spontaneously breathing or who have severe facial injury. Relative contraindications (situations where NIPPV may be less effective) include life-threatening refractory hypoxaemia (PaO₂ < 60 mm Hg or 8kPa on 100% inspired oxygen), bronchiectasis with copious secretions, severe pneumonia and haemodynamic instability. These patients may require intubation (The Thoracic Society of Australia and New Zealand, 2002).

It is important to ascertain the patient's wishes, either directly or from family and carers, regarding intubation and resuscitation - preferably prior to an admission for management of respiratory failure (The Thoracic Society of Australia and New Zealand, 2002).

7.2.2.1 PPNIV should be used as the treatment of choice for persistent hypercapnic ventilatory failure during exacerbations despite optimal medical therapy. It should be delivered by staff trained in its application, experienced in its use and aware of its limitations. (National Institute for Health and Care Excellence, 2010b)

Grading embedded in recommendation.

7.2.2.2 When patients are started on PPNIV, there should be a clear plan covering what to do in the event of deterioration and ceilings of therapy should be agreed. (National Institute for Health and Care Excellence, 2010b)

Grading embedded in recommendation.

7.2.2.3 Ventilatory support, either NIPPV or invasive positive pressure ventilation (IPPV) via an endotracheal tube, should be considered in patients who are unable to ventilate adequately with rising PaCO₂. (The Thoracic Society of Australia and New Zealand, 2002)

Evidence from nonrandomised trials and observational studies.

7.2.2.4 We make no recommendation about the use of continuous positive airway pressure by mask in patients who have a severe exacerbation of COPD, because of a lack of RCTs. (Keenan, et al., 2011)

Strength of recommendation unknown, level of evidence unknown.

7.2.3 Intubation

7.2.3.1 Criteria for intubation: Clinical indications: Cardiac arrest, Respiratory arrest, Altered mental status, Progressive exhaustion, Silent chest. Laboratory indications: Severe hypoxia with maximal oxygen delivery, Failure to reverse severe respiratory acidosis despite intensive therapy, pH < 7.2, carbon dioxide pressure increasing by 5 mm Hg/h or to 55–70 mm Hg, or oxygen pressure of < 60 mm Hg. (Schatz et al., 2009)

Evidence from consensus judgement.

7.2.3.2 Intubation technique: In general, orotracheal intubation with sedation and neuromuscular blockade are preferred for asthmatic patients in critical respiratory distress. The use of ketamine might be preferred over other sedative agents. ^{adapted}

7.2.4 Ventilation

7.2.4.1 Recommendations for appropriate ventilator settings: Control of hyperinflation and auto-PEEP: Reduction of respiratory rate might help control hyperinflation, Reduction of tidal volume might help control hyperinflation, An initial set-up of 80 L/min with a decelerating wave form configuration might be appropriate in adults, Shortening of inspiration with a square wave pattern and an inspiratory flow rate of 60 L/min allows greater time for exhalation in each respiratory cycle and might help control hyperinflation, Auto-PEEP and plateau pressure should be followed during mechanical ventilation. Hypercapnia is preferable to hyperinflation - It should not be used in the presence of increased intracranial pressure. An acceptable level of hypercapnia and acidosis is a pH as low as 7.15 and a PaCO₂ of < 80 mm Hg. (Schatz et al., 2009)

Evidence from consensus judgement.

7.3 Paediatric Asthma

Although assessment and treatment of young children pose unique challenges, the management of asthma exacerbations in older children and adults is fairly similar (National Heart, Lung, and Blood Institute, 2007).

The diagnosis of asthma is often difficult and overused in children with a wheeze. EMS practitioners uncertain of the diagnosis should be guided by history from parents and current medication. The use of asthma medication as described is probably not harmful even when the diagnosis is unclear.

- Signs of a severe asthma attack in children include all those in adults, but in addition young children appear restless, unable to settle or become drowsy. He or she might 'suck' in muscles around the ribs and may have problems eating or drinking due to shortness of breath. A child also may have severe coughing and vomiting (Australian Resuscitation Council, 2014a).
- It is particularly important to monitor SaO₂ by pulse oximetry in infants because their ventilation/perfusion characteristics lead them to become hypoxemic more readily than adults. SaO₂ should be normal for altitude (>95 percent at sea level). Decreased SaO₂ is often an early sign of severe airway obstruction, and an SaO₂ <92 percent of room air 1 hour after initial treatment is a good predictor of the need for hospitalization in small infants (National Heart, Lung, and Blood Institute, 2007).
- Inhaled beta-2 agonist treatment can be delivered via a nebulizer but use of an MDI is preferable when tolerated.
- Oral steroids are beneficial for asthma treatment, but their onset is slow (4-6 hours).

CHILD > 2 years.

7.3.1 Children with life-threatening asthma or SpO₂<94% should receive high flow oxygen via a tight-fitting face mask or nasal cannula at sufficient flow rates to achieve normal saturations of 94–98%. (British Thoracic Society, 2014) *

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.3.2 Inhaled β₂ agonists are the first line treatment for acute asthma. (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.3.3 If symptoms are refractory to initial β₂ agonist treatment, add ipratropium bromide (250 micrograms/dose mixed with the nebulised β₂ agonist solution). (British Thoracic Society, 2014) *

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.3.4 Give oral steroids early in the treatment of acute asthma attacks. (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.3.5 Consider adding 150 mg magnesium sulphate to each nebulised salbutamol and ipratropium in the first hour in children with a short duration of acute severe asthma symptoms presenting with an oxygen saturation less than 92%. (British Thoracic Society, 2014)*

Evidence from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship or evidence extrapolated from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship.

INFANT < 2yrs

7.3.6 For mild to moderate acute asthma attacks, a pressurised metered dose inhaler (pMDI) + spacer and mask is the optimal drug delivery device. (British Thoracic Society, 2014)

Evidence from at least one meta-analysis, systematic review or clinical trial rated as high quality or well-conducted.

7.3.7 Consider inhaled ipratropium bromide in combination with an inhaled β 2agonist for more severe symptoms. (British Thoracic Society, 2014)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high quality clinical trials.

7.4 Paediatric Pneumonia

Pneumonia is unfortunately a common occurrence in South Africa and needs to be considered in any child who is short of breath, or even apnoeic in infants and neonates.

7.4.1 Bacterial pneumonia should be considered in children when there is persistent or repetitive fever >38.5 °C together with chest recession and a raised respiratory rate. (British Thoracic Society Standards of Care Committee, 2011) *

Evidence from other information.

7.4.2 Children with community acquired pneumonia in the community or in hospital should be reassessed if symptoms persist and/or they are not responding to treatment. adapted

7.4.3 Children who have oxygen saturations $<92\%$ should be referred to hospital for assessment and management. adapted

Evidence from one or more clinical studies.

7.4.4 Auscultation revealing absent breath sounds with a dull percussion note should raise the possibility of a pneumonia complicated by effusion and should trigger a referral to hospital. (British Thoracic Society Standards of Care Committee, 2011) *

Evidence from one or more retrospective clinical studies.

7.4.5 Patients whose oxygen saturation is $\leq 92\%$ while breathing air should be treated with oxygen given by nasal cannulae, high flow delivery device, head box or face mask to maintain oxygen saturation $>92\%$. adapted

Evidence from one or more clinical studies or/and evidence from one or more retrospective clinical studies.

7.5 Paediatric Bronchiolitis

Bronchiolitis is the most common disease of the lower respiratory tract during the first year of life. It usually presents with cough with increased work of breathing, and it often affects a child's ability to feed. In primary care, the condition may often be confused with a common cold, though the presence of lower respiratory tract signs (wheeze and/or crackles on auscultation) in an infant in mid-winter would be consistent with this clinical diagnosis. The symptoms are

usually mild and may only last for a few days, but in some cases the disease can cause severe illness (National Institute for Health and Care Excellence, 2015).

7.5.1 When diagnosing bronchiolitis, take into account that it occurs in children under 2 years of age and most commonly in the first year of life, peaking between 3 and 6 months.

(National Institute for Health and Care Excellence, 2015)

Grading embedded in recommendation.

7.5.2 Diagnose bronchiolitis if the child has a coryzal prodrome lasting 1 to 3 days, followed by: persistent cough and either tachypnoea or chest recession (or both) and either wheeze or crackles on chest auscultation (or both).

(National Institute for Health and Care Excellence, 2015)

Grading embedded in recommendation.

7.5.3 When diagnosing bronchiolitis, take into account that young infants with this disease (in particular those under 6 weeks of age) may present with apnoea without other clinical signs.

(National Institute for Health and Care Excellence, 2015)

Grading embedded in recommendation.

7.5.4 Measure oxygen saturation in every child presenting with suspected bronchiolitis, including those presenting to primary care if pulse oximetry is available.

(National Institute for Health and Care Excellence, 2015)

Grading embedded in recommendation.

7.5.5 Suspect impending respiratory failure and take appropriate action as these children may need intensive care, if any of the following are present: signs of exhaustion, for example listlessness or decreased respiratory effort; recurrent apnoea; failure to maintain adequate oxygen saturation despite oxygen supplementation.

(National Institute for Health and Care Excellence, 2015)

Grading embedded in recommendation.

7.5.6 Immediately refer children with bronchiolitis for emergency hospital care if they have any of the following: apnoea (observed or reported); child looks seriously unwell to a healthcare professional; severe respiratory distress, for example grunting, marked chest recession, or a respiratory rate of over 70 breaths/minute; central cyanosis; persistent oxygen saturation of less than 92% when breathing air.

(National Institute for Health and Care Excellence, 2015) *

Grading embedded in recommendation.

7.5.7 Consider referring children with bronchiolitis to hospital if they have any of the following: a respiratory rate of over 60 breaths/minute; difficulty with breastfeeding or inadequate oral fluid intake (50–75% of usual volume, taking account of risk factors and using clinical judgement); clinical dehydration.

(National Institute for Health and Care Excellence, 2015)

Grading embedded in recommendation.

7.5.8 Do not use any of the following to treat bronchiolitis in children: antibiotics; hypertonic saline; adrenaline (nebulised); salbutamol; montelukast; ipratropium bromide; systemic or inhaled corticosteroids; a combination of systemic corticosteroids and nebulised adrenaline.

(National Institute for Health and Care Excellence, 2015) *

Grading embedded in recommendation.

- 7.5.9 Give oxygen supplementation to children with bronchiolitis if their oxygen saturation is persistently less than 92%.** (National Institute for Health and Care Excellence, 2015)
Grading embedded in recommendation.
- 7.5.10 Consider continuous positive airway pressure in children with bronchiolitis who have impending respiratory failure.** (National Institute for Health and Care Excellence, 2015)
Grading embedded in recommendation.
- 7.5.11 Do not routinely perform upper airway suctioning in children with bronchiolitis.** (National Institute for Health and Care Excellence, 2015) *
Grading embedded in recommendation.
- 7.5.12 Consider upper airway suctioning in children who have respiratory distress or feeding difficulties because of upper airway secretions.** (National Institute for Health and Care Excellence, 2015)
Grading embedded in recommendation.
- 7.5.13 Perform upper airway suctioning in children with bronchiolitis presenting with apnoea even if there are no obvious upper airway secretions.** (National Institute for Health and Care Excellence, 2015)
*
Grading embedded in recommendation.

7.6 Other Respiratory Disorders in Children

7.6.1 Croup

- 7.6.1.1 No deviation from current practice can be recommended at this time.**

7.6.2 Epiglottitis

- 7.6.2.1 No deviation from current practice can be recommended at this time.**

7.7. Pulmonary Embolism

Pulmonary embolism may present as chest pain, dyspnoea, syncope, haemoptysis, cardiac arrest or a combination of these. Symptoms and signs are highly non-specific and may be found in many other cardiac or pulmonary conditions (Beygui et al., 2015).

7.7.1 Patient Pathway

- 7.7.1.1 Transfer to emergency centre is recommended for stable patients with suspicion of pulmonary embolism.** (Beygui et al., 2015)
Grading embedded in recommendation.
- 7.7.1.2 Transfer of patients with severe symptoms or haemodynamic instability (cardiac arrest, syncope, shock) or right ventricular enlargement on echocardiography – if performed – to emergency centres equipped for thrombectomy is highly recommended.** *adapted*

7.7.2 Management

To be implemented where resources allow and in-hospital and pre-hospital local reperfusion protocols have been implemented (See also Section 5, Acute Coronary Syndrome & Similar Conditions). Implementation dependent on local shared protocol and local resources.

7.7.2.1 The use of clinical prediction scores developed to determine the likelihood of pulmonary embolism is highly recommended. (Beygui et al., 2015)*

Grading embedded in recommendation.

7.7.2.1 Recommended clinical prediction scores for pulmonary embolism include the modified Wells rule (Beygui et al., 2015)

ParameterParameter	Simplified pulmonary embolism severity index
Age	1 point (if age >80 years)
Cancer	1 point
Chronic heart failure	1 point
Pulse rate ≥ 110 b.p.m.	1 point
Systolic blood pressure <100 mm Hg	1 point
Arterial oxyhaemoglobin saturation <90%	1 point
0 points= 30-day mortality risk 1.0% (95% CI 0.0%–2.1%)	
≥ 1 point(s)= 30-day mortality risk 10.9% (95% CI 8.5%–13.2%)	

Table: Example of a clinical prediction rule: Simplified pulmonary embolism severity index (Beygui et al., 2015).

7.7.2.2 The use of point of care D-dimer, troponin and BNP tests is not recommended. (Beygui et al., 2015)

Grading embedded in recommendation.

7.7.2.3 In patients with suspected pulmonary embolism continuous ECG and blood oxygen saturation monitoring, and an IV access during transfer are highly recommended. (Beygui et al., 2015)

Grading embedded in recommendation.

7.7.2.4 Point of care FoCUS echocardiography may be considered in the pre-hospital setting for evaluation of the severity of pulmonary embolism. (Beygui et al., 2015)

Grading embedded in recommendation.

8. Trauma

"Injury is an increasingly significant health problem throughout the world. Every day, 16 000 people die from injuries, and for every person who dies, several thousand more are injured, many of them with permanent sequelae. Injury accounts for 16% of the global burden of disease. The burden of death and disability from injury is especially notable in low- and middle-income countries. By far the greatest part of the total burden of injury, approximately 90%, occurs in such countries" (Mock et al., 2004).

8.1 Patient Pathway

The focus of pre-hospital trauma management remains the rapid access and extrication of patients to allow for the rapid assessment and control of bleeding, the airway and ventilation. There is a renewed focus on the importance of rapid transport as the most important factor for trauma survival remains time to access of definitive care and operative haemostasis.

Documentation of patient presentation, intervention and patient response is a medico-legal imperative and should be reviewed by quality improvement processes.

8.1.1 General Approach to trauma patients: adapted

- **Establish patent airway**
- **Ensure adequate ventilation and oxygenation**
- **Control any external bleeding by applying direct pressure (including indirect pressure, topical haemostatic agents and tourniquets if indicated)**
- **Secure venous access – large bore cannula x 2 (If indicated),**
- **Rapidly identify patients requiring operative haemostasis and prioritise transport to definitive care, Establish prompt contact with the major referral hospital and retrieval service.**

8.1.2 Record details related to patients with major trauma in the pre-hospital setting in the following way: Catastrophic haemorrhage, Airway with in line spinal immobilisation, Breathing, Circulation, Disability (neurological), Exposure and environment. (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.1.3 If possible, record information on whether the assessments show that the patient's condition is improving or deteriorating. Record pre-alert information using a structured system and include all of the following: the patient's age and sex, time of incident, mechanism of injury, injuries suspected, signs, including vital signs and Glasgow Coma Scale, treatment so far, estimated time of arrival at emergency centre, special requirements, the ambulance call sign, name of the person taking the call and time of call. (National Institute for Health and Care Excellence, 2016)*

Grading embedded in recommendation.

8.2 Bleeding and Shock

Bleeding remains one of the most important contributors to traumatic death. The prevention of the trauma triad of death: hypothermia, acidosis and coagulopathy remains an important goal. Haemodilution and the role of pre-hospital fluid management has also received significant attention. Many well developed trauma systems are moving towards restrictive fluid management regimes, specific haemodynamic targets and the introduction of pre-hospital initiation of blood product administration. The control and prevention of bleeding remains a central focus for pre-hospital providers.

8.2.1 Venous Access & Type of Fluid for Haemorrhagic Shock

Type of Fluid for Haemorrhagic Shock

The NICE Guideline Development Group (National Institute for Health and Care Excellence, 2016) acknowledged that a recommendation to avoid using crystalloids and other clear fluids except in patients with profound haemorrhagic shock in the pre-hospital environment is a change in clinical practice. The NICE Guideline Development Group (National Institute for Health and Care Excellence, 2016) wanted to highlight that haemorrhage and other forms of shock (inadequate perfusion of end organs) in major trauma has a potential early and continued detrimental effect on clotting function ranging from an alteration in the complex systems involved in clotting itself to an absolute reduction in the body's raw materials required for creating adequate clot formation (National Institute for Health and Care Excellence, 2016).

Both crystalloids and colloids have an effect upon the complex clotting systems and their effective function in the patient who is severely injured. Additionally, continued and prolonged periods of shock have a detrimental effect upon outcome manifesting as inadequate perfusion of organs converting to organ failure and hence multi-organ dysfunction syndrome – so there is impact from the severity of the shock, the type of shock, the length of time that the patient is shocked for; this will affect the end organs and the clotting systems and both (for example, bone marrow and haematopoietic organs and their capability to manufacture essential ingredients for clot formation and replenishment of the circulating blood components and volume). The optimum management is fluid replacement with blood components (National Institute for Health and Care Excellence, 2016).

The NICE Guideline Development Group (National Institute for Health and Care Excellence, 2016) discussed the situation when a pre-hospital practitioner is treating a patient in profound haemorrhagic shock but does not have access to blood components. In this case small boluses of crystalloids would be appropriate.

The implementation of the pre-hospital initiation of blood administration may not be possible in all settings. Local EMS systems need to evaluate feasibility and particular contextual need (long transport times, the availability of blood, patient requirements). It may be particularly useful and feasible to implement systems to provide blood products in the aeromedical setting.

8.2.1.1 In pre-hospital settings only use crystalloids to replace fluid volume in patients with active bleeding if blood components are not available. (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.2.1.2 For adults (16 or over) use a ratio of 1 unit of plasma to 1 unit of red blood cells to replace fluid volume. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

This recommendation is applicable to both the primary and inter-facility transfer settings for the management of haemorrhagic hypovolemic shock where resources and system allow for the use of blood products.

8.2.1.3 For children (under 16s) use a ratio of 1-part plasma to 1part red blood cells and base the volume on the child's weight. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

This recommendation is applicable to both the primary and inter-facility transfer settings where resources and system allow for this.

8.2.1.4 Isotonic saline solution should not be used; Ringer's malate, or alternatively Ringer's acetate or Ringer's lactate, should be preferred. (Sumann et al., 2009)

Recommended.

This recommendation applies to trauma patients in particular. There is concern around the possibly of patients developing hyperchloraemic acidosis when using large volumes of sodium chloride for fluid resuscitation in trauma. The use of Ringer's lactate/malate/acetate is believed to buffer the development of iatrogenic acidosis in trauma patients, although it is a contentious point in practice.

Timing of Vascular Access in Trauma

8.2.1.5 The placement of vascular access at the scene of injury should not be performed when it would cause unnecessary delay in transport to definitive care. ^{adapted}

Delaying transport to place venous access seems to be associated with increased overall time to hospital, in some cases exceeding that of the actual transport itself (Cotton et al., 2009). In seriously injured patients increased time to definitive care is associated to poorer patient outcomes, including increased risk of mortality (Cotton et al., 2009). The definition of an unnecessary delay is dependent on the clinical status and injury profile of the individual patient as well as the context and distance or transport time to hospital. It should be noted that this recommendation does not address *per se* the situations in which urgent IV access may be required for reasons other reasons such as medication administration. Providers should use clinical judgement to decide on the appropriateness and need for IV cannulation in the pre-hospital setting.

8.2.1.6 Placement of vascular access during transport is feasible and does not delay transport to definitive care. (Cotton et al., 2009)

Evidence from retrospectively collected data.

The success rate of obtaining IV access en route is comparable to that on scene irrespective of the patient's haemodynamic status (Cotton et al., 2009).

Vascular Access Technique

8.2.1.7 The use of IO access in trauma patients requiring vascular access in which IV access is unobtainable or has failed two attempts is recommended. (Cotton et al., 2009)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data.

The site most often used for adult IO access is the proximal tibia (medial and inferior to the tibial tuberosity) and the sternum and humeral head (Cotton et al., 2009). In trauma the potential of proximal vascular injury should be considered when selecting a site for IO placement. In order to provide IO access in adult patients an appropriate device with either a spring loaded mechanism or IO drill designed for this purpose is an ideal.

8.2.1.8 Attempts at peripheral IV access should be limited to two attempts during pre-hospital transport after which, alternative methods (IO, central access) should be attempted if equipment and trained personnel are available. (Cotton et al., 2009) *

Evidence from retrospectively collected data.

Brachial access was advocated as the preferred route for bolus injection delivery in the emergency setting as it provides expedient bolus delivery equal to central access and is superior to femoral access.

8.2.1.9 For circulatory access in small children with major trauma, consider intra-osseous access as first-line access if peripheral access is anticipated to be difficult. adapted

IO access in children is associated to various adverse effects. These include pain in insertion, pain on injection of fluid and possibility of fractures and epiphyseal plate injury. Although the recommendation indicates IO as a first line option this should be reserved for serious injured children where IV access is required for the administration of fluid or medications, not as a prophylactic measure. This recommendation is therefore made in the context that peripheral IV placement should always be considered first but IO should not be delayed if clearly indicated or access is urgently required as IV access is like to be more difficult and delay care (National Institute for Health and Care Excellence, 2016).

8.2.2 Fluid Management Regime

Indications & Contraindications for Pre-Hospital Fluid Administration

Other indications for pre-hospital fluid management in trauma may include blood pressure measurements which indicated blood pressure below the targets indicated for trauma patients in other parts of the guideline.

8.2.2.1 It is recommended that in the pre-hospital management of adults and older children, IV fluid should not be administered if a radial pulse can be felt (or, for penetrating torso injuries, if a central pulse can be felt). (National Institute for Health and Care Excellence, 2004) *

Grading embedded in recommendation.

This recommendation relates to the expected physical examination findings in patients who are not shocked to the point where they are peripherally vasoconstricted. In patients with present radial pulses it is likely that blood pressure is equal to or in excess of the haemodynamic targets specified to trauma fluid resuscitation. Penetrating torso injuries are related to non-compressible internal bleeding which required urgent surgery. Delaying fluid replacement may minimise the time delay at the scene in these patients. It is also believed that delaying fluid replacement may reduce the risk of re-bleeding caused by the mechanical disruption of blood clots and the dilution of clotting factors, which can occur, particularly when large volumes of IV fluid are administered (National Institute for Health and Care Excellence, 2004).

8.2.2.2 Normotensive patients do not require volume replacement, but venous access should be placed. (Neugebauer et al., 2012)*

Recommended.

Placement of vascular access should be considered in light of the recommendation regarding indications and timing made in other parts of this guideline.

The practice of permissive hypotension is relatively new in the South African context. Implementation may require substantial retraining of providers in practice, particularly those at the intermediate life support level of care.

Uncontrolled Internal & External Bleeding

The practice of administering large amounts of fluid without clear fluid resuscitation targets has been described to be potentially detrimental to trauma patients, particularly those with active, uncontrolled and non-compressible bleeding. Haemodilution results and has been described one of the major contributors to mortality in trauma. The approach of using volume per kilogram based fluid bolus (20ml/kg) targets is no longer advised. Patients should be given fluid only if required in a restricted strategy aimed at maintaining systolic or mean arterial pressure targets as described in the recommendations.

The recommendations presented here denote a significant change from current practice. Implementation will require retraining of providers and quality assurance systems.

8.2.2.3 In severely injured patients, volume replacement should be started in such a way that it can be carried out in reduced form if uncontrollable bleeding occurs, in order to keep the circulation at a stable low level and not exacerbate the bleeding. (Neugebauer et al., 2012)

Recommended.

8.2.2.4 In the presence of uncontrolled haemorrhage and a delay of greater than 30 minutes to operative haemostasis, infuse small aliquots of fluid (100-200mL) to maintain systolic blood pressure between 80-90 mmHg. Use caution in the elderly. Contraindicated in unconscious patients without a palpable blood pressure and those with traumatic brain injury. (Pascoe and Lynch, 2007)

Evidence from at least one RCT.

See also Section 8.4, Head & Facial Injury

This recommendation refers to the concept of hypotensive resuscitation or permissive hypotension. Although systolic targets are presented, sufficient MAP is what is desired. As MAP is not always measured in the pre-hospital setting systolic targets provide useful endpoints. It should be noted that the MAP targets suggested for these patients are 60 - 65mmHg in patient with active internal bleeding. The recommendation assumes that all external / compressible bleeding has been aggressively controlled. Although patients may require a large amount of fluids to maintain these pressure the concept of careful titration of fluid to avoid haemodilution while resuscitating to a clear endpoint is emphasised by this recommendation. More aggressive fluid resuscitation is recommended in elderly and unconscious patients without a palpable blood pressure. Separate recommendations are presented in this CPG for fluid resuscitation endpoints in patients with traumatic brain injuries. Patients with no palpable pulse should receive "standard" IV fluid resuscitation.

8.2.2.5 For patients with active bleeding use a restrictive approach to volume resuscitation until definitive early control of bleeding has been achieved. (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.2.2.6 In the presence of uncontrolled haemorrhage in the patient with a concurrent traumatic brain injury, prevention of secondary brain injury from hypotension is crucial as a systolic blood pressure <90mm Hg is associated with poor outcomes. Infuse small aliquots of fluid (100-200mL) to maintain systolic blood pressure above 90mm Hg. (Pascoe and Lynch, 2007)

Grading embedded in recommendation)

This recommendation refers to the concept of hypotensive resuscitation or permissive hypotension. Although systolic targets are presented sufficient MAP is what is desired. As MAP is not always measured in the pre-hospital setting, systolic targets provide useful endpoints. The MAP targets suggested for these patients are 70 - 80mmHg in the setting of uncontrolled internal bleeding.

The presence of a brain injury necessitates higher SBP targets than those in 8.2.2.4

8.2.2.7 In pre-hospital settings, titrate volume resuscitation to maintain a palpable central pulse (carotid or femoral). (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

8.2.2.8 For patients who have haemorrhagic shock and a traumatic brain injury: if haemorrhagic shock is the dominant condition, continue restrictive volume resuscitation or if traumatic brain injury is the dominant condition, use a less restrictive volume resuscitation approach to maintain cerebral perfusion. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

Providers should use clinical judgement to determine the dominant elements in the patient's condition.

8.2.3 Temperature & Haemorrhage Control

The interventions recommended here have been shown to be effective in highly developed trauma systems where definitive care is available and pre-hospital time intervals are short. During the implementation of these recommendations development of local trauma systems and patient pathways should optimize access to operative haemostasis and definitive care.

8.2.3.1 We recommend early application of measures to reduce heat loss and warm the hypothermic patient in order to achieve and maintain normothermia. (Spahn et al., 2013)

Strong recommendation, low-quality or very-low quality of evidence.

8.2.3.2 We recommend the use of topical haemostatic agents in combination with other surgical measures or with packing for venous or moderate arterial bleeding associated with parenchymal injuries. (Spahn et al., 2013)

Strong recommendation, moderate-quality of evidence.

Availability and cost of suitable agents for this purpose in the South African setting may impede implementation.

8.2.3.3 The use of direct, sustained pressure is usually the fastest, easiest and most effective way to stop bleeding. However, in some circumstances, indirect pressure may be used. If there is an obvious embedded object, use indirect pressure. (Australian Resuscitation Council, 2008a)

Expert Consensus Opinion.

8.2.3.4 We recommend adjunct tourniquet use to stop life-threatening bleeding from open extremity injuries in the pre-surgical setting. (Spahn et al., 2013)

Strong recommendation, moderate-quality of evidence.

The use of tourniquets is only indicated in the following settings:

- where direct and indirect pressure has failed to stop catastrophic life threatening active bleeding
- as a first line intervention in the setting of limb amputation with catastrophic bleeding
- situations where immediate bleeding control is required to allow for life support interventions such as airway management.

8.2.3.5 The panel suggests using commercially produced windlass, pneumatic, or ratcheting devices that have been demonstrated to occlude arterial flow. (Snyder et al., 2014) *

Strength of Recommendation: Weak, Quality of Evidence: Low

8.2.3.6 The panel suggests against the use of narrow, elastic, or bungee-type devices. (Snyder et al., 2014)

Strength of Recommendation: Weak, Quality of Evidence: Low.

8.2.3.7 The panel suggests that improvised tourniquets be applied only if no commercial device is available. (Snyder et al., 2014)

Strength of Recommendation: Weak, Quality of Evidence: Low.

8.2.3.8 The panel suggests against releasing a tourniquet that has been properly applied in the pre-hospital setting until the patient has reached definitive care. (Snyder et al., 2014)

Strength of Recommendation: Weak, Quality of Evidence: Low.

The context of the guideline from which this recommendation was extracted considers relatively short transport times for most civilian EMS agencies. In such settings it is considered the safest option to leave a tourniquet that had been placed in the field in place until the patient can be assessed in the hospital (Snyder et al., 2014). There may be exceptions to this approach for prolonged transport times or austere environments. Prolonged transport times are generally considered more than 1 hour for this purpose. A properly applied tourniquet will occlude all arterial flow in the affected limb and will result in limb ischaemia.

8.2.3.9 We recommend that tranexamic acid be administered as early as possible to the trauma patient who is bleeding or at risk of significant haemorrhage at a loading dose of 1 g infused over 10 minutes, followed by an IV infusion of 1 g over 8 h. (Spahn et al., 2013)

Strong recommendation, high quality of evidence.

This recommendation applies to any patient who is hypotensive post-trauma with a significant mechanism of injury and/or ongoing bleeding.

8.2.3.10 Use IV tranexamic acid as soon as possible in patients with major trauma and active or suspected active bleeding. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

8.2.3.11 Do not use IV tranexamic acid more than 3 hours after injury in patients with major trauma unless there is evidence of hyperfibrinolysis. (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.2.3.12 We suggest that protocols for the management of bleeding patients consider administration of the first dose of tranexamic acid en route to the hospital. (Spahn et al., 2013) *

Weak recommendation, high quality of evidence.

This recommendation applies to any patient who is hypotensive post-trauma with a significant mechanism of injury and/or ongoing bleeding.

8.2.3.13 If active bleeding is suspected from a pelvic fracture after blunting high-energy trauma: apply a purpose-made pelvic binder or consider an improvised pelvic binder, but only if a purpose-made binder does not fit. (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.2.4 Assessment of Shock & Identification of At-Risk Patients

8.2.4.1 Traditional haemodynamic parameters do not adequately quantify the degree of physiological derangement in hypovolaemic trauma patients. If point of care blood gas analysis is available base deficit and lactate levels should be used to identify the magnitude of tissue oxygen debt and the adequacy of resuscitation. These tests are only of value when interpreted in a series, therefore should be repeated. A persistently high or increasing base deficit indicates the presence of ongoing blood loss or inadequate volume replacement. (Pascoe and Lynch, 2007) *

Evidence from analytical studies with concurrent controls, cohort studies, case-control studies or interrupted time series studies with a control group.

The context for using point of care arterial blood gas analysis would generally be confined to urgent interfacility transfers and the aeromedical setting where continued tissue oxygen debt may increase the risks of decompensation during flight. The cost of point of care blood gas analysis may limit its availability in the pre-hospital setting.

8.2.4.2 In the absence of point of care blood gas analysis capability, the restoration of a normal mentation, heart rate, skin perfusion and urine output and maintaining the systolic blood pressure at 80-90 mmHg serve as the endpoint of resuscitation. (Pascoe and Lynch, 2007)

Consensus.

8.3 Immobilisation in Trauma

8.3.1 Assessment for Spinal Injury & C-Spine Clearance

Spinal immobilisation is currently a common practice in the South African pre-hospital for all trauma patients. The concern with possible cervical spinal injuries is that neurologic function may be further impaired as a result of pathologic motion of the injured vertebrae. It has been postulated that between 3% to 25% of spinal cord injuries occur after the initial traumatic injury, either during transit or early in the course of management (Theodore et al., 2013). The evidence supporting the practice of routine spinal immobilisation in the pre-hospital setting has been questioned (Theodore et al., 2013). The use of spinal clearance protocols has been shown to avoid unnecessary spinal immobilisation and potentially avoid the risks and complications associated to unnecessary immobilisation with minimal risk (Theodore et al., 2013).

The implementation of pre-hospital spinal clearance should be accompanied by quality assurance systems which ensure correct implementation, particularly if system wide implementation is desired.

Prolonged scene times possibly related to the time taken to perform spinal immobilisation have been linked to increased mortality in seriously injured patients due to delayed resuscitation (Theodore et al., 2013). Spinal Immobilisation is possibly indicated in the following circumstances: (Theodore et al., 2013)

- Spinal pain or tenderness, including any neck pain with a history of trauma
- Significant multiple system trauma
- Severe head or facial trauma
- Numbness or weakness in any extremity after trauma
- Loss of consciousness caused by trauma
- If mental status is altered (including drugs, alcohol, trauma) and no history is available, or the patient is found in a setting of possible trauma (e.g. lying at the bottom of stairs or in the street); or the patient experienced near drowning with a history or probability of diving
- Any significant distracting injury

8.3.1.1 An awareness of potential spinal injury and careful victim handling, with attention to spinal alignment, is the key to harm minimisation. (Australian Resuscitation Council, 2012)

Evidence from case-series, either post-test or pre-test/ post-test

It is suggested that all trauma patients with suspected cervical spinal column injury or with a mechanism of injury having the potential to cause cervical spinal injury should be immobilised at the scene and during transport using one of several available methods, unless they can be cleared by a trained provider.

8.3.1.2 Triage of patients with potential spinal injury at the scene by trained and experienced EMS personnel to determine the need for immobilisation during transport is recommended. (Theodore et al., 2013)

Recommended; Evidence from high evidence from lesser quality RCTs, or prospective comparative studies or strong case series studies.

This recommendation applies to all patients at risk for spinal injury particularly related to blunt trauma. The context for this recommendation relates to patients whom have not been assessed for spinal clearance or do not meet pre-hospital spinal clearance recommendations.

Triage and spinal clearance procedures should follow a validated c-spine clearance rule or protocol such as the Nexus or Canadian C-Spine rule criteria. It should be noted that these rules may apply only to the C-Spine and not injuries to other parts of the spine.

8.3.1.3 Immobilisation of trauma patients who are awake, alert, and are not intoxicated; who are without neck pain or tenderness; who do not have an abnormal motor or sensory examination; and who do not have any significant associated injury that might detract from their general evaluation is not recommended. (Theodore et al., 2013)

Recommended; Evidence from high evidence from lesser quality RCTs, or prospective comparative studies or strong case series studies.

Not all trauma patients require treatment with spinal immobilisation as many of these patients do not have spinal injuries (Theodore et al., 2013).

8.3.1.4 Spinal immobilization in patients with penetrating trauma is not recommended because of increased mortality from delayed resuscitation. (Theodore et al., 2013)

Evidence from high evidence from lesser quality RCTs, or prospective comparative studies or strong case series studies.

8.3.1.5 Cardiac Arrest patient: When multisystem trauma is present, or trauma involves the head and neck, excluding penetrating trauma, the cervical spine must be stabilized. A jaw thrust should be used instead of a head tilt– chin lift to establish a patent airway. *adapted*

8.3.2 Equipment & Techniques for Cervical Spinal Immobilization in Trauma

The emergency care provider should maintain manual inline stabilisation by standing behind an upright victim or lying/kneeling above the head of a supine victim. He/she should hold the victim's head, whilst stabilising their own arms by locking their elbows together or resting their elbows on the ground. The aim is to maintain the victim's head in a neutral position aligned with the body, thus avoiding side to side movements. In healthy adults, padding under the head to lift it 2cm above the level of the body optimises the neutral position (Australian Resuscitation Council, 2012).

The use of the cervical collar has become contentious, but there is no strong evidence to support its use or discontinued use at this stage (Theodore et al., 2013). The collar is a precautionary measure. Full spinal immobilization is indicated in patients whose spine cannot be cleared. Cervical collars have been shown to be associated with potential harm, the risks increasing with duration of use. Adverse effects include: (Australian Resuscitation Council, 2012)

- discomfort and pain
- restricted mouth opening and difficulty swallowing
- airway compromise should the victim vomit
- pressure on neck veins raising intra-cranial pressure (harmful to head injured victims)
- hiding potential life-threatening conditions

Victims should not be left on rigid spinal boards. Healthy subjects left on spine boards develop pain in the neck, back of the head, shoulder blades and lower back. The same areas are at risk of pressure necrosis. Conscious victims may attempt to move around in an effort to improve comfort, potentially worsening their injury. Paralysed or unconscious victims are at higher risks of development of pressure necrosis due to their lack of pain sensation. Strapping has been shown to restrict breathing and should be loosened if causing compromise (Australian Resuscitation Council, 2012).

Victims may be more comfortable on a padded spine board, air mattress or bead filled vacuum mattress, such devices are preferred over hard spine boards where available (Australian Resuscitation Council, 2012).

8.3.2.1 A combination of a rigid cervical collar and supportive blocks on a backboard with straps is effective in limiting motion of the cervical spine and is recommended. (Theodore et al., 2013) *

Inconclusive recommendation. Evidence uncertain.

The collar is a precautionary measure. Full spinal immobilisation is indicated in patients whose spine cannot be cleared.

8.3.2.2 The longstanding practice of attempted spinal immobilisation with sandbags and tape is insufficient and is not recommended. (Theodore et al., 2013)

Inconclusive recommendation. Evidence uncertain.

8.3.2.3 The cervical collar serves as a precaution and it may be removed by trained personnel who can clinically assess and clear the neck of spinal injury. (Australian Resuscitation Council, 2012) *

Evidence from case-series, either post-test or pre-test/ post-test.

8.3.2.4 Children: After road traffic accidents, conscious infants should be left in their rigid seat or capsule until assessed by ambulance personnel. If possible, remove the infant seat or capsule from the car with the infant/child in it. Older children can be placed in a cervical collar but should not have their head strapped to a spine board. An uncooperative child struggling with their head in a fixed position causes movement at the neck. (Australian Resuscitation Council, 2012) *

Evidence from case-series, either post-test or pre-test/ post-test.

There is controversy surrounding the use of cervical collars in paediatric patients, and there is no strong evidence to support its use or discontinued use at this point in time.

8.3.3 Thoracic & Lumbar Injury

8.3.3.1 No deviation from current practice can be recommended at this time.

8.4 Head & Facial Injury

“Half of those who die from TBI do so within the first 2 hours of injury. It is now known however that all neurological damage does not occur at the moment of impact (primary injury), but rather evolves over the ensuing minutes, hours and days. This secondary brain injury can result in increased mortality and disability. Consequently, the early and appropriate management of TBI is critical to the survival of these patients” (Badjatia et al., 2007).

8.4.1 Assessment Head Injury Patients

Pulse oximetry in all patients with TBI may be idealistic in the South African setting. However, as pulse oximetry may be used as a possible indicator of respiratory or airway compromise in TBI patients it is valuable for EMS system to consider patient safety when deciding on investments in monitoring equipment.

Assessment of Oxygenation & Blood Pressure in Adults

8.4.1.1 Patients with suspected severe TBI should be monitored in the pre-hospital setting for hypoxemia (<90% arterial haemoglobin oxygen saturation) or hypotension (<90 mmHg SBP). (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.2 Blood oxygenation: Percentage of blood oxygen saturation should be measured in the field with a pulse oximeter. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.3 Blood pressure: SBP and diastolic blood pressure (DBP) should be measured using the most accurate method available under the circumstances. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.4 Oxygenation and blood pressure should be measured as often as possible and should be monitored continuously if possible. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

Assessment of Oxygenation & Blood Pressure in Paediatrics

8.4.1.5 In the paediatric population there is no pre-hospital evidence that directly associates oxygenation and blood pressure to patient outcome. In-hospital data in children indicate hypotension is linked to poor outcome. Paediatric hypotension is defined as follows:

(Badjatia et al., 2007) *

Age	SBP
0 to 28 days	<60 mmHg
1 – 12 months	<70
1 – 10 years	< 70 + 2 X age in years
> 10 years	<90

Weak recommendation, low quality of evidence.

8.4.1.6 Blood oxygenation measurement in paediatrics: Percentage of blood oxygen saturation should be measured in the field with a pulse oximeter using an appropriate paediatric sensor. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.7 Blood pressure: SBP and DBP should be measured using an appropriately sized paediatric cuff. When a blood pressure is difficult to obtain because of the child's age or body habitus, documentation of mental status, quality of peripheral pulses, and capillary refill time can be used as surrogate measures. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

Assessment of Glasgow Coma Scale: Adults

8.4.1.8 Pre-hospital measurement of the Glasgow Coma Scale (GCS) is a significant and reliable indicator of the severity of TBI, particularly in association with repeated scoring and improvement or deterioration of the score over time. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.9 The GCS must be obtained through interaction with the patient (i.e. by giving verbal directions or, for patients unable to follow commands, by applying a painful stimulus such as nail bed pressure or axillary pinch). (Badjatia et al., 2007)*

Weak recommendation, low quality of evidence.

8.4.1.10 The GCS should be measured after the initial assessment, after a clear airway is established, and after necessary ventilatory or circulatory resuscitation has been performed. The GCS should be measured preferably prior to administering sedative or paralytic agents, or after these drugs have been metabolised. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.11 The GCS can be measured with moderate reliability by pre-hospital providers that are appropriately trained in how to administer the GCS. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

Assessment of Glasgow Coma Scale Score: Paediatrics

8.4.1.12 No data exist regarding the relationship between pre-hospital assessment of the GCS and outcome in paediatric patients. Hospital data from the emergency centre indicate that the GCS and the paediatric GCS are reliable indicators of the severity of TBI in children.

(Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

GCS			PGCS		
Eye Opening			Eye Opening		
- Spontaneous	4		- Spontaneous	4	
- Speech	3		- Speech	3	
- Pain	2		- Pain	2	
- None	1		- None	1	
Verbal response			Verbal response		
- Oriented	5		- Coos, Babbles	5	
- Confused	4		- Irritable cries	4	
- Inappropriate	3		- Cries to pain	3	
- Incomprehensible	2		- Moans to pain	2	
- None	1		- None	1	
Motor response			Motor response		
- Obey command	6		- Normal spontaneous movement	6	
- Localize pain	5		- Withdraws to touch	5	
- Flexor withdrawal	4		- Withdraws to pain	4	
- Flex abnormal	3		- Abnormal flexion	3	
- Extend	2		- Abnormal extension	2	
- None	1		- None	1	

Table: Comparison of Glasgow Coma Scale (GCS) and Paediatric GCS (Badjatia, N. et al., 2007)

8.4.1.13 Follow the adult protocol for standard GCS measurement in children over 2 years of age.

In pre-verbal children EMS personnel are encouraged to use a specific paediatric GCS scale, assigning a full verbal score of 5 to infants cooing or babbling. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

Pupil Examination (Adults & Paediatrics)

8.4.1.14 No data specific to pupillary assessment in the pre-hospital setting support its diagnostic and prognostic value for patients with TBI. In-hospital data show that the pupillary exam is important for diagnosis, treatment, and prognosis. Therefore, in the absence of pre-hospital data, it is recommended that pupils be assessed in the field. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.15 Protocol for Measuring Pupils: Evidence of orbital trauma should be noted. Pupils should be measured after the patient has been resuscitated and stabilized. Note left and right pupillary findings. Unilateral or bilateral dilated pupil(s). Fixed and dilated pupil(s). Definitions: Asymmetry is defined as > 1 mm difference in diameter; A fixed pupil is defined as < 1 mm response to bright light. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

Management of Adult Patients with Traumatic Brain Injuries

8.4.1.16 Avoid hypoxemia (arterial haemoglobin oxygen saturation [SaO₂] < 90%) and correct immediately when identified. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.17 An airway should be established in patients who have severe TBI (Glasgow Coma Scale [GCS] <9), the inability to maintain an adequate airway, or hypoxemia not corrected by supplemental oxygen by the most appropriate means available. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.18 In patients with TBI in urban environments, the routine practice of endotracheal intubation and the use of paralytics to assist endotracheal intubation in patients who are spontaneously breathing, maintaining their own airway and an SaO₂ above 90% on supplemental oxygen, is not recommended. ^{adapted}

8.4.1.19 When endotracheal intubation is used to establish an airway, confirmation of placement of the tube in the trachea should include lung auscultation and end-tidal CO₂ (ETCO₂) determination. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.1.20 EMS systems implementing endotracheal intubation protocols including the use of rapid sequence intubation (RSI) protocols must monitor blood pressure, oxygenation, and ETCO₂ in all patients undergoing pre-hospital ETI. ^{adapted}

8.4.1.21 Patients should be maintained with normal breathing rates (ETCO₂ 35-40 mmHg) and hyperventilation (ETCO₂ <35 mmHg) should be avoided unless the patient shows signs of cerebral herniation and corrected immediately when identified. (Badjatia et al., 2007) *

Weak recommendation, low quality of evidence.

There is evidence that hyperventilation with hypocapnia is associated to poor outcomes in patients with TBI. Maintaining eucapnia should be the goal for pre-hospital providers during transport.

8.4.1.22 Use drug-assisted RSI as the definitive method of securing the airway in patients with major trauma who cannot maintain their airway and/or ventilation. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

8.4.1.23 If RSI fails, use basic airway manoeuvres and adjuncts and/or a supraglottic device until a surgical airway or assisted tracheal placement is performed. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

In the setting where RSI is not immediately available it may be reasonable for providers to employ this recommendation.

8.4.1.24 Aim to perform RSI as soon as possible and within 45 minutes of the initial call to the emergency services, preferably at the scene of the incident. (National Institute for Health and Care Excellence, 2016) *

Grading embedded in recommendation.

8.4.1.25 If RSI cannot be performed at the scene: ^{adapted}

- consider using a supraglottic device if the patient's airway reflexes are absent
- use basic airway manoeuvres and adjuncts if the patient's airway reflexes are present or supraglottic device placement is not possible

- **transport the patient to an emergency centre for RSI provided the journey time is 60 minutes or less**
- **Only divert to a trauma unit for RSI before onward transfer if a patent airway cannot be maintained or the journey time to a major trauma centre is more than 60 minutes.**

Providers in such circumstances should provide the most appropriate care possible and be vigilant for signs of hypoventilation, hypoxia, regurgitation and loss of airway control. Short on scene times should be encouraged and providers should be ready to provide immediate airway support such as mask ventilation, suctioning and patient positioning to ensure oxygenation.

In the South African rural setting the timeline suggested by this recommendation may not always be possible.

8.4.2 Management of Paediatrics Patients with Traumatic Brain Injuries

8.4.2.1 **There is no evidence to support out of hospital endotracheal intubation over bag valve mask ventilation in paediatric patients with TBI.** (Badjatia et al., 2007) *

Moderate quality RCT or good quality cohort/case-control.

This recommendation is based in a setting where transport times are short and facilities are adequately equipped to manage paediatric emergencies. Endotracheal intubation could be considered in some context, SA specific research on this issue in paediatric patients with TBI is required. In the case of facilitated intubation, the current practice of RSI may be reasonable in some circumstances.

8.4.3 Hyperventilation in TBI with Suspected Herniation

Clinical signs of cerebral herniation include dilated and unreactive pupils, asymmetric pupils, a motor exam that identifies either extensor posturing or no response or progressive neurologic deterioration (decrease in the GCS score of more than 2 points from the patients prior best score in patient with an initial GCS < 9) (Badjatia et al., 2007).

“In patients who are normoventilated, well oxygenated, and normotensive - and still have signs of cerebral herniation - hyperventilation may be used as a temporizing measure and discontinued when clinical signs of herniation resolve” (Badjatia et al., 2007).

Hyperventilation is administered as:

- 20 breaths per minute in an adult
- 25 breaths per minute in a child
- 30 breaths per minute in an infant less than 1 year old.
- The goal is to maintain the end tidal carbon dioxide (ETCO₂) at 30-35 mmHg using capnography (Badjatia et al., 2007).

8.4.3.1 Neurologic status requires frequent re-evaluation and, in the subsequent absence of clinical signs of herniation, hyperventilation should not be continued. (Badjatia et al., 2007)*

Weak recommendation, low quality of evidence.

This recommendation applies only to patients who have advanced airways and where ETCO₂ monitoring is in place.

8.4.4 Patient Pathway for Patient with Suspected TBI

The implementation of these recommendations is locally dependant on the availability of resources. Local patient pathways should be developed to ensure the most appropriate patient pathways possible to enable the recommended care. Aeromedical evacuation may play a particularly important role in the rural setting and should be considered.

Adults Patient

8.4.4.1 It is recommended that patients with severe TBI be transported directly to a facility with immediately available CT scanning, prompt neurosurgical care, and the ability to monitor intracranial pressure (ICP) and treat intracranial hypertension. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

8.4.4.2 The mode of transport should be selected so as to minimise total pre-hospital time for the patient with TBI. (Badjatia et al., 2007)

Weak recommendation, low quality of evidence.

Paediatric Patients

8.4.4.3 In a metropolitan area, paediatric patients with severe TBI should be transported directly to an emergency centre. *adapted*

8.4.4.4 Paediatric patients with severe TBI should be treated in an emergency centre with added qualifications to treat children in preference to a general emergency centre. *adapted*

8.5 Airway, Ventilation & Oxygenation in Trauma

Airway management in trauma presents many complex challenges for pre-hospital providers. Potential complications include hypotension, facial injuries, TBI, lung injury, airway obstruction and potential cervical spine injuries are but some of the complications facing pre-hospital providers during the management of trauma patients. Airway management and normal oxygenation are two of the most important factors during the pre-hospital phase for patients with TBI (Badjatia et al., 2007). Endotracheal intubation remains the airway intervention of choice to secure the airway for trauma patients in the pre-hospital setting. Much of the controversy around this practice focuses on the maintenance of provider skills, choice of

medications (particularly the use of paralytic agents), identification of oesophageal intubation and management of difficult airways or failed airways (Badjatia et al., 2007). These management issues are dependant upon properly identifying the patients who need intubation as compared to those where pre-hospital intubation is not required or likely to result in further complications (Badjatia et al., 2007). The additional time spent outside the hospital to provide advanced airway management, especially in well developed trauma systems, has also been questioned. Hypoxia is a strong predictor of mortality in TBI particularly and management of the airway and ventilation remains one of the primary goals for pre-hospital providers in trauma patients (Badjatia et al., 2007).

8.5.1 Assessment for the Need for Airway Management in the Pre-Hospital Trauma Setting

As indicated in other parts of this CPG, RSI is the method of choice for facilitated intubation in trauma. The recommendation for situations where RSI cannot be performed are less clear but included below.

8.5.1.1 Endotracheal intubation and ventilation, and hence securing of the airway, with the aim of the best possible oxygenation and ventilation of the patient, is a central therapeutic measure. Thus, in multiply injured patients with apnoea or gasping (<6 breaths per minute) in the pre-hospital phase, emergency anaesthesia, endotracheal intubation, and ventilation should be carried out. (Sumann et al., 2009)*

Strongly recommended.

Implementation will depend on the availability of resources and personnel. During the development of this CPG, we found no clear recommendations about treatment alternatives in the pre-hospital setting to endotracheal intubation for trauma patients.

8.5.1.2 Other pre-hospital indications for intubation: hypoxia (SPO₂ <90%) despite administration of oxygen and after tension pneumothorax has been excluded, severe head injury (Glasgow Coma Scale [GCS] 8 or less, trauma-associated hemodynamic instability (SBP <90 mm Hg), and severe chest injury with respiratory insufficiency (>29 breaths per minute). (Sumann et al., 2009)

Recommended.

8.6 Chest Trauma

“Major trauma incidents, particularly motor vehicle accidents, frequently involve serious injuries to the thorax. Such injuries include pneumothorax, haemothorax, pulmonary contusion, cardiac tamponade, flail chest and aortic laceration. The direct effects of these injuries on pulmonary and cardiovascular function can be life threatening, accounting for 25% of all deaths from trauma” (National Institute for Health and Care Excellence, 2016).

The cost of implementing ultrasound should be considered as this may not be possible in all settings.

If chest injuries are suspected, careful ventilation and continued monitoring is required to detect the development of tension pneumothorax.

8.6.1 Assessment & Identification

8.6.1.1 A clinical examination (at least including respiratory rate and auscultation of the lungs, chest, and respiratory function) should be carried out. (Sumann et al., 2009)

Strongly recommended.

8.6.1.2 A suspected diagnosis of pneumothorax and/or haemothorax should be made if breathing sounds are weaker or absent on one side (so long as the endotracheal tube is correctly placed in intubated patients). Absence of such auscultation findings largely rules out pneumothorax of any major degree, especially if the patient is normopnoeic and has no chest pain. (Sumann et al., 2009) *

Strongly recommended.

8.6.1.3 A suspected diagnosis of tension pneumothorax should be made if auscultation reveals no breathing sounds on one side (so long as the tube is correctly placed) and, in addition, typical symptoms are present, especially severe respiratory impairment or an upper inflow congestion in combination with arterial hypotension. (Sumann et al., 2009)

Strongly recommended.

8.6.1.4 Consider using eFAST (extended focused assessment with sonography for trauma) to augment clinical assessment only if a specialist team equipped with ultrasound is immediately available and onward transfer will not be delayed. (National Institute for Health and Care Excellence, 2016)

(National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

In the pre-hospital setting, hand-held ultrasound (US) devices are becoming increasingly available. However, there is little understanding of the diagnostic accuracy of such devices for use in this setting and for the different types of chest trauma injuries. It is also important to consider whether these devices have a positive impact on patient outcomes or lead to longer times on scene and delaying potentially life-saving intervention (National Institute for Health and Care Excellence, 2016). In light of the uncertainty as to the contribution of FAST and eFAST to patient outcomes there should be considerations as to the economic feasibility for EMS systems to employ this technology. It may however be useful in patients where diagnostic uncertainty is present and can be performed if available.

8.6.1.5 **Be aware that a negative eFAST of the chest does not exclude a pneumothorax.** (National

Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

eFAST has a high specificity (98 - 100%) but a low sensitivity (19 - 47%) for detecting pneumothorax from pooled data. As such the technique is prone to false negative results, particularly with small pneumothoraxes and does not represent a good screening test. If a large pneumothorax is present, it appears to be a good diagnostic test with a low false positive rate (National Institute for Health and Care Excellence, 2016).

8.6.2 **Pre-Hospital Interventions for Chest injuries**

The implementation of open thoracostomy and intercostal drain insertion will require additional resources. Cost of equipment should be considered.

8.6.2.1 **A clinically suspected tension pneumothorax should be decompressed immediately.**

(Neugebauer et al., 2012)*

Strongly recommended.

8.6.2.2 **Pneumothorax diagnosed on the basis of auscultation findings in a patient on positive pressure ventilation should be decompressed.** (Neugebauer et al., 2012)

Strongly recommended.

8.6.2.3 **Pneumothorax diagnosed on the basis of auscultation findings in patients not on ventilation should usually be managed by close clinical observation.** (Neugebauer et al., 2012)

Strongly recommended.

8.6.2.4 **Only perform chest decompression in a patient with suspected tension pneumothorax if there is haemodynamic instability or severe respiratory compromise.** (National Institute for Health

and Care Excellence, 2016)

Grading embedded in recommendation.

8.6.2.5 **Use open thoracostomy instead of needle decompression if the expertise is available, followed by a chest drain via the thoracostomy in patients who are breathing spontaneously.** (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.6.2.6 **Observe patients after chest decompression for signs of recurrence of the tension pneumothorax.** (National Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.6.2.7 **In patients with an open pneumothorax: cover the open pneumothorax with a simple occlusive dressing and observe for the development of a tension pneumothorax.** (National

Institute for Health and Care Excellence, 2016)

Grading embedded in recommendation.

8.7 Abdominal and Pelvic Trauma

Trauma patients with abdominal and pelvic trauma often have occult bleeding which may be difficult to detect clinically in the pre-hospital setting. If hypotension is present or develops in a patient with suspected abdominal or pelvic trauma, the possibility of bleeding should be strongly considered. The use of ultrasound (eFAST) in for these patients does not yet appear to be uniformly recommended for the pre-hospital setting. Recommendations regarding the management of patients with shock and uncontrolled bleeding presented in this CPG may be appropriate and should be considered. Providers should use clinical judgement.

8.7.1 No deviation from current practice can be recommended at this time.

8.8 Extremity Trauma

8.8.1 Assessment and identification

8.8.1.1 No deviation from current practice can be recommended at this time.

8.8.2 Splinting

There is no clarity as to what constitutes effective immobilisation on the basis of our guideline search. Providers should use clinical judgement.

8.8.1.2 Effective immobilisation of fractures to minimise morbidity should be carried out and a written record of the treatment passed to the hospital. (Ellerton et al., 2009)*

Strength of recommendation unknown, level of evidence unknown.

8.8.3 Compound Fracture

8.8.3.1 No deviation from current practice can be recommended at this time.

8.8.4 Amputation

8.8.4.1 No recommendations additional to those made with reference to amputation regarding the control of bleeding can be made at this time.

8.8.5 Dislocations

8.8.5.1 No deviation from current practice can be recommended at this time.

8.9 Burns

Burns are a major cause of mortality and morbidity in South Africa, mainly from household and industrial sources. Devastating household fires are an all too frequent occurrence with makeshift housing settlements and casualties often including children. Although prevention of burns is paramount, early management of burn wounds in addition to standard resuscitation procedures is of great importance to reduce the burn damage.

8.9.1 Patient Pathway for Burns Patients

8.9.1.1 Health care practitioners should follow the South Africa Burns Society guidance when deciding the level of care that is appropriate for people with a new burn injury. adapted

8.9.2 Wound Care

- Early first aid treatment of burn wounds with running cold water has been shown to reduce the need for hospital procedures and duration of therapy and is key to the initial management.
- Plastic “cling wrap” is the preferred material for dressing burns.
- Jewellery should be removed to avoid constriction.

8.9.2.1 Stop the burning process: Stop, Drop, Cover and Roll; Smother any flames with a blanket; Move away from the burn source. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.9.2.2 Assess the adequacy of airway and breathing and check for other injuries. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.9.2.3 Cool burns or scalds by immediate immersion in running tap water (8–15°C) for at least 20 minutes. Irrigation of chemical burns should continue for one hour. (New Zealand Guidelines Group, 2007) *

Supported by expert opinion.

Care should be taken to avoid hypothermia in burns patients during cooling as these patients are already at risk for hypothermia as result of the burn injury.

8.9.2.4 Water is always the first choice for cooling a burn injury. If water is not available, hydrogel products are an alternative to water. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.9.2.5 Cover the burnt area with a loose and light non-stick dressing, preferably clean, dry, lint free (non-fluffy) material e.g. plastic cling film. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.9.3 Fluid Management in Burns Patients

The Parklands burn formula may be initiated in the pre-hospital setting but in hypotensive patients, fluid bolus requirements may exceed the volumes and rate suggest by the Parklands formula. Providers should use clinical judgement in such situations.

8.9.3.1 Proper fluid management is critical to the survival of patients with extensive burns. (Brychta and Magonette, 2011)

Evidence from retrospective studies with relatively clear results.

8.9.3.2 Fluid resuscitation needs are related to the extent of the burn and body size. (Brychta and Magonette, 2011)

Evidence from retrospective studies with relatively clear results.

8.9.3.3 The effects of the fluid resuscitation on the hemodynamic status of the patient should consistently be assessed. (Brychta and Magonette, 2011)

Evidence from retrospective studies with relatively clear results.

8.9.3.4 We recommend that crystalloids are used for resuscitation in burn patients with trauma rather than colloids. (Perner et al., 2015)

Strong recommendation, moderate quality of evidence.

8.9.3.5 There is uncertainty as to the pre-hospital fluid resuscitation regime in burns patients in general. Further systematic reviews are required. ^{adapted}

8.9.4 Assessment of Burns

An ABCDEF survey includes: airway, breathing, circulation, disability, exposure, and fluid resuscitation.

8.9.4.1 For major burns perform an ABCDEF primary survey as indicated. ^{adapted}

8.9.4.2 Establish and record the cause of the burn, the exact mechanism and timing of injury, other risk factors and what first aid has been given. (New Zealand Guidelines Group, 2007)

Supported by expert opinion.

8.9.4.3 Assess burn size and depth. (New Zealand Guidelines Group, 2007)

Supported by expert opinion.

8.9.4.4 Where time allows, use the Lund and Browder chart as the standard assessment tool for estimating the TBSA of the burn. (New Zealand Guidelines Group, 2007)

Supported by fair evidence.

8.9.5 Analgesia for Burn Injuries

The appropriateness of oral medication administration and the degree of analgesia needs to be assessed in relation to patient presentation and the extent and severity of the burn injury.

8.9.5.1 Immediately after the injury, cooling and covering the burn may provide analgesia. (New Zealand Guidelines Group, 2007)

Supported by expert opinion.

8.9.5.2 Address analgesic requirements. (New Zealand Guidelines Group, 2007)

Supported by expert opinion.

8.9.5.3 Paracetamol and NSAIDs can be used to manage background pain. (New Zealand Guidelines Group, 2007) *

Supported by expert opinion.

Avoid the use of nonsteroidal analgesics in burns where there may be renal impairment, such as extensive and third degree burns.

8.9.5.4 Consider administering opioids for intermittent and procedural pain. (New Zealand Guidelines Group, 2007)

Supported by expert opinion.

8.9.6 Inhalation Burns & Airway Management

There are no specific recommendation regarding changes to airway management approaches or procedures for burns patients. Providers should use clinical judgement. It should be considered that oxygen is a gas that supports combustion and should only be administered to patients in environments in which it is safe to do so.

8.9.6.1 An inhalation burn should be suspected when an individual is trapped in an enclosed space for some time with hot or toxic gas or fumes produced by a fire, a leak, chemicals etc. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.9.6.2 Always assume inhalation injury if there are burns to the face, nasal hairs, eyebrows or eyelashes, or if there is evidence of carbon deposits in the nose or mouth. Coughing of black particles in sputum, hoarse voice and/or breathing difficulties may indicate damage to the airway. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.9.6.3 If safe, give oxygen to all victims with smoke inhalation or facial injury. (Australian Resuscitation Council, 2008b)

Expert Consensus.

8.11 Trauma Management in Special Circumstances

8.11.1 Trauma Management Principles in Pregnancy

General Management

- 8.11.1.1 Every female of reproductive age with significant injuries should be considered pregnant until proven otherwise by a definitive pregnancy test or ultrasound scan.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

- 8.11.1.2 A nasogastric tube should be inserted in a semiconscious or unconscious injured pregnant woman to prevent aspiration of acidic gastric content.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

- 8.11.1.3 Oxygen supplementation should be given to maintain maternal oxygen saturation > 95% to ensure adequate foetal oxygenation.** (Jain et al., 2015)

Fair evidence to recommend the clinical preventive action; Evidence from well-designed controlled trials without randomisation.

- 8.11.1.4 Two large bore (14 to 16 gauge) IV lines should be placed in a seriously injured pregnant woman.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees)

This should be performed when possible and without delaying transport. Because of their adverse effect on uteroplacental perfusion, vasopressors in pregnant women should be used only for intractable hypotension that is unresponsive to fluid resuscitation.

- 8.11.1.5 After mid-pregnancy, the gravid uterus should be moved off the inferior vena cava to increase venous return and cardiac output in the acutely injured pregnant woman. This may be achieved by manual displacement of the uterus or left lateral tilt. Care should be taken to secure the spinal cord when using left lateral tilt.** (Jain et al., 2015)

Fair evidence to recommend the clinical preventive action; Evidence from well-designed controlled trials without randomisation)

- 8.11.1.6 The abdominal portion of military anti-shock trousers should not be inflated on a pregnant woman because this may reduce placental perfusion.** (Jain et al., 2015)

Fair evidence to recommend the clinical preventive action; Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments)

There is uncertainty regarding the effectiveness of the MAST suit and it should be used with caution.

- 8.11.1.7 Foetal well-being should be carefully documented in cases involving violence, especially for legal purposes.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Patient Pathway for Pregnant Trauma Patients

- 8.11.1.8 Transfer or transport to a maternity facility (triage or a labour and delivery unit) is advocated when injuries are neither life-nor limb-threatening and the foetus is viable (≥ 23 weeks), and to the emergency centre when the foetus is under 23 weeks' gestational age or considered to be non-viable. When the injury is major, the patient should be transferred or transported to the trauma unit or emergency gestational age.**

(Jain et al., 2015)

Fair evidence to recommend the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

- 8.11.1.9 When the severity of injury is undetermined or when the gestational age is uncertain, the patient should be evaluated in the trauma unit or emergency centre to rule out major injuries.** (Jain et al., 2015)

Evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

- 8.11.1.10 During prenatal visits, the caregiver should emphasise the importance of wearing seatbelts properly at all times.** (Jain et al., 2015)

Fair evidence to recommend the clinical preventive action; Evidence from well-designed cohort (prospective or retrospective) or case-control studies).

8.11.2 Paediatric Trauma Resuscitation Termination

In cases of paediatric cardiac arrest termination, seek clinical advice.

- 8.11.2.1 The withholding of resuscitative efforts should be considered in paediatric victims of penetrating or blunt trauma with injuries obviously incompatible with life, such as decapitation or hemicorporectomy.** (American College of Surgeons Committee on Trauma, 2014)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data).

- 8.11.2.2 The withholding of resuscitative efforts should be considered in paediatric victims of penetrating or blunt trauma with evidence of a significant time lapse following pulselessness, including dependent lividity, rigor mortis, and decomposition.** (American College of Surgeons Committee on Trauma, 2014)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data).

- 8.11.2.3 Initiation of standard resuscitation should be considered for a cardiopulmonary arrest patient in whom the mechanism of injury does not correlate with a traumatic cause of arrest unless recommendation 8.11.2.1 or 8.11.2.2 above applies.** (American College of Surgeons Committee on Trauma, 2014)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data).

- 8.11.2.4** **Initiation of standard resuscitation should be considered in cardiopulmonary arrest victims of lightning strike or drowning in whom there is significant hypothermia unless 8.11.2.1 or 8.11.2.2 above applies.** (American College of Surgeons Committee on Trauma, 2014)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data).

- 8.11.2.5** **Immediate transportation to an emergency centre should be considered for children who exhibit witnessed signs of life before traumatic cardiopulmonary resuscitation and have CPR ongoing or initiated within 5 minutes in the field, with resuscitation manoeuvres including airway management and IV or IO line placement planned during transport.** (American College of Surgeons Committee on Trauma, 2014)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data).

- 8.11.2.6** **Following blunt or penetrating trauma in victims in whom there is an unwitnessed traumatic cardiopulmonary arrest, a longer period of hypoxia may be presumed to have occurred, and an acceptable duration of CPR (including bystander CPR) of less than 30 minutes may be considered.** ^{adapted}

BLS and ILS providers must seek clinical advice before a decision to terminate.

- 8.11.2.7** **The inclusion of children in termination-of-resuscitation protocols should be considered, including children who are victims of blunt and penetrating trauma who have or in whom there is EMS-witnessed cardiopulmonary arrest and at least 30 minutes of unsuccessful resuscitative efforts, including CPR.** (American College of Surgeons Committee on Trauma, 2014)

Evidence from clinical studies in which data were collected prospectively or retrospective analyses that were based on clearly reliable data or evidence from retrospectively collected data).

9. Pain & Procedural Sedation

9.1 Pre-Hospital Analgesia in Trauma

“The management of acute traumatic pain is a crucial component of pre-hospital care and yet the assessment and administration of analgesia is highly variable, frequently suboptimal, and often determined by consensus-based protocols” (Gausche-Hill et al., 2014). Pain management is also frequently based on the assessment of need by a provider, rather than the requirements of patients. Historically only entonox and morphine have been available for pre-hospital pain management in the local setting with the more recent introduction of ketamine. Availability of appropriate and effective treatment options, especially for non-ALS providers, remains a challenge.

Redosing does not always apply to every patient. Redosing is required if there is an increase in pain score, pain is likely to occur due to unavoidable movement, half-life of medication is reached and effect starts to reduce. Redosing may also be required if aliquots were used with initial administration and full dose has not yet been administered.

9.1.1 Assess pain as part of general patient care and consider all patients with acute traumatic pain as candidates for analgesia, regardless of transport interval. (Gausche-Hill et al., 2014)

Strong recommendation, low quality of evidence.

9.1.2 Use an age-appropriate pain scale to assess pain (Gausche-Hill et al., 2014)*

9.1.2.1 <4 years: Consider using an observational scale, such as Faces, Arms, Legs, Cry, Consolability or Children’s Hospital of Eastern Ontario Pain Scale.

Weak recommendation, very low quality evidence.

9.1.2.2 4–12 years: Consider using a self-report scale, such as Wong Baker Faces, Faces Pain Scale, or Faces Pain Scale Revised.

Weak recommendation, very low quality of evidence

9.1.2.3 >12 years: Consider using a self-report scale, such as the Numeric Rating Scale.

Weak recommendation, moderate quality of evidence.

There should be nationally-standardised, age-group-appropriate pain scales taught within curricula designed for EMS courses. EMS quality assurance programs should also monitor use and compliance for the implementation of such standardized pain assessment tools.

9.1.3 Use narcotic analgesics for patients in moderate to severe pain. Consider: IV morphine (0.1 mg/kg) or IV or IN fentanyl (1.0 µg/kg). (Gausche-Hill et al., 2014) *

Strong recommendation, moderate quality of evidence.

Doses of 1.5 to 20 µg/kg of fentanyl may be considered: for procedural sedation use 2µg/kg; for procedural anaesthesia, pre-treatment and induction use in the range 2-20 µg/kg.

IN fentanyl may be particularly useful for pain management in children (given at 1.5µg/kg) who do not have IV lines in place. Fentanyl is also available in the other preparations including transdermal patches, transmucosal lozenges, sublingual spray and tablets. It is not clear from the recommendation if these preparations may have a role in the pre-hospital setting, especially for non-ALS providers in the South African setting. Providers should also consider the timing of dosing in relation to medication half-life and onset of action. Both fentanyl and morphine are medications generally recommended for use in patients with severe pain. We found no clear recommendations suggesting additional options to manage mild to moderate pain relief options in the context of trauma (other than those suggested for Burns, Section 8.9).

Cautions and relative contraindications to morphine and fentanyl include (Gausche-Hill et al., 2014): (Gausche-Hill et al., 2014)

- GCS < 15
- Hypotension
- Allergy to morphine and/or fentanyl
- Hypoxia (SpO₂ < 90%) after maximal supplemental oxygen therapy
- Signs of hypoventilation
- Condition preventing administration (blocked nose, no IV/IO)

9.1.4 Reassess all patients who have received analgesia using an age-appropriate scale every 5 minutes. Evidence of sedation or other serious adverse effects (hypotension, hypoxia, anaphylaxis) should preclude further drug administration. *adapted*

9.1.5 Redose if still in significant pain. (Gausche-Hill et al., 2014)
Strong recommendation, low quality of evidence.

9.1.6 Redose at half the initial dose. (Gausche-Hill et al., 2014)
Weak recommendation, very-low quality of evidence.

9.2 Procedural Sedation

Situations requiring procedural sedation and analgesia in the pre-hospital setting are common and may range from alignment of fracture to extrication and complex disentanglement during medical rescue. Until recently South African pre-hospital providers did not have agents suitable for this purpose, particularly in the setting of severe trauma and hypotension. As ketamine has been introduced into some scopes of practice providing safe and effective dissociative procedural analgesia has become a possibility. However, the use of procedural sedation and

analgesia is not without risks and, at this time, no uniform practice has been suggested in the South African pre-hospital setting.

- 9.2.1 Capnography may be used as an adjunct to pulse oximetry and clinical assessment to detect hypoventilation and apnoea earlier than pulse oximetry and/or clinical assessment alone in patients undergoing procedural sedation and analgesia. Capnography includes all forms of quantitative exhaled carbon dioxide analysis.** adapted

Continuous real-time capnography is required, which excludes colorimetric devices. Using End Tidal CO₂ as an early detection method for opiate-induced hypoventilation may be valuable, SpO₂ must be independently monitored as ETCO₂ monitoring is not a substitute for monitoring

- 9.2.2 During procedural sedation, a qualified provider should be present for continuous monitoring of the patient. An additional emergency care provider should coordinate procedures requiring procedural sedation and analgesia (e.g. extrication).** adapted

- 9.2.3 Ketamine can be safely administered to children for procedural sedation and analgesia.** adapted

- 9.2.4 Ketamine can be safely administered to adults for procedural sedation and analgesia.** adapted

- 9.2.5 Etomidate can be safely administered to adults and children for procedural sedation.** adapted

Etomidate is not considered the first line option, this remains ketamine. There is concern over adrenal suppression and thrombophlebitis especially in children. If used, additional analgesia is required, as etomidate has no analgesic properties.

- 9.2.6 The literature is strongly supportive of the safety and efficacy of dissociative sedation for a variety of brief painful or emotionally disturbing procedures in both children and adults e.g., fracture reduction, laceration repair, abscess drainage. Dissociative sedation is useful for procedures in the mentally disabled, who are often uncooperative.** adapted

The recommended medication to provide dissociative sedation is ketamine.

- 9.2.7 Ketamine Administration: General**

- 9.2.7.1 Ketamine is not administered until the provider is ready to begin the procedure because onset of dissociation typically occurs rapidly.** adapted

- 9.2.7.2 Ketamine is initially administered as a single IV loading dose or IM injection. There is no apparent benefit from attempts to titrate to effect.** adapted

Larger doses increase the anaesthetic time duration and may increase the risk of emergence delirium. IN ketamine delivery may be an additional method of medication delivery and should be considered.

9.2.7.3 In settings in which IV access can be obtained with minimal upset, the IV route is preferable because recovery is faster and there is less emesis. *adapted*

9.2.7.4 The IM route is especially useful when IV access cannot be consistently obtained with minimal upset, and for patients who are uncooperative or combative (e.g., the mentally disabled). *adapted*

IN ketamine may also be considered in such cases, including in children.

9.2.7.5 IV access is unnecessary for children receiving IM ketamine. Because unpleasant recovery reactions are more common in adults, IV access is desirable in these patients to permit rapid treatment of these reactions, should they occur. *adapted**

Local expert opinion recommends that IV access is however strongly recommended for patients receiving ketamine if possible, even in children.

9.2.8 Ketamine Administration: IV Route

9.2.8.1 Administer a loading dose of 1.5 to 2.0 mg/kg IV in children or 1.0 mg/kg IV in adults, with this dose administered during 30 to 60 seconds. More rapid administration produces high central nervous system levels and has been associated with respiratory depression or apnoea. *(Green et al. 2011)*

Strength of recommendation unknown, level of evidence unknown.

9.2.8.2 Additional incremental doses of ketamine may be administered (0.5 to 1.0 mg/kg) if initial sedation is inadequate or if repeated doses are necessary to accomplish a longer procedure. *(Green et al. 2011)*

Strength of recommendation unknown, level of evidence unknown.

9.2.9 Ketamine Administration: IM Route

9.2.9.1 Administer ketamine 4 to 5 mg/kg IM in children; the IV route is preferred for adults *(Green et al. 2011)**

Strength of recommendation unknown, level of evidence unknown.

Local expert opinion suggests that IV dosing is preferable in children as well, if it is possible to establish IV access. IM dosing at much higher dosages can result in anaesthesia and sedation lasting much longer than with IV dosing, translating to greater risks of adverse events. It is suggested to only use IM dosing if IV access cannot be established, or if it is impractical to do so (e.g. a hysterical child).

9.2.10 Co-administered Medications with Ketamine

9.2.10.1 Prophylactic anticholinergics are no longer recommended. (Green et al. 2011)

Strength of recommendation unknown, level of evidence unknown.

9.2.10.2 Prophylactic benzodiazepines are no longer recommended for children; however, they should be available to treat rare, unpleasant recovery reactions, should they occur. Prophylactic midazolam 0.03 mg/kg IV may be considered for adults. (Green et al. 2011)*

Strength of recommendation unknown, level of evidence unknown.

Local expert opinion strongly recommends the use of prophylactic benzodiazepines for both adults and children.

9.2.10.3 Prophylactic ondansetron can slightly reduce the rate of vomiting (number needed to benefit 9 or more). (Green et al. 2011) *

Strength of recommendation unknown, level of evidence unknown.

Ondansetron may be used prophylactically if available.

9.2.11 Procedure of Ketamine Administration

9.2.11.1 Adjunctive physical immobilisation may be occasionally needed to control random motion. (Green et al. 2011) *

Strength of recommendation unknown, level of evidence unknown.

9.2.11.2 Suction equipment, oxygen, a bag-valve-mask, and age-appropriate equipment for advanced airway management should be immediately available. (Green et al. 2011)

Strength of recommendation unknown, level of evidence unknown.

9.2.11.3 Supplemental oxygen is not mandatory but may be used when capnography is used to monitor ventilation. (Green et al. 2011)

Strength of recommendation unknown, level of evidence unknown.

All patients should be prepared as for general anaesthesia. Full monitoring, oxygen, and suction must be available, as well all modalities necessary for airway control and ventilation. Immobilisation should be for selected patients in whom random motion control may be required.

10. Airway

10.1 Basic Airway Principles

10.1.1 Oxygen Therapy

Oxygen is one of the most common medications administered during the care of patients who present with medical emergencies. At present, oxygen appears to be administered for three main indications in the emergency setting, of which only one is evidence-based (British Thoracic Society Emergency Oxygen Guideline Group, 2008). Firstly, oxygen is given to correct hypoxaemia as there is good evidence that severe hypoxaemia is harmful. Secondly, oxygen is administered to ill patients prophylactically to prevent hypoxaemia. Recent evidence suggests that this practice may place patients at increased risk of the development of hyperoxaemia, reactive oxygen species, and absorption atelectasis amongst other adverse effects. Thirdly, a very high proportion of medical oxygen is administered because most clinicians believe that oxygen can alleviate breathlessness; however, there is no evidence that oxygen relieves breathlessness in non-hypoxaemic patients (British Thoracic Society Emergency Oxygen Guideline Group, 2008).

For critically ill patients, high concentration oxygen should be administered immediately and this should be documented in the patient's health record. Oxygen saturation should be checked by pulse oximetry in all breathless and acutely ill patients (supplemented by blood gases when available and necessary) and the inspired oxygen concentration should be documented on the observation chart with the oximetry result. Oxygen should be prescribed to achieve a target saturation of 94–98% for most acutely ill patients, or 88–92% for those at risk of hypercapnic respiratory failure.

The current practice of prophylactic oxygen administration may be harmful in some patients and should be discouraged.

10.1.1.1 The oxygen saturation should be monitored continuously until the patient is stable or arrives at hospital for a full assessment. The oxygen concentration should be adjusted upwards or downwards to maintain the target saturation range. (British Thoracic Society Emergency Oxygen Guideline Group, 2008) *

Evidence from expert committee reports or opinions and/or clinical experience of respected authorities or extrapolated from SRs or meta-analysis of RCTs or extrapolated evidence from at least one RCT or one controlled study without randomisation or extrapolated evidence of quasi experimental studies or non-experimental descriptive studies.

Continuous pre-hospital monitoring of oxygen saturation should be considered for patients with abnormal vital signs or initial abnormal oxygen saturation.

10.1.1.2 During ambulance journeys oxygen-driven nebulisers should be used for patients with asthma and may be used for patients with COPD in the absence of an air-driven compressor system. If oxygen is used for patients with known COPD, its use should be limited to 6 L/min. This will deliver most of the nebulised drug dose but limit the risk of hypercapnic respiratory failure. (British Thoracic Society Emergency Oxygen Guideline Group, 2008)

Evidence from expert committee reports or opinions and/or clinical experience of respected authorities or extrapolated from SRs or meta-analysis of RCTs or extrapolated evidence from at least one RCT or one controlled study without randomisation or extrapolated evidence of quasi experimental studies or non-experimental descriptive studies.

10.1.1.3 If a patient is suspected to have hypercapnia or respiratory acidosis due to excessive oxygen therapy, the oxygen therapy should not be discontinued but should be stepped down to 28% or 24% oxygen from a Venturi mask depending on oxygen saturation and subsequent blood gas results. (British Thoracic Society Emergency Oxygen Guideline Group, 2008)

Evidence from non-experimental descriptive studies or extrapolated from SRs or meta-analysis of RCTs or extrapolated evidence from at least one RCT or extrapolated from at least one controlled study without randomisation or quasi experimental study.

10.1.1.4 It is recommended that the following delivery devices should be available in pre-hospital settings where oxygen is administered: (British Thoracic Society Emergency Oxygen Guideline Group, 2008) *

Evidence from expert committee reports or opinions and/or clinical experience of respected authorities or extrapolated from SRs or meta-analysis of RCTs or extrapolated evidence from at least one RCT or one controlled study without randomisation or extrapolated evidence of quasi experimental studies or non-experimental descriptive studies.

- **high concentration reservoir mask (non-rebreather mask) for high-dose oxygen therapy**
- **nasal cannulae (preferably) or a simple face mask for medium-dose oxygen therapy**
- **28% Venturi mask for patients with definite or likely COPD**
- **tracheostomy masks for patients with tracheostomy or previous laryngectomy.**

Tracheostomy masks are an additional option for oxygen delivery, as they may not be uniformly available in the South African setting.

10.1.1.5 For many patients Venturi masks can be substituted with nasal cannulae at low flow rates (1–2 l/min) to achieve the same target range once patients have stabilised. (British Thoracic Society Emergency Oxygen Guideline Group, 2008)

Evidence from expert committee reports or opinions and/or clinical experience of respected authorities or extrapolated from SRs or meta-analysis of RCTs or extrapolated evidence from at least one RCT or one controlled study without randomisation or extrapolated evidence of quasi experimental studies or non-experimental descriptive studies.

10.1.1.6 The flow rate from simple face masks should be adjusted between 5 and 10 l/min to achieve the desired target saturation. Flow rates below 5 l/min may cause carbon dioxide rebreathing and increased resistance to inspiration. (British Thoracic Society Emergency Oxygen Guideline Group, 2008) *

Evidence from non-experimental descriptive studies or extrapolated from SRs or meta-analysis of RCTs or extrapolated evidence from at least one RCT or extrapolated from at least one controlled study without randomisation or quasi experimental study.

Flow rates are normally specified by the manufacturer and differ between various manufacturers.

10.1.2 Adult BLS Airway

Basic Airway Manoeuvres & Mask Ventilation

The use of basic airway adjuncts such as oropharyngeal airways should be accompanied by basic airway manoeuvres (jaw thrust or head tilt/chin lift) to ensure a patent airway.

In the South African setting, there may be situations in which prolonged mask ventilation and basic airway management may be required secondary to the lack of availability of advance providers and prolonged transport times. There were no specific recommendations found regarding the techniques to provide prolonged mask ventilation or basic airway management and reduce to the risk of gastric inflation and aspiration. In such settings, providers administering mask ventilation should be vigilant to the risk of regurgitation and have suction on hand to clear the airway.

10.1.2.1 **A healthcare provider should use the head tilt– chin lift manoeuvre to open the airway of a victim with no evidence of head or neck trauma.** (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.1.2.2 **For victims with suspected spinal injury, rescuers should initially use manual spinal motion restriction (e.g., placing 1 hand on either side of the patient's head to hold it still) rather than immobilisation devices.** (Berg et al., 2010a) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

10.1.2.3 **If healthcare providers suspect a cervical spine injury, they should open the airway using a jaw thrust without head extension.** (Berg et al., 2010a)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

10.1.2.4 **Mouth-to-nose ventilation is recommended if ventilation through the victim's mouth is impossible (e.g., the mouth is seriously injured), the mouth cannot be opened, the victim is in water, or a mouth-to-mouth seal is difficult to achieve.** (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

See also Section 8.4, Immobilisation in Trauma

In the South African context, it is strongly advised to always use a barrier device when providing mouth to mouth or mouth to nose ventilation.

10.1.2.5 Deliver each rescue breath over 1 second. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

Delivering breaths over less than 1 second may increase peak airway pressures and predispose the patient to gastric inflation and aspiration.

10.1.2.6 Give a sufficient tidal volume to produce visible chest rise. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

10.1.2.7 Excessive ventilation is unnecessary and can cause gastric inflation and its resultant complications, such as regurgitation and aspiration. (Berg et al., 2010a)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

10.1.2.8 If an adult victim with spontaneous circulation (i.e. strong and easily palpable pulses) requires support of ventilation, the healthcare provider should give rescue breaths at a rate of about 1 breath every 5 to 6 seconds, or about 10 to 12 breaths per minute. (Berg et al., 2010a) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

10.1.2.9 The routine use of cricoid pressure in adult cardiac arrest is not recommended. (Berg et al., 2010a)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

10.1.2.10 To facilitate delivery of ventilations with a bag-mask device, oropharyngeal airways can be used in unconscious (unresponsive) patients with no cough or gag reflex and should be inserted only by persons trained in their use. (Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

Nasopharyngeal airways may be used in both conscious patients (with a gag reflex) and unconscious patients.

10.1.3 Foreign Body Airway Obstruction

These isolated recommendations need to be viewed in a sequential, integrated protocol for full understanding of the management.

10.1.3.1 Chest thrusts, back slaps, and abdominal thrusts are feasible and effective for relieving severe foreign body airway obstruction in conscious (responsive) adults. ^{adapted}**10.1.3.2 If abdominal thrusts are not effective, the rescuer may consider chest thrusts.** (Berg et al., 2010a)

Recommendation may be considered; Evidence from single RCTs or pseudo-RCTs.

10.1.3.3 An infant may be placed in a head downwards position prior to delivering back blows, i.e. across the rescuer's lap. (Australian Resuscitation Council, 2014b)

Low-moderate risk of bias; Evidence from case-series, either post-test or pre-test/ post-test.

10.1.3.4 Chest Thrusts: Children and adults may be treated in the sitting or standing position.

(Australian Resuscitation Council, 2014b)

Low-moderate risk of bias; Evidence from case-series, either post-test or pre-test/ post-test.

10.1.3.5 Unconscious Victim: The finger sweep can be used in the unconscious victim with an obstructed airway if solid material is visible in the airway. (Australian Resuscitation Council, 2014b)

Low risk of bias; Evidence from case-series, either post-test or pre-test/ post-test.

10.1.4 Paediatric BLS Airway

Basic Airway Manoeuvres

10.1.4.1 Open the airway using a head tilt–chin lift manoeuvre for both injured and non-injured victims. (Berg et al., 2010a)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

10.1.4.2 If there is evidence of trauma that suggests spinal injury, use a jaw thrust without head tilt to open the airway. (Berg et al., 2010a)

Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

10.1.4.3 In an infant, if you have difficulty making an effective seal over the mouth and nose, try either mouth-to-mouth or mouth-to-nose ventilation. (Berg et al., 2010a)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

Mask Ventilation

Make sure the breaths are effective (i.e. the chest rises). Each breath should take about 1 second. If the chest does not rise, reposition the head, make a better seal, and try again. It may be necessary to move the child's head through a range of positions to provide optimal airway patency and effective rescue breathing (Berg et al., 2010b).

10.1.4.4 In the pre-hospital setting it is reasonable to ventilate and oxygenate infants and children with a bag-mask device, especially if transport time is short. (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

This recommendation is made in the context of comparison to advanced airway placement in paediatric patients. The definition of what constitutes a short transport time in the context of this recommendation is uncertain. In the South African context, especially in the rural setting where transport times are long this recommendation should be considered with caution. Clinical judgement should be applied by advanced providers in such settings regarding the choice of airway management strategy.

10.1.4.5 During mask ventilation use only the force and tidal volume needed to just make the chest rise visibly. (Keinman et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

10.1.4.6 **During mask ventilation avoid delivering excessive ventilation during cardiac arrest.**

(Keinman et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

In the South African context, it is strongly advised to always use a barrier.

Cricoid Pressure in Paediatric Patients

Consider passing a nasogastric or orogastric tube to relieve gastric inflation, especially if oxygenation and ventilation are compromised. Pass the tube after intubation because a gastric tube interferes with gastroesophageal sphincter function, allowing regurgitation during intubation (Keinman et al., 2010).

10.1.4.7 **The risk of gastric inflation can be decreased by applying cricoid pressure in an unresponsive victim to reduce air entry into the stomach.** *adapted*

10.1.4.8 **Avoid excessive cricoid pressure so as not to obstruct the trachea.** (Keinman et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

10.1.4.9 **There is insufficient evidence to recommend routine cricoid pressure application to prevent aspiration during endotracheal intubation in children. Do not continue cricoid pressure if it interferes with ventilation or the speed or ease of intubation.** (Keinman et al., 2010)

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

Paediatric Ventilation with Oxygen

10.1.4.10 **It is reasonable to ventilate with 100% oxygen during CPR because there is insufficient information on the optimal inspired oxygen concentration.** (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

10.1.4.11 **In general, it is appropriate to wean the FIO₂ when peripheral oxygen saturation is 100%, provided it can be maintained above 94%.** *adapted*

10.2 Advanced Airway Management

10.2.1 Facilitated Endotracheal Intubation

"Hypoxia and airway compromise are recognised to be significant contributing factors in up to 34% of deaths pre-hospitally." (Japanese Society of Anesthesiologists, 2014). The compromised airway after trauma places the patient at risk of hypoxia and hypercarbia. Aspiration of gastric contents and the subsequent lung injury are independent factors increasing morbidity and mortality in this group of patients (Japanese Society of Anesthesiologists, 2014). "It has been reported that 9-28% of trauma patients require intubation. There are numerous complications which arise as a result of emergency intubations but failure or delay in securing an adequate

airway causes unacceptably high morbidity and mortality rates" (Japanese Society of Anesthesiologists, 2014). Facilitated intubation includes all intubation procedures which require the administration of medication in order to achieve a successful and safe laryngoscopy and placement of an endotracheal tube. The use of facilitation aims to improve both laryngoscopy and intubation conditions in order to provide the laryngoscopist with the best possible conditions for first pass success while avoiding the undesired adverse cardiovascular and reflex responses which occur as a result of stimulation to the airway.

Indications for Facilitated Airway in Trauma

10.2.1.1 Emergency Tracheal Intubation (ETI) is indicated in trauma patients with the following traits: (Eastern Association for the Surgery of Trauma, 2012) *

Evidence from RCTs or clinical trials or retrospective analysis on reliable data

- **Airway obstruction**
- **Hypoventilation**
- **Persistent hypoxemia (arterial oxygen saturation [SaO₂] ≤90%) despite supplemental oxygen**
- **Severe cognitive impairment (Glasgow Coma Scale [GCS] score ≤8)**
- **Severe haemorrhagic shock**
- **Cardiac arrest**

When considering the indications for ETI the following signs may also be considered: ((Japanese Society of Anesthesiologists, 2014)

- Look to see if the patient is agitated, obtunded or cyanosed.
- Look for accessory muscle use and retractions.
- Assess for deformity from maxillofacial, neck or tracheal trauma and airway debris such as blood, vomitus and loose teeth.
- Listen for abnormal breathing sounds, e.g. snoring, gurgling, stridor and hoarseness.
- Palpate the trachea to ascertain whether it is deviated from the midline.
- Consider the likelihood of encountering a difficult airway at intubation, e.g. small chin, protruding dentition, large body habitus, facial hair, pregnancy.

In cardiac arrest ventilation with BVM, alternative advanced airway devices are the preferred option; however, if ETI can be performed without interrupting CPR, it is acceptable.

10.2.1.2 ETI is indicated for patients experiencing smoke inhalation with any of the following traits:

adapted

- **Airway obstruction;**
- **Severe cognitive impairment (GCS score ≤ 8);**
- **Major cutaneous burn ($\geq 40\%$);**
- **Major burns and/or smoke inhalation with an anticipated prolonged transport time to definitive care;**
- **Impending airway obstruction as follows:**
 - **Moderate-to-severe facial burn;**
 - **Moderate-to-severe oropharyngeal burn;**
 - **Moderate-to-severe airway injury.**

The definition of prolonged transport time in the context of this recommendation is not clear. Providers should use clinical judgement.

10.2.1.3 ETI may also be indicated in trauma patients with any of the following traits: (Eastern Association for the Surgery of Trauma, 2012) *

Retrospective case series or database review.

- **Facial or neck injury with the potential for airway obstruction**
- **Moderate cognitive impairment (GCS score $>9-12$)**
- **Persistent combativeness refractory to pharmacologic agents**
- **Respiratory distress (without hypoxia or hypoventilation)**
- **Preoperative management (i.e. patients with painful injuries or undergoing painful procedures before non-emergent operation)**
- **Early ETI is indicated in cervical spinal cord injury (SCI) with any evidence of respiratory insufficiency (complete cervical SCI or incomplete injuries C5 and above)**

Airway assessment to predict possible difficult laryngoscopy and intubation should be considered when evaluating trauma patients for ETI.

Procedural Options for Facilitated Intubation in Trauma

10.2.1.4 Orotracheal intubation guided by direct laryngoscopy is the ETI procedure of choice for trauma patients. (Eastern Association for the Surgery of Trauma, 2012)

Evidence from RCTs or clinical trials or retrospective analysis on reliable data.

See also Section 8.6, Airway, Ventilation & Oxygenation in Trauma

10.2.1.5 RSI should be used to facilitate orotracheal intubation unless markers of significant difficulty with intubation are present. An RSI drug regimen should be given to achieve the following clinical objectives: (Eastern Association for the Surgery of Trauma, 2012) *

Evidence from RCTs or clinical trials or retrospective analysis on reliable data.

- **Adequate sedation and neuromuscular blockade**
- **Maintenance of hemodynamic stability and central nervous system (CNS) perfusion**
- **Maintenance of adequate oxygenation**
- **Prevention of increases in intracranial hypertension**

- **Prevention of vomiting and aspiration**

Clinicians should weigh the risks and benefits for RSI in relation to each case in context of the patient's clinical status, injury profile and transport time to definitive care.

10.2.1.6 There is currently uncertainty as to the preferred induction agents and regimes for pre-hospital RSI in trauma. Succinylcholine and Rocuronium have been recommended for neuromuscular blockade, in the absence of any contraindications to their use. Ketamine, Etomidate and Fentanyl have been recommended as induction agents for trauma patients. adapted

Clinical judgement should be employed when induction agents are selected. The provider should consider risks and benefits associated with each agent in the context of the patient's clinical status and injuries.

10.2.1.7 Enhancements for safe and effective ETI in trauma patients include the following: (Eastern Association for the Surgery of Trauma, 2012) *

Evidence from RCTs or clinical trials or retrospective analysis on reliable data.

- **Availability of experienced personnel**
- **Pulse-oximetry monitoring**
- **Maintenance of cervical neutrality**
- **Confirmation of tube placement using auscultation of bilateral breath sounds and end-tidal carbon dioxide (CO₂) detection.**
- **Continuous end-tidal CO₂ monitoring for patients with severe traumatic brain injury**

In addition to the abovementioned requirements it is recommended that the following monitoring be in place before and throughout RSI (Japanese Society of Anesthesiologists, 2014):

- Heart rate
- Non-invasive blood pressure
- Cardiac monitor (ECG)
- Pulse oximetry
- Capnography

There is uncertainty as to the level of experience providers should have before attempting pre-hospital RSI. Providers should consider the risks of performing RSI without sufficient experience and personnel on scene to assist. It may be preferable when two providers able to perform RSI and intubation are available to manage patients undergoing RSI.

10.2.1.8 When ETI cannot be achieved rapidly with direct laryngoscopy, a number of airway rescue devices may be used as follows: (Eastern Association for the Surgery of Trauma, 2012) *

10.2.1.8.1 Blind-insertion supraglottic devices (i.e. laryngeal mask airway [LMA], Combitube, and King Airway) (Eastern Association for the Surgery of Trauma, 2012)

Evidence from clinical trials or retrospective analysis on reliable data or retrospective case series or database review.

10.2.1.8.2 Gum-elastic bougie (Eastern Association for the Surgery of Trauma, 2012)

Evidence from RCTs or clinical trials or retrospective analysis on reliable data

10.2.1.8.3 Video laryngoscopy (Eastern Association for the Surgery of Trauma, 2012)

Evidence from RCTs or clinical trials or retrospective analysis on reliable data

10.2.1.8.4 Surgical cricothyroidostomy (Eastern Association for the Surgery of Trauma, 2012)

Evidence from RCTs or clinical trials or retrospective analysis on reliable data

In trauma, supraglottic devices are generally only considered appropriate in patients who have no airway reflexes. The CPG panel found no direct recommendations suggesting that these devices should be used as first line agents in combination with sedation other than in situations where they are used as rescue devices in patients with failed DL as an alternative to ETI. Decisions regarding the most appropriate rescue technique should be guided by the clinical scenario at hand, resource availability, and the skill and experience of the treating clinician.

In situations where ETI is not immediately available and providers capable of inserting supraglottic devices are present, the use of these devices (laryngeal mask airway (LMA), combitube or laryngeal tube (LT)) may be considered; however, the risks of airway stimulation and cardiovascular reflex responses should be considered in the context of the patient.

10.2.1.9 Cricothyroidotomy is appropriate when emergent/urgent tracheal intubation is needed and cannot be achieved rapidly with DL or with the use of alternative airway techniques and devices. (Eastern Association for the Surgery of Trauma, 2012)

Evidence from RCTs or clinical trials or retrospective analysis on reliable data.

A surgical airway is indicated in scenarios where providers are unable to intubate or ventilate using alternative airway devices or a bag valve mask in a patient who requires emergent airway access. The use of a needle cricothyroidotomy (especially in children) may be considered, although older patients will be difficult to ventilate using jet ventilation. It should be noted that the use of a bag valve mask device to ventilate a patient through a 14G (used in needle cricothyroidotomy) will not be effective and a high pressure jet ventilation mechanism is necessary. Surgical cricothyroidotomy is a procedure that is undertaken quickly and decisively without unnecessary extra attempts at intubation when indicated (Japanese Society of Anesthesiologists, 2014). A size 6 ETT and a size 11 scalpel blade is recommended for the procedure (Japanese Society of Anesthesiologists, 2014). There is some uncertainty as to the age limit for surgical cricothyrotomy. Surgical cricothyroidotomy is not recommended for children under the age of 12. In these patients needle cricothyroidotomy using a 12-14G catheter is acceptable.

Surgical cricothyroidotomy is rarely performed in either pre-hospital or in hospital contexts. Skills maintenance for this procedure should be considered important as skills attrition is a concern. Although these recommendations apply mostly to advanced providers, other providers may consider needle cricothyroidotomy and jet insufflation in scenarios where they are unable to ventilate patients with upper airway obstruction or facial injuries.

10.2.1.10 Video laryngoscopy may offer significant advantages over DL, including the following: Superior views of the glottis (Cormack-Lehane I/II); patients with difficult anatomical airway, obese patients and cervical injury patients; and higher intubation success rates by inexperienced airway providers. ^{adapted}

There is uncertainty around whether video laryngoscopy should be used as a routine first line method when available, only for expected difficult airways, or as a rescue method for failed direct laryngoscopy ETI. There is no clear evidence which suggests that video laryngoscopy should replace direct laryngoscopy, however video laryngoscopy does offer advantages in expected difficult airways and in such cases can be used as a first line method.

Video laryngoscopy is costly and may not be available in all settings. There are numerous devices available, but there is uncertainty as to the best device for the pre-hospital setting.

10.2.2 Airway Management in Patients with Suspected or Potential Cervical Spine Injury

10.2.2.1 RSI is the stepwise process to be undertaken for the intubation of this group of patients.

Oral endotracheal intubation is the technique of choice. (Japanese Society of Anesthesiologists, 2014)

Consensus.

Manual in-line stabilisation entails "firmly holding the patient's head on RSI is recommended as it produces the best possible conditions for direct either side with the neck midline and the head firmly on a hard surface. No laryngoscopy and orotracheal intubation. Manual in-line stabilisation traction is applied. The aim is to prevent any flexion or rotation of the c-spine should be maintained throughout direct laryngoscopy attempts to prevent spine when direct laryngoscopy is performed. The provider maintaining movement of the cervical spine (Japanese Society of Anesthesiologists, 2014). There is uncertainty as to the amount of neck movement that can side to allow direct laryngoscopy to be performed. The c-collar should be be considered safe in these patients. (Japanese Society of Anesthesiologists, 2014). The best technique for limiting neck movement (Japanese Society of Anesthesiologists, 2014). While not unnecessarily compromising the quality of glottic view during direct laryngoscopy is also not clear (Japanese Society of Anesthesiologists, 2014). Intubation of a patient with a potential c-spine injury should be considered as a predicted difficult airway and recommendations for rescue strategy argued to provide the best compromise to allow for minimal neck preparation should be implemented pre-emptively to ensure patient movement with the best possible view of the vocal cords and appears to safety. Video laryngoscopy may have a role in these patients as it has been be safe and effective. (Japanese Society of Anesthesiologists, 2014). The use of LMA or other

supraglottic devices as first line agents in patients with potential c-spine injury remain uncertain. It has been suggested that these devices may cause more c-spine movement during insertion than established intubation techniques (Japanese Society of Anesthesiologists, 2014). It appears more appropriate to reserve the role of supraglottic airways to that of rescue devices in these patient at this time (Japanese Society of Anesthesiologists, 2014).

10.2.2.2 It is recommended that a tracheal tube introducer (i.e. flexible bougie or stylet) is immediately to hand whenever RSI is undertaken. The tracheal tube introducer should be considered for routine, first-line use in all cases to maximise rates of intubation on first attempt. (Japanese Society of Anesthesiologists, 2014)*

Evidence obtained from at least one properly-designed randomised control trial.

The use of a stylet or a gum elastic bougie should be considered standard practice during pre-hospital RSI and should be used as a first line strategy. This is argued to be particularly important in trauma patient where manual in-line stabilisation will limit the neck mobility and possibly limit the view of the glottis. The use of a gum elastic bougie (rail road) technique as a first line option in patient in whom the vocal cords are not immediately visible with potential c-spine injury has been suggested (Japanese Society of Anesthesiologists, 2014).

10.2.3 Induction of the Hypotensive Trauma Patient

There are no clear alternative treatment recommendations, other than standard BLS techniques using c-spine precautions, for the management trauma patients in whom intubation is not possible or for providers who cannot provide intubation.

10.2.3.1 **RSI is the optimal basic technique to intubate hypotensive trauma patients.** (Japanese Society of Anesthesiologists, 2014)

Consensus.

Hypotension is defined as <90 mmHg in adult patients and less than 100 mmHg in adult patients older than 55 years (Japanese Society of Anesthesiologists, 2014).

10.2.3.2 **Induction agent options may include ketamine and etomidate, but emphasis is given to the requirement for experience in its pharmacodynamic profile before use. It is recommended that propofol should be avoided in this group of patients.** (Japanese Society of Anesthesiologists, 2014) *

Consensus.

Ketamine use is generally supported as the preferred agent for RSI in the context of a hypotensive trauma patient. There is uncertainty around the relationship between etomidate and adrenal suppression in trauma patients.

10.2.3.3 **A fluid bolus should be administered at the time of induction to attenuate further haemodynamic compromise.** (Japanese Society of Anesthesiologists, 2014) *

Consensus.

There are risks associated with fluid bolus administration in patients with increased ICP secondary to TBI as well as those at risk of haemodilution. Fluid resuscitation targets should be considered when prophylactic fluid is administered as suggest in this recommendation.

10.3 Ventilation

10.3.1 Capnography

Although expensive, measurement of ETCO₂ provides an important patient safety element for intubated and ventilated patients.

10.3.1.1 Capnography should be used in all critically ill patients who require mechanical ventilation during inter-hospital or intra-hospital transfer. (Intensive Care Society, 2011)

Strong recommendation, moderate quality of evidence.

Waveform capnography is preferred for continuous monitoring in the inter-hospital transfer setting.

10.3.1.2 Continuous waveform capnography is recommended in addition to clinical assessment as the most reliable method of confirming and monitoring correct placement of endotracheal tube. (Walsh and Croftwell, 2011)

Strong recommendation, benefits outweigh risk; Evidence from well performed RCTs or overwhelming evidence of another design.

“Capnography will not be reliable if there is no circulation to deliver CO₂ to the lungs or absolute bronchospasm prevents any gas exchange. It is possible for the capnograph to provide a false positive result under various circumstances. So useful as it is (and it is likely the best tool available pre-hospital) it needs to be interpreted carefully in the context of each patient” (Intensive Care Society, 2011).

10.3.1.3 If waveform capnography is not available, a non-waveform exhaled CO₂ monitor in addition to clinical assessment is suggested as the initial method for confirming correct tube placement in a patient in cardiac arrest. (Walsh and Croftwell, 2011) *

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

Colorimetric capnography also has limitations and risks for false positive results.

10.3.1.4 ETCO₂ is suggested as a method to guide ventilator management. (Walsh and Croftwell, 2011)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

“ETCO₂ is determined by arterial CO₂, but also by many other factors, including physiological dead space, these other factors may alter independently of arterial CO₂. Continuous monitoring of ETCO₂, with the measurement of arterial CO₂ when the ETCO₂ changes significantly and at additional planned intervals, would seem most likely to offer tight control of arterial CO₂ until newer technologies become available” (Intensive Care Society, 2011).

“Intracranial pressure may be exquisitely sensitive to changes in arterial CO₂ and the Brain Trauma Foundation guidelines now recommend the avoidance of hypocarbia in patients with brain injury. Alteration in ETCO₂ should give an early warning of changing CO₂ levels before the routine estimation of arterial CO₂ and falling ETCO₂ should also trigger estimation of arterial CO₂ levels” (Intensive Care Society, 2011).

10.3.1.5 Capnography is suggested to identify abnormalities of exhaled air flow. (Walsh and Croftwell, 2011)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

“The capnograph waveform is frequently abnormal in patients with bronchospasm and other conditions causing heterogeneous V/Q ratios and time constants. The review of the capnograph waveform may help in diagnosis and establishing response to treatment in patients with bronchospasm and other conditions” (Intensive Care Society, 2011).

10.3.1.6 Volumetric capnography is suggested to assess CO₂ elimination and deadspace ventilation (VD/VT) to optimise mechanical ventilation. (Walsh and Croftwell, 2011)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.1.7 Quantitative waveform capnography is suggested in intubated patients to monitor CPR quality, optimise chest compressions, and detect return of spontaneous circulation during chest compressions or when rhythm check reveals an organised rhythm. (Walsh and Croftwell, 2011) *

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

“There are many reports demonstrating that CO₂ will be produced by effective cardiopulmonary resuscitation to give a capnograph trace. The adequacy of the capnograph trace has been used as a guide to the effectiveness of resuscitation and as a prognostic guide to the chances of survival after cardiac arrest” (Intensive Care Society, 2011).

Uncertainty exists around the use of capnography to monitor the quality of CPR in paediatric patients.

10.3.2 Humidification

- When selecting a HME it should be noted that different sizes are required for adults, paediatrics and neonates. It should be ensured the that selected HME unit is appropriate for the patient (usually determined by patient weight) (Restrepo and Walsh, 2012)
- HME (heat moisture exchangers) are not considered equivalent humidification, however is more likely to be available and practical during pre-hospital care and transport. (Restrepo and Walsh, 2012)
- When using HME units the following should be kept in mind: (Restrepo and Walsh, 2012)
 - HME's may become obstructed by secretions or blood.
 - HME's may interfere with the delivery of nebulized medications and it may be necessary to remove them during administration.
 - HME's increased dead space, this is of particular concern in paediatrics and neonates.
 - HME's may restrict flow and increase work of breathing in patient with high spontaneous minute volumes
 - HME's may affect capnography readings particularly when the HME unit's internal volume is significant in relation to the tidal volume. Lower than expected
 - Not all HME units are designed to filter microbes of viruses. When selecting filters for the prevention of ventilator associated pneumonia. It is therefore important to distinguish between HME and Heat Moisture Exchanger Filter
 - For tuberculosis, the Centers for Disease Control and Prevention recommends a filter that filters particles 0.3 μm in size with an efficiency of more than 95% in both the unloaded and loaded states at the maximum flow rate of the ventilator.

10.3.2.1 Humidification is recommended on every patient receiving invasive mechanical ventilation. (Restrepo and Walsh, 2012)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.2.2 When providing passive humidification to patients undergoing invasive mechanical ventilation, it is suggested that the HME provide a minimum of 30 mg H₂O/L. (Restrepo and Walsh, 2012)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.2.3 Passive humidification is not recommended for PPNIV. (Restrepo and Walsh, 2012)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3 Suction

The lung derecruitment as a result of disconnection of the ventilator circuit or endotracheal suctioning presents additional risk of ventilator induced lung injury, especially in patients with acute lung injury. The manoeuvres should be minimized, and as suggested recruitment procedures performed subsequent to possible lung derecruitment. Post suctioning recruitment procedures include: Increasing fraction inspired oxygen (FiO₂) post suctioning, administer 2 to 20 tidal volume breaths at twice the baseline value given that the airway pressures do not exceed 25 - 50 cmH₂O given the specific lung pathology. The need for recruitment procedures may be reduced by the use of closed endotracheal suctioning systems (American Association for Respiratory Care, 2010).

The recommendation mentioned in this section refers to suction of the ETT or advanced airway device and not suctioning of the oropharynx.

10.3.3.1 It is recommended that endotracheal suctioning should be performed only when secretions are present, and not routinely. (American Association for Respiratory Care, 2010)*

Strong recommendation, benefits outweigh risk; Evidence from Observational studies or evidence with RCTs with serious flaws.

Recruitment manoeuvres should be used after every suctioning event and after each time that the circuit is disconnected.

10.3.3.2 It is suggested that pre-oxygenation be considered if the patient has a clinically important reduction in oxygen saturation with suctioning. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.3 Performing suctioning without disconnecting the patient from the ventilator is suggested. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.4 There is uncertainty as to the safety of deep suctioning in adults and also uncertainty around the effectiveness of shallow suctioning. Practitioners should perform suctioning while observing patients for adverse effects and ensuring that suctioning effectively clears the airway ETT.^{adapted}

10.3.3.5 It is suggested that routine use of normal saline instillation prior to endotracheal suction should not be performed. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.6 The use of closed suction is suggested for adults with high FIO₂, or PEEP, or at risk for lung derecruitment, and for neonates. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.7 Endotracheal suctioning without disconnection (closed system) is suggested in neonates. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.8 Avoidance of disconnection and use of lung-recruitment manoeuvres are suggested if suctioning-induced lung derecruitment occurs in patients with acute lung injury. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.9 It is suggested that a suction catheter is used that occludes less than 50% of the lumen of the ETT in children and adults, and less than 70% in infants. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.3.3.10 It is suggested that the duration of the suctioning event be limited to less than 15 seconds. (American Association for Respiratory Care, 2010)

Weak recommendation, benefits and risk closely balanced; Evidence from RCTs that are less consistent or strong evidence of another design.

10.4 Difficult Airway

10.4.1 Evaluation of the Airway

The recommendations above apply particularly to predicting difficult laryngoscopy. During the assessment of the airway, it may be pertinent to also assess for possible difficulty regarding mask ventilation, placement supraglottic airways, and surgical airways. Different acronyms (such as LEMON) guiding these assessments exists, these include MOANS (for difficult mask ventilation), SHORT or SMART (difficult surgical airway) and RODS (difficult supraglottic placement).

The implementation of routine recording of the airway assessment parameters on the patient report form may add a valuable patient safety component to pre-hospital quality assurance processes around advanced airway management and should be encouraged.

10.4.1.1 An airway history should be conducted, whenever feasible, before the initiation of airway management in all patients. The intent of the airway history is to detect medical, surgical, and anaesthetic factors that may indicate the presence of a difficult airway. ^{adapted}

10.4.1.2 An airway physical examination should be conducted, whenever feasible, before the initiation airway management in all patients. The intent of the physical examination is to detect physical characteristics that may indicate the presence of a difficult airway. Multiple airway features should be assessed. Regarding the features to be assessed, it's mandatory to perform systematically at least: adapted

- **interincisor distance measurement**
- **mental-thyroidal distance measurement**
- **grade of maxillary prognatism and correction possibility**
- **neck flexion-extension degree - consider the need for manual in-line stabilisation**
- **consideration of possibly of obstruction of the airway or the presence of obesity.**

10.4.1.3 The documentation of all measured parameters on the patient report form is mandatory. adapted

10.4.2 Preparation for Anticipated Difficult Airway

In the context of preparation for an anticipated difficult airway prepare the following devices as a minimum requirement: (Petrini et al., 2005)

- conventional rigid laryngoscope with medium and long curved blades
- cuffed endotracheal tubes ranging 5.5 - 8 ID
- malleable short stylet
- tracheal introducer or bougie (preferably a hollow one)
- Magill forceps
- LMA or other supraglottic devices
- According to individual skill and experience
 - cannula for cricothyroid membrane puncture (cannula over the needle, at least 14G)
 - percutaneous cricothyrotomy set (preferably based on Seldinger technique) or surgical cricothyrotomy set.
 - suction unit with a Yankauer catheter should also be available immediately if required.

Preoxygenation is key to patient safety during advanced airway management procedures and should not be omitted even during crash airway situations. If possible preoxygenation techniques should avoid unnecessary positive pressure ventilation to reduce aspiration risk. If oxygenation saturation decreases below 90% oxygenation must be prioritized above further laryngoscopy or intubation attempts. The inclusion of additional providers on the scene to aid in the management of a patient with a predicted difficult airway is recommended to improve patient safety.

10.4.2.1 Where a difficult airway is anticipated seek assistance to aid with management where possible especially if RSI is the selected strategy. ^{adapted}

10.4.2.2 Administer facemask preoxygenation before initiating management of the difficult airway. The uncooperative or paediatric patient may impede opportunities for preoxygenation. (Petrini et al., 2005)*

Evidence from small RCTs with uncertain results.

Preoxygenation should be done via a nonrebreather mask at 15 L/min oxygen and can be supplemented with a nasal cannula at 15 L/min. The nasal cannula can also remain on during the apnoea period to facilitate apnoeic oxygenation.

10.4.2.3 Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management. (Petrini et al., 2005)

Evidence from small RCTs with uncertain results.

10.4.2.4 Opportunities for supplemental oxygen administration include (but are not limited to) oxygen delivery by nasal cannulae, facemask or laryngeal mask airway, insufflation; and oxygen delivery by facemask, blow-by, or nasal cannulae after extubation of the trachea. (Petrini et al., 2005)

Evidence from small RCTs with uncertain results.

This may also include apnoeic oxygenation techniques during laryngoscopy attempts. The role of apnoeic oxygenation techniques in the pre-hospital setting is still evolving.

10.4.2.5 Adequate preoxygenation and continuous oxygen saturation monitoring during manoeuvres are mandatory, also in the non-anaesthetised patient. (Petrini et al., 2005)

Evidence from small RCTs with uncertain results.

10.4.2.6 It is recommended that in case of severe predicted difficulty, consciousness and spontaneous breathing should be maintained. (Petrini et al., 2005)*

Evidence from small RCTs with uncertain results.

The use of sedative, anaesthetic, and/or paralytic medications in patients with severe predicted difficulty may result in 'cannot intubate, cannot ventilate' situations and ultimately the need for surgical airway or significant adverse events. Careful consideration should be given to any airway management procedures requiring sedation or paralysis (such as RSI) in these patients and the ability to maintain oxygenation must remain the utmost priority. Providers should use clinical judgement when weighing the risks and benefits for electing or not electing invasive airway management strategies in these patients.

10.4.2.7 It is recommended to apply Sellick manoeuvre (3 fingers cricoid compression with neck sustain) for every case of intubation in anaesthetised patients with high aspiration risk.

(Petrini et al., 2005) *

Evidence from small RCTs with uncertain results.

There appears to be uncertainty with regard to the effectiveness and safety of the use of cricoid pressure during RSI in the pre-hospital environment although this practice is still recommended in some settings for the prevention of aspiration in patients with presumably full stomachs.

10.4.3 Intubation of the Difficult Airway

10.4.3.1 The emergency care provider / practitioner should on the basis of the initial airway evaluation develop a strategy for the management of the airway when a difficult airway is suspected based on their level of skill an available airway management options (according to appropriate evidence-based algorithm).^{adapted}

Clinical judgement is required to select the most appropriate approach for the individual patient in the presenting situation. The development and communication of the strategy to all participating emergency care providers on the scene may improve patient safety and should be encouraged.

10.4.3.2 The recommended strategy for intubation of the difficult airway includes:(Petrini et al., 2005)

Evidence from small RCTs with uncertain results.

- **An assessment of the likelihood and anticipated clinical impact of six basic problems that may occur alone or in combination:**
 - **difficulty with patient cooperation or consent**
 - **difficult mask ventilation**
 - **difficult supraglottic airway placement**
 - **difficult laryngoscopy**
 - **difficult intubation**
 - **difficult surgical airway access**
- **The identification of a primary or preferred approach to:**
 - **the patient who can be adequately ventilated but is difficult to intubate**
 - **the life-threatening situation in which the patient cannot be ventilated or intubated**
 - **the identification of alternative approaches that can be used if the primary approach fails or is not feasible**

The primary and secondary approaches to the management of the airway may be predicted through assessment. Airway assessment is an important component in the decision making process for difficult airway management and should be emphasised.

10.4.3.3 In the context of a difficult airway confirmation of tracheal intubation should be performed with capnography or end-tidal carbon dioxide monitoring. *adapted*

10.4.3.4 Patient's oxygenation is mandatory and is the absolute priority. (Petrini et al., 2005) *
Evidence from one large RCT.

The risks to patients from unrecognised hypoxia during repeated or prolonged invasive airway management attempts in the context of difficult airway is well documented in the literature and preventable. At no point should attempts at performing invasive airway management procedures be prioritized above monitoring and maintain oxygenation or reversing hypoxia through ventilation.

10.4.3.5 It is recommended to refer to the modified Cormack and Lehane grading system. (Petrini et al., 2005)

Evidence from non-randomised studies, retrospective controls, case series, on controlled studies or expert opinion.

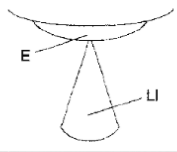



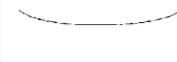
Original Cormack and Lehane system	1	2		3	4
	Full view of the glottis	Partial view of the glottis or arytenoids		Only epiglottis visible	Neither glottis nor epiglottis visible
View at laryngoscopy					
Modified system	1 As for original Cormack and Lehane above	2a Partial view of the glottis	2b Arytenoids or posterior part of the vocal cords only just visible	3 As for original Cormack and Lehane above	4 As for original Cormack and Lehane above

Table: modified Cormack and Lehane grading system (Yentis and Lee, 1998)

This refers to the identification of a difficult airway during laryngoscopy to aid decision making regarding choices in management options to follow.

10.4.3.6 It is recommended that in the event of a Grade IV laryngoscopy and in case of Grade III-e laryngoscopy, inexperienced operators do not attempt multiple laryngoscopy and intubation attempts before reverting to alternate intubation strategies such as the use of a gum elastic bougie or other airway management strategy. *adapted*

For the purpose of this recommendation, an attempt should be defined as a direct laryngoscopy attempt with the best possible access to the patient, best possible positioning of both provider and patient, using the optimal laryngoscopic technique (If using direct laryngoscopy) to obtain the best possible view. In principle providers should evaluate possible elements such as technique and positioning which may be easily corrected to improve the view of the glottis.

The definition of an inexperienced operator is unclear. The degree of experience amongst ALS providers in the pre-hospital setting varies greatly depending on the frequency of intubation and difficult airway encounters. In the absence of a definition, it may be most appropriate for providers to consider their preparedness and skill in the management of difficult airways when considering this recommendation. Regular simulation of difficult airway scenarios on airway manikin simulators has been recommended for maintaining skills and competencies in relation to difficult airway management (Petrini et al., 2005).

10.4.3.7 It is mandatory that the correct tube position is routinely checked, especially in case of difficult intubation, with both clinical (chest auscultation / epigastric auscultation) and instrumental techniques. (Petrini et al., 2005) *

Evidence from small RCTs with uncertain results.

Instrumental techniques should include capnography and the oesophageal detector device.

10.4.3.8 For the definitive confirmation of the correct tube position in a difficult airway with poor views of the glottis it is recommended to verify the correct position with the exhaled CO₂ detection, with evidence of repeated capnographic waves of appropriate morphology.

adapted

10.5 Failed Intubation

10.5.1 It is recommended not to exceed three laryngoscopic attempts, after the first one performed by an unskilled operator, in all laryngoscopic visualisation grades. (Petrini et al., 2005)*

Evidence from non-randomised studies, retrospective controls, case series, on controlled studies or expert opinion.

The definition of an “unskilled” operator is unclear. The degree of experience amongst ALS providers in the pre-hospital setting varies greatly depending on the frequency of intubation. In the absence of a clear definition, it may be most appropriate for providers to consider their preparedness and skill in the use of laryngoscopy when considering this recommendation. For all levels of experience, it is, however, not appropriate to continue to perform laryngoscopy after multiple attempts have failed in the pre-hospital setting. Providers should revert to the pre-planned secondary management strategy in such cases and ensure the patient remains oxygenated.

10.5.2 It is recommended not to perform the three attempts with the same technique, but “alternative” devices and procedures should be employed. (Petrini et al., 2005) *

Evidence from non-randomised studies, retrospective controls, case series, on controlled studies or expert opinion.

Change the operator, change equipment (e.g. video laryngoscopy/other blades/stylets/bougie) or change the positioning (patient positioning or alignment of the airway axis, as well as the positioning of the laryngoscopist in relation to the patient) and consider the possible reasons for failure to improve the next attempt.

10.5.3 Re-oxygenation and re-evaluation of ventilability are mandatory before any new laryngoscopic attempt. (Petrini et al., 2005)

Evidence from at least one non-randomised study, retrospective controls.

This may include the use of NIPPV, which should be administered with care to mitigate the risk of gastric insufflation. A FiO₂ of 1.0 should be administered. The time duration or number of breaths required is not clearly defined (although a duration of 3 minutes has been suggested in spontaneously breathing patients) and may depend on the individual patient. It may be most appropriate to use SpO₂ monitoring to guide duration of re-oxygenation. It should be noted that the ventilability of a patient, particularly after the administration of paralytic agents may be reduced and difficult to predict, and hence should be re-evaluated

10.5.4 It is recommended to reach an appropriate preliminary knowledge of alternative devices suggested for Grade II and Grade-III laryngoscopies. (Petrini et al., 2005)

Evidence from non-randomised studies, retrospective controls, case series, on controlled studies or expert opinion.

The use of stylets, the gum elastic bougie and the use of video laryngoscopy have been suggested in scenarios where poor view is predicted.

10.5.5 It is recommended to consider the use of LMA or other supraglottic devices early. (Petrini et al., 2005)*

Evidence from at least one non-randomised study, retrospective controls.

Consider the use of supraglottic devices before the initiation of intubation as part of preparation for failed laryngoscopy or unexpected difficult airway.

- 10.5.6 Blind intubation via LMA or other supraglottic devices designed for this purpose is recommended as a possible alternative strategy after multiple failed intubation attempts if ventilation via EGD alone is not achievable or inadequate.** ^{adapted}

10.6 Failed Airway

Where possible, consideration should be given to sterility of the procedure, and as bleeding is likely to occur during the procedure it will be appropriate to have an additional provider to assist. Consideration should be given to the administration of procedural sedation and analgesia where appropriate.

Specific equipment is required to perform pre-hospital surgical airway access procedures. As this technique is rarely performed by pre-hospital providers regular practice on airway simulators is required to maintain skills and procedural knowledge (Petrini et al., 2005).

- 10.6.1 An early rapid tracheal access is mandatory to achieve patient's oxygenation in case of intubation failure and inadequate or impossible ventilation.** (Petrini et al., 2005) *

Evidence from at least one non-randomised study, retrospective controls.

This recommendation applies to patients where intubation attempts have failed, and the patient cannot be ventilated. Management options include;

- Needle cricothyroidotomy following by jet ventilation
- Surgical cricothyroidotomy

Surgical airways are considered the last resort after other attempts have failed, but this does not imply that they should be delayed if all other

10.7 Paediatric Advanced Airway Management

10.7.1 Selection of Endotracheal Tube Size

- Uncuffed tubes will generally be a larger size. The formula is:
uncuffed endotracheal tube ID (mm) = $4 + (\text{age}/4)$; or for
cuffed tubes ID (mm) = $3.5 + (\text{age}/4)$
- When a cuffed ETT is used cuff pressures of between 10 - 30 cmH₂O are generally accepted in paediatric patients. Cuff pressure

10.7.1.1 Both cuffed and uncuffed endotracheal tubes are acceptable for intubating infants and children. (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

10.7.1.2 In certain circumstances (e.g., poor lung compliance, high airway resistance, or a large glottic air leak) a cuffed endotracheal tube may be preferable to an uncuffed tube, provided that attention is paid to endotracheal tube size, position, and cuff inflation pressure. (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.7.1.3 If a cuffed tube is used for emergency intubation of an infant less than 1 year of age, it is reasonable to select a 3.0 mm ID tube. For children between 1 and 2 years of age, it is reasonable to use a cuffed endotracheal tube with an internal diameter of 3.5 mm. (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.7.1.4 After age 2 it is reasonable to estimate tube size with the formula: **Cuffed endotracheal tube ID (mm) = $3.5 + (\text{age}/4)$** . (Keinman et al., 2010) *

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.7.2 Premedication Before Intubation in Paediatric Patients

10.7.2.1 The available evidence does not support the routine use of atropine pre-intubation of critically ill infants and children. It may be reasonable for practitioners to use atropine as a premedication in specific emergency intubations when there is higher risk of bradycardia (e.g., when giving succinylcholine as a neuromuscular blocker to facilitate intubation) A dose of 0.02 mg/kg of atropine with no minimum dose may be considered when atropine is used as a premedication for emergency intubation. (van de Jagt et al., 2015)

Recommendation may be considered, Evidence from limited data.

10.7.3 Confirmation of ETT Placement in Paediatrics

The oesophageal detector device is susceptible to false positive errors in children weight less than 20kg.

10.7.3.1 Since no single confirmation technique, including clinical signs or the presence of water vapour in the tube is completely reliable, use both clinical assessment and confirmatory devices to verify proper tube placement immediately after intubation, again after securing the endotracheal tube, during transport, and each time the patient is moved (e.g., from gurney to bed). (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.7.3.2 When available, exhaled CO₂ detection (capnography or colorimetric) is recommended as confirmation of tracheal tube position for neonates, infants, and children with a perfusing cardiac rhythm in all settings (e.g., pre-hospital, emergency centre, ICU, ward, operating room) and during intra-hospital or transport. (Keinman et al., 2010)

Recommendation should be performed. Evidence from expert consensus, case studies or series or standard of care.

10.7.3.3 During cardiac arrest, if exhaled CO₂ is not detected, confirm tube position with direct laryngoscopy. (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.7.3.4 If capnography is not available, an oesophageal detector device may be considered to confirm endotracheal tube placement in children weighing 20 kg with a perfusing rhythm, but the data are insufficient to make a recommendation for or against its use in children during cardiac arrest. (Keinman et al., 2010)

Recommendation may be considered, Evidence from single RCTs or pseudo-RCTs.

10.7.4 Management of Failed Intubation in Paediatric Patients

10.7.4.1 When bag-mask ventilation is unsuccessful and when endotracheal intubation is not possible, the LMA is acceptable when used by experienced providers to provide a patent airway and support ventilation. (Keinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

10.7.4.2 Transtracheal catheter oxygenation and ventilation may be considered for patients with severe airway obstruction above the level of the cricoid cartilage if standard methods to manage the airway are unsuccessful. This technique is intended for temporary use while a more effective airway is obtained. Attempt this procedure only after proper training and with appropriate equipment. (Keinman et al., 2010)

Recommendation may be considered, Evidence from single RCTs or pseudo-RCTs.

Transtracheal catheter ventilation is indicated for children of all ages as surgical cricothyrotomy is only indicated at ages above 10-12 years. Ventilatory methods should use a longer expiratory time (e.g. inhalation to exhalation (I:E ratio of 1:8 to 1:10), lower oxygen delivery pressure and flow rate, and as large a catheter as possible in children and infants with complete airway obstruction and ventilation rates of 10 to 12 and I:E ratios of 1:4, 1:5 in other children. The preferred needle size in children is 16 - 18G. In younger children, use a maximum flow rate of 10 to 12 L/minute, which provides oxygen at 25 to 35 psi for jet ventilation. The clinician should locate the cricothyroid membrane by palpating the prominence of the thyroid cartilage in older children moving the finger inferiorly into the depression between the thyroid and cricoid cartilages. In infants and young children, the clinician should palpate the trachea just above the suprasternal notch and move superiorly until the prominence of the cricoid cartilage is felt. The needle should be placed just above the cricoid cartilage in the midline. If the cricothyroid membrane cannot be located with certainty in an infant or a young child, percutaneous transtracheal ventilation can be safely performed by introducing the needle between the tracheal cartilages.

11. Adult Resuscitation

11.1 BLS CPR

11.1.1 Dispatch

The correct and timely identification of cardiac arrest is critical to ensuring (1) the appropriate dispatch of a high-priority response, (2) the provision of telephone CPR instructions, and (3) the activation of community first responders carrying automated external defibrillators (AED) (Travers et al., 2015).

Recognition of unconsciousness with abnormal breathing is central to dispatcher recognition of cardiac arrest. Many terms may be used by callers to describe abnormal breathing: difficulty breathing, poorly breathing, gasping breathing, wheezing breathing, impaired breathing, occasional breathing, barely/hardly breathing, heavy breathing, laboured or noisy breathing, sighing, and strange breathing. Offering dispatchers additional education that specifically addresses agonal breaths can increase the rates of telephone-assisted CPR and decrease the number of missed cases (Travers et al., 2015).

Bystander CPR rates remain relatively low in most communities. Dispatcher-assisted telephone CPR instructions have been demonstrated to improve bystander CPR rates (Travers et al., 2015).

BLS care in the out-of-hospital setting is often provided by laypersons who may be involved in a resuscitation attempt only once in their lives. Thus, creating an effective strategy to translate BLS skills to real-world circumstances presents a challenge (Berg et al., 2010a).

Optimising EMS dispatch is likely to be one of the most cost-effective solutions to improving outcomes from cardiac arrest. Thus, optimizing the ability of dispatchers to identify cardiac arrest and deliver telephone CPR instructions is critical to improving outcomes (Travers et al., 2015).

The available evidence shows consistent results favouring scripted dispatch protocols and that education including a description of the presenting signs of cardiac arrest and populations at risk (e.g., patients presenting with seizures) enables dispatchers to identify cardiac arrest. We recognize that dispatch protocols for a range of conditions (including but not limited to "seizures," "breathing problems," "chest pains," "falls," and "unknown problem") optimised to identify potential cardiac arrest without undue delay may further improve early recognition of cardiac arrest (Travers et al., 2015).

11.1.1.1 All dispatchers should be appropriately trained to provide telephone CPR instructions. (Berg et al., 2010a)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

11.1.1.2 We recommend that dispatchers determine if a patient is unconscious with abnormal breathing. If the victim is unconscious with no signs of life, it is reasonable to assume that the patient is in cardiac arrest at the time of the call. ^{adapted}

11.1.1.3 We recommend that dispatchers be educated to identify unconsciousness with abnormal breathing. This education should include recognition and significance of agonal breaths across a range of clinical presentations and descriptions. (Travers et al., 2015)

Strong recommendation, very-low-quality evidence.

11.1.1.4 We recommend that dispatchers provide chest compression– only CPR instructions to callers for adults with suspected out-of-hospital cardiac arrest. (Travers et al., 2015)

Strong recommendation, low-quality evidence.

11.1.2 Drowning

Drowning is the third leading cause of unintentional injury death worldwide, accounting for nearly 400 000 deaths annually. Care of a submersion victim in high-income countries often involves a multiagency approach, with several different organisations being independently responsible for different phases of the victim's care, from the initial aquatic rescue, on-scene resuscitation, transfer to hospital, and hospital and rehabilitative care. Attempting to rescue a submerged victim has substantial resource implications and may place rescuers at risk themselves (Travers et al., 2015).

There is a great deal of uncertainty in the literature around prognostication for drowning victims. Although duration of drowning seems the most useful factor, there are seldom clear timelines and estimates can be imprecise. Submersion durations of less than 10 minutes are associated with a very high chance of favourable outcome, and submersion durations more than 25 minutes are associated with a low chance of favourable outcomes. Given the known difficulties with accurate timing, we suggest the time of the emergency service call as the start point for estimating submersion duration (Travers et al., 2015).

When attempting to rescue a drowning victim, the rescuer should get to the victim as quickly as possible. It is crucial, however, that the rescuer pays constant attention to his or her own personal safety during the rescue process (Vanden Hoek et al., 2010).

The victim is likely to vomit when the rescuer performs chest compressions or rescue breathing. If vomiting occurs, turn the victim to the side and remove the vomitus using your finger, a cloth, or suction (Vanden Hoek et al., 2010).

11.1.2.1 We recommend that submersion duration be used as a prognostic indicator when making decisions surrounding search and rescue resource management/operations.

(Travers et al., 2015)

Strong recommendation, moderate-quality evidence for prognostic significance.

11.1.2.2 We suggest against the use of age, EMS response time, water type (fresh or salt), water temperature, and witness status when making prognostic decisions. (Travers et al., 2015)

Weak recommendation, very-low-quality evidence for prognostic significance.

11.1.2.3 If a lone healthcare provider aids an adult drowning victim or a victim of foreign body airway obstruction who becomes unconscious, the healthcare provider may give about 5 cycles (approximately 2 minutes) of CPR before activating the emergency response system. (Berg et al., 2010a)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

11.1.2.4 All victims of drowning who require any form of resuscitation (including rescue breathing alone) should be transported to the hospital for evaluation and monitoring, even if they appear to be alert and demonstrate effective cardiorespiratory function at the scene.

(Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

11.1.2.5 Routine stabilisation of the cervical spine in the absence of circumstances that suggest a spinal injury is not recommended. (Vanden Hoek et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

11.1.2.6 The routine use of abdominal thrusts or the Heimlich manoeuvre for drowning victims is not recommended. (Vanden Hoek et al., 2010)

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

11.1.3 Pregnancy

See also Section 1.7, Cardiac Arrest in Pregnancy and 11.3.4, Special Circumstances in Cardiac Arrest: Pregnancy.

11.1.3.1 Priorities for the pregnant woman in cardiac arrest are provision of high quality CPR and relief of aortocaval compression. (Lavonas et al., 2015)

Recommendation should be performed, Evidence from limited data.

11.1.3.2 If the fundus height is at or above the level of the umbilicus, manual left lateral uterine displacement can be beneficial in relieving aortocaval compression during chest compressions. (Lavonas et al., 2015)

Recommendation is reasonable to perform, Evidence from limited data.

11.1.4 CPR Assessment/Commencement/Start Sequence

Delivering high quality chest compressions as early as possible is vital to high quality CPR and optimises the chance of ROSC and survival after cardiac arrest (Travers et al., 2015).

The lay rescuer should not check for a pulse and should assume that cardiac arrest is present if an adult suddenly collapses or an unresponsive victim is not breathing normally. (Berg et al., 2010a) During an unmonitored cardiac arrest, we suggest a short period of CPR until the defibrillator is ready for analysis and, if indicated, defibrillation. As soon as a defibrillator arrives the patient should be defibrillated when appropriate as there is no benefit to a period of CPR prior to defibrillation versus immediate defibrillation (Travers et al., 2015).

The risks of injury from CPR to patients not in cardiac arrest are low relative to the survival benefit of CPR initiated by laypersons for cardiac arrest so CPR should be encouraged if there is doubt (Travers et al., 2015).

There is uncertainty around the use of the precordial thump with conflicting evidence around benefits versus risks (Cave et. al, 2010).

11.1.4.1 If the victim has absent or abnormal breathing (i.e. only gasping), and no signs of life, the rescuer should assume the victim is in cardiac arrest. *adapted*

11.1.4.2 The trained rescuer should treat the victim who has occasional gasps as if he or she is not breathing. (Berg et al., 2010a)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

11.1.4.3 The healthcare provider should take no more than 10 seconds to check for a pulse and, if the rescuer does not definitely feel a pulse within that time period, the rescuer should start chest compressions. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

11.1.4.4 We recommend that laypersons initiate CPR for presumed cardiac arrest without concerns of harm to patients not in cardiac arrest. (Travers et al., 2015)

Strong recommendation, very-low-quality evidence.

11.1.4.5 We suggest commencing CPR with compressions rather than ventilations. (Travers et al., 2015)*

Weak recommendation, very-low-quality evidence.

11.1.4.6 The precordial thump should not be used for unwitnessed out-of-hospital cardiac arrest.

(Cave et. al, 2010)

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

11.1.4.7 The precordial thump may be considered for patients with witnessed, monitored, unstable ventricular tachycardia including pulseless VT if a defibrillator is not immediately ready for use. but it should not delay CPR and shock delivery. There is insufficient evidence to recommend for or against the use of the precordial thump for witnessed onset of asystole. (Cave et. al, 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.1.5 Compressions-Only CPR

Passive ventilation techniques include positioning the body, opening the airway, and passive oxygen administration during chest compression (Travers et al., 2015).

Advocates of chest compression-only CPR note that it is easier to teach, remember, and perform compared with chest compressions with assisted ventilation. Others are concerned that chest compressions without assisted ventilation are less effective because of inadequate oxygenation and worse respiratory acidosis. These concerns are especially pertinent in the setting of asphyxial cardiac arrests (and perhaps others with a non-cardiac cause) and in the setting of prolonged CPR (Travers et al., 2015).

11.1.5.1 We recommend that chest compressions should be performed for all patients in cardiac arrest. (Travers et al., 2015) *

Strong recommendation, very-low-quality evidence.

11.1.5.2 We suggest that those who are trained and willing to give rescue breaths do so for all adult patients in cardiac arrest. (Travers et al., 2015)

Weak recommendation, very-low-quality evidence.

11.1.5.3 We suggest against the routine use of passive ventilation techniques during conventional CPR. (Travers et al., 2015)

Weak recommendation, very-low-quality evidence.

11.1.5.4 We suggest that where EMS systems have adopted bundles of care involving continuous chest compressions, the use of passive ventilation techniques may be considered as part of that bundle for patients in out-of-hospital cardiac arrest. (Travers et al., 2015)*

Weak recommendation, very-low-quality evidence.

11.1.6 CPR: Compressions & Ratio

CPR should be performed on a firm surface when possible (Travers et al., 2015).

11.1.6.1 In the healthcare provider, trained population it is reasonable for both EMS and in-hospital professional rescuers to provide chest compressions and rescue breaths for cardiac arrest victims. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

11.1.6.2 We suggest performing chest compressions on the lower half of the sternum on adults in cardiac arrest. (Travers et al., 2015)*

Weak recommendation, very-low-quality evidence.

11.1.6.3 We recommend a manual chest compression rate of 100 to 120/min. (Travers et al., 2015) *

Strong recommendation, very-low-quality evidence.

11.1.6.4 We recommend a chest compression depth of approximately 5 cm (2 inches) (strong recommendation, low-quality evidence) while avoiding excessive chest compression depths (greater than 6 cm [greater than 2.4 inches] in an average adult) during manual CPR. (Travers et al., 2015)

Weak recommendation, low-quality evidence.

11.1.6.5 We suggest that rescuers performing manual CPR avoid leaning on the chest between compressions to allow full chest wall recoil. (Travers et al., 2015) *

Weak recommendation, low-quality evidence.

11.1.6.6 We suggest a compression-ventilation ratio of 30:2 in patients in cardiac arrest. ^{adapted}

11.1.6.7 We suggest pausing chest compressions every 2 minutes to assess the cardiac rhythm.

(Travers et al., 2015)

Weak recommendation, low-quality evidence.

11.1.7 Minimise Interruptions During CPR

Where invasive monitoring is available, there is insufficient data around the value of a pulse check while performing CPR. We therefore do not make a treatment recommendation regarding the value of a pulse check (Travers et al., 2015).

Achieving short pre-shock and post-shock pauses requires awareness of the importance of minimizing the pause, attention during training, and an excellent interplay among the rescuers working together during a resuscitation attempt (Travers et al., 2015).

High quality CPR is important not only at the onset, but throughout the course of resuscitation. Defibrillation and advanced care should be interfaced in a way that minimizes any interruption in CPR (Berg et al., 2010a).

11.1.7.1 We suggest that in adult patients receiving CPR with no advanced airway, the interruption of chest compressions for delivery of 2 breaths should be less than 10 seconds. (Travers et al., 2015)

(Travers et al., 2015)

Weak recommendation, low-quality evidence.

11.1.7.2 We recommend that total pre-shock and post-shock pauses in chest compressions be as short as possible. For manual defibrillation, we suggest that pre-shock pauses be as short as possible and no more than 10 seconds. (Travers et al., 2015)

Strong recommendation, low-quality evidence.

11.1.7.3 Healthcare providers should interrupt chest compressions as infrequently as possible and try to limit interruptions to no longer than 10 seconds, except for specific interventions such as insertion of an advanced airway or use of a defibrillator. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

11.1.7.4 We suggest during conventional CPR that chest compression fraction (i.e. total CPR time devoted to compressions) should be as high as possible and at least 60%. (Travers et al., 2015)

Weak recommendation, low-quality evidence.

11.1.8 Ongoing CPR

11.1.8.1 When 2 or more rescuers are available it is reasonable to switch chest compressors approximately every 2 minutes (or after about 5 cycles of compressions and ventilations at a ratio of 30:2) to prevent decreases in the quality of compressions. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs)

11.1.8.2 Rescuers should continue CPR until an AED arrives, the victim wakes up, or EMS personnel take over CPR. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs)

11.1.8.3 Because of the difficulty in providing effective chest compressions while moving the patient during CPR, the resuscitation should generally be conducted where the patient is found. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

11.1.9 CPR Feedback (“Q-CPR” like devices giving input on quality of CPR)

CPR feedback devices may be useful training and improvement tools but there is no compelling evidence that they improve CPR and other parameters should be considered instead of or in addition to these feedback/prompting devices.

A higher value is placed on development of systems of care with continuous quality improvement than on cost. Resource-poor environments may choose not to adopt this technology in favour of allocating resources to other system developments. Devices that provide real-time CPR feedback also document CPR metrics that may be used to debrief and inform strategies aimed at improving CPR quality. Currently available audio-visual feedback devices provide information on key CPR parameters such as compressions and ventilation; however, the optimal targets and the relationships among different targets have not been fully defined (Travers et al., 2015).

The use of CPR feedback or prompt devices during CPR in clinical practice or CPR training is intended to improve CPR quality as a means to improving ROSC and survival. The forms of CPR feedback or prompt devices include audio and visual components such as voice prompts, metronomes, visual dials, numerical displays, waveforms, verbal prompts, and visual alarms. Visual displays enable the rescuer to see compression-to-compression quality parameters, including compression depth and rate, in real time. All audio prompts may guide CPR rate (e.g., metronome) and may offer verbal prompts to rescuers (e.g., "push harder," "good compressions") (Travers et al., 2015).

11.1.9.1 We suggest the use of real-time audio-visual feedback and prompt devices during CPR in clinical practice as part of a comprehensive system for care for cardiac arrest. (Travers et al., 2015)*

Weak recommendation, very-low-quality evidence.

11.1.9.2 We suggest against the use of real-time audio-visual feedback and prompt devices in isolation (i.e. not part of a comprehensive system of care). (Travers et al., 2015)*

Weak recommendation, very-low-quality evidence.

11.1.10 Defibrillation

Rapid defibrillation is a powerful predictor of successful resuscitation following ventricular fibrillation (VF) sudden cardiac arrest (SCA). (Berg et al., 2010a)

Evidence supports not pausing CPR to reassess rhythm after defibrillation, unless there is alternative physiologic evidence of ROSC (e.g. arterial waveform or rapid rise in ETCO₂), in which case chest compressions can be paused briefly for rhythm analysis (Travers et al., 2015).

Public sites with large population densities may benefit the most from public access defibrillation programs (Travers et al., 2015).

11.1.10.1 Rapid defibrillation is the treatment of choice for VF of short duration, such as for victims of witnessed out-of-hospital cardiac arrest or for hospitalised patients whose heart rhythm is monitored. (Berg et al., 2010a)

Recommendation should be performed, Evidence from multiple RCTs or meta-analysis.

11.1.10.2 When 2 or more rescuers are present, one rescuer should begin chest compressions while a second rescuer activates the emergency response system and gets the AED.^{adapted}

11.1.10.3 We suggest immediate resumption of chest compressions after shock delivery for adults in cardiac arrest in any setting. (Travers et al., 2015)

Weak recommendation, very-low-quality evidence.

11.1.11 Recovery

The recovery position is used for unresponsive adult victims who clearly have normal breathing and effective circulation. This position is designed to maintain a patent airway and reduce the risk of airway obstruction and aspiration. The victim is placed on his or her side with the lower arm in front of the body (Berg et al., 2010a).

11.1.11.1 Recovery Position: The position should be stable, near a true lateral position, with the head dependent and with no pressure on the chest to impair breathing. (Berg et al., 2010a)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

11.2 Advanced Life Support - Resuscitation

Advanced life support (ALS) is still considered a vital link in the chain of survival for patients with out-of-hospital cardiac arrest. Despite this the quality of evidence for many ALS interventions remains poor (Callaway et al., 2015) as do the outcomes of patients, particularly those suffering unwitnessed out-of-hospital cardiac arrest where CPR and defibrillation is delayed. As part of the development of these guidelines, the core guideline panel opted to adopt the AHA resuscitation guidelines for advanced cardiac life support. It should therefore be noted that for recommendations not reviewed by the AHA in the 2015 edition, the 2010 recommendation are considered valid.

11.2.1 Ventilation

11.2.1.1 During continuous chest compression (asynchronous CPR): We suggest a ventilation rate of 10 breaths/min in adults with cardiac arrest with a secure airway receiving continuous chest compressions. (Callaway et al., 2015)

Weak recommendation, very-low-quality evidence.

11.2.1.2 We recommend against the routine use of the Impedance Threshold Device (ITD) in addition to conventional CPR. (Callaway et al., 2015)

Grade: strong recommendation, high quality evidence.

11.2.2 Compressions

These devices may be useful in the setting where limited providers are available for provision of compressions such as interfacility transfers. Providers will need to be trained in the use of the specific device, as these application and use vary.

11.2.2.1 We suggest against the routine use of automated mechanical chest compression devices to replace manual chest compressions. (Callaway et al., 2015)

Weak recommendation, moderate-quality evidence.

11.2.3 Monitoring During CPR

Cardiac ultrasound can be performed if available.

11.2.3.1 We recommend against using ETCO₂ cutoff values alone as a mortality predictor or for the decision to stop a resuscitation attempt. (Callaway et al., 2015) *

Strong recommendation, low-quality evidence.

11.2.3.2 We suggest that an ETCO₂ 10 mm Hg or greater measured after tracheal intubation or after 20 minutes of resuscitation may be a predictor of ROSC. (Callaway et al., 2015) *

Weak recommendation, low-quality evidence.

11.2.3.3 We suggest that an ETCO₂ 10 mm Hg or greater measured after tracheal intubation or an ETCO₂ 20 mm Hg or greater measured after 20 minutes of resuscitation may be a predictor of survival to discharge. (Callaway et al., 2015) *

Weak recommendation, moderate-quality evidence.

11.2.3.4 We suggest that if cardiac ultrasound can be performed without interfering with standard ACLS protocol, it may be considered as an additional diagnostic tool to identify potentially reversible causes. (Callaway et al., 2015) *

Weak recommendation, very-low-quality evidence.

11.2.4 Defibrillation

11.2.4.1 There is insufficient evidence to determine if 1 1/2 to 3 minutes of CPR should be provided prior to defibrillation. CPR should be performed while a defibrillator is being readied. (Link et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

Although empty left ventricle syndrome may be a concern, defibrillation should not be delayed to perform CPR if the defibrillator is ready.

11.2.4.2 Data demonstrate that 4 pad positions (anterolateral, anteroposterior, anterior-left infrascapular, and anterior-right infrascapular) are equally effective to treat atrial or ventricular arrhythmias. All 4 positions are equally effective in shock success. Any of the 4 pad positions is reasonable for defibrillation. (Link et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

11.2.4.3 In patients with ICDs or pacemakers, pad/paddle placement should not delay defibrillation. It might be reasonable to avoid placing the pads or paddles over the device. (Link et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.2.4.4 If shock delivery will not be delayed, remove medication patches and wipe the area before attaching the electrode pad. (Link et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.2.4.5 If an unresponsive victim is lying in water or if the victim's chest is covered with water or the victim is extremely diaphoretic, it may be reasonable to remove the victim from water and briskly wipe the chest before attaching electrode pads and attempting defibrillation

(Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care). AEDs can be used when the victim is lying on snow or ice. (Link et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.2.4.6 It may be reasonable for rescuers to take precautions to minimise sparking during attempted defibrillation; try to avoid defibrillation in an oxygen-enriched atmosphere. (Link et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.2.4.7 We recommend that a biphasic waveform (biphasic truncated exponential [BTE] or rectilinear-biphasic [RLB]) is used for both atrial and ventricular arrhythmias in preference to a monophasic waveform. In the absence of biphasic defibrillators, monophasic defibrillators are acceptable. (Callaway et al., 2015)

Strong recommendation, very-low-quality evidence.

11.2.4.8 We recommend following the manufacturer's instructions for first and subsequent shock energy levels for the pulsed biphasic waveform. (Callaway et al., 2015) *

Strong recommendation, very-low-quality evidence.

11.2.4.9 We recommend an initial biphasic shock energy of 150 J or greater for BTE waveforms, and 120 J or greater for RLB waveforms (strong recommendation, very-low-quality evidence). If a monophasic defibrillator is used, we recommend an initial monophasic shock energy of 360 J. (Callaway et al., 2015)

Grade: strong recommendation, very-low-quality evidence

11.2.4.10 We recommend a single-shock strategy when defibrillation is required. (Callaway et al., 2015)

Strong recommendation, low-quality evidence.

11.2.4.11 We suggest if the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy for subsequent shocks.

(Callaway et al., 2015)

Weak recommendation, very-low-quality evidence.

11.2.4.12 Recurrent VF: We suggest an escalating defibrillation energy protocol to prevent refrillation. (Callaway et al., 2015)

Weak recommendation, low-quality evidence.

11.2.4.13 Electric pacing is not recommended for routine use in cardiac arrest. (Neumar et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs).

11.2.5 Medications Administered During CPR

Placement of IV Access

11.2.5.1 It is reasonable for providers to establish IO access if IV access is not readily available.

(Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

It may also be appropriate to use IO as a first line access option in cardiac arrest if the appropriate equipment is available.

- 11.2.5.2 **If IV or IO access cannot be established, adrenaline, vasopressin, and lidocaine may be administered by the endotracheal route during cardiac arrest.** (Neumar et al., 2010) *
Recommendation may be considered, Evidence from single RCTs or pseudo-RCTs.

Adrenaline or Equivalent

- 11.2.5.3 **We suggest standard-dose adrenaline (defined as 1 mg) be administered to patients in cardiac arrest.** (Callaway et al., 2015)
Weak recommendation, very-low-quality evidence.
- 11.2.5.4 **We suggest vasopressin should not be used instead of adrenaline in cardiac arrest.** (Callaway et al., 2015)*
Weak recommendation, low-quality evidence.
- 11.2.5.5 **We suggest against the routine use of high-dose adrenaline (at least 0.2 mg/kg or 5 mg bolus dose) in cardiac arrest.** (Callaway et al., 2015)
Weak recommendation, low-quality evidence.
- 11.2.5.6 **For cardiac arrest with an initial non-shockable rhythm, we suggest that if adrenaline is to be administered, it is given as soon as feasible after the onset of the arrest.** (Callaway et al., 2015)
Weak recommendation, low-quality evidence.
- 11.2.5.7 **For cardiac arrest with an initial shockable rhythm, we found insufficient evidence to make a treatment suggestion regarding the timing of administration of adrenaline, particularly in relation to defibrillation, and the optimal timing may vary for different groups of patients and different circumstances.** (Callaway et al., 2015)
Weak recommendation, low-quality evidence.

Antiarrhythmic and Other Medications

- 11.2.5.8 **We suggest the use of lidocaine as an alternative to amiodarone in adult patients with refractory VF/pulseless VT.** ^{adapted}
- 11.2.5.9 **We recommend against the routine use of magnesium in adult patients.** (Callaway et al., 2015)
Strong recommendation, low-quality evidence.
- 11.2.5.10 **When VF/pulseless VT cardiac arrest is associated with torsades de pointes, providers may administer an IV/IO bolus of magnesium sulphate at a dose of 1 to 2 g diluted in 10 mL D5W.** (Neumar et al., 2010)
Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.
- 11.2.5.11 **Routine use of sodium bicarbonate is not recommended for patients in cardiac arrest.** (Neumar et al., 2010) *
Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

11.2.5.12 Routine administration of calcium for treatment of in-hospital and out-of-hospital cardiac arrest is not recommended. (Neumar et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

11.2.5.13 We suggest against the routine use of steroids during CPR for out-of-hospital cardiac arrest. (Callaway et al., 2015)

Weak recommendation, very- low-quality evidence.

11.2.5.14 We suggest the use of amiodarone in adult patients with refractory VF/pulseless VT to improve rates of ROSC. (Callaway et al., 2015)

Weak recommendation, moderate-quality evidence.

11.3 Cardiac Arrest in Special Circumstances

11.3.1 Opioid Overdose

11.3.1.1 Empiric administration of IM or IN naloxone to all unresponsive opioid-associated life-threatening emergency patients may be reasonable as an adjunct to standard first aid and non-healthcare provider BLS protocols. (Lavonas et al., 2015) *

Recommendation may be considered, Evidence from consensus opinion.

Opioid overdose in other countries (particularly the USA) is such a common occurrence that administration of naloxone is often done by BLS providers according to 2015 ILCOR/ AHA.

11.3.1.2 Victims who respond to naloxone administration should access advanced healthcare services. (Lavonas et al., 2015)

Recommendation should be performed, Evidence from consensus opinion.

11.3.1.3 For patients with known or suspected opioid overdose who have a definite pulse but no normal breathing or only gasping (i.e. a respiratory arrest), in addition to providing standard BLS care, it is reasonable for appropriately trained BLS healthcare providers to administer IM or IN naloxone. (Lavonas et al., 2015) *

Recommendation is reasonable to perform, Evidence from limited data.

11.3.1.4 Patients with no definite pulse may be in cardiac arrest or may have an undetected weak or slow pulse. [1] These patients should be managed as cardiac arrest patients. Standard resuscitative measures should take priority over naloxone administration with a focus on high quality CPR (compressions plus ventilation). [2] It may be reasonable to administer IM or IN naloxone based on the possibility that the patient is not in cardiac arrest. (Callaway et al., 2015)

[1] Recommendation should be performed, Evidence from consensus opinion.

[2] Recommendation may be considered, Evidence from consensus opinion.

- 11.3.1.5 Responders should not delay access to more-advanced medical services while awaiting the patient's response to naloxone or other interventions.** (Callaway et al., 2015)
Recommendation should be performed, Evidence from consensus opinion.
- 11.3.1.6 After ROSC or return of spontaneous breathing, patients should be observed in a healthcare setting until the risk of recurrent opioid toxicity is low and the patient's level of consciousness and vital signs have normalised.** (Lavonas et al., 2015)
Recommendation should be performed, Evidence from limited data.
- 11.3.1.7 We recommend the use of naloxone by IV, IM, subcutaneous, IO, or IN routes in respiratory arrest associated with opioid toxicity. The dose of naloxone required will depend on the route.** (Callaway et al., 2015)
Strong recommendation, very- low- quality evidence.
- 11.3.1.8 Respiratory Arrest: ACLS providers should support ventilation and administer naloxone to patients with a perfusing cardiac rhythm and opioid-associated respiratory arrest or severe respiratory depression. Bag-mask ventilation should be maintained until spontaneous breathing returns, and standard ACLS measures should continue if return of spontaneous breathing does not occur.** (Lavonas et al., 2015)
Recommendation should be performed, Evidence from limited data.
- 11.3.1.9 If recurrent opioid toxicity develops, repeated small doses or an infusion of naloxone can be beneficial in healthcare settings.** (Lavonas et al., 2015)
Recommendation is reasonable to perform, Evidence from limited data.
- 11.3.1.10 Naloxone administration in post-cardiac arrest care may be considered in order to achieve the specific therapeutic goals of reversing the effects of long-acting opioids.** (Lavonas et al., 2015)
Recommendation may be considered, Evidence from consensus opinion.

11.3.2 Resuscitation in Near Fatal Asthma (see also Respiratory section)

See also Section 7.1.3, Adult Asthma, Airway & Ventilation

- 11.3.2.1 The effects of auto-PEEP in an asthmatic patient with cardiac arrest are likely quite severe, a ventilation strategy of low respiratory rate and normal-to-high tidal volume is reasonable.** *adapted*
- 11.3.2.2 During arrest a brief disconnection from the bag mask or ventilator may be considered, and compression of the chest wall to relieve air-trapping can be effective.** (Vanden Hoek et al., 2010)*
Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

During this disconnection, chest compressions should continue.

- 11.3.2.3 For all asthmatic patients with cardiac arrest, and especially for patients in whom ventilation is difficult, the possible diagnosis of a tension pneumothorax should be considered and treated.** (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

11.3.3 Resuscitation in Anaphylaxis

- 11.3.3.1 Given the potential for the rapid development of oropharyngeal or laryngeal oedema, immediate referral to a health professional with expertise in advanced airway placement is recommended.** (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

Endotracheal intubation may be required in these patients. Providers should provide rapid transport unless ALS assistance is immediately available. ALS providers should prepare for difficult and failed airway in patients with suspected laryngeal oedema.

- 11.3.3.2 Adrenaline should be administered early by IM injection to all patients with signs of a systemic allergic reaction, especially hypotension, airway swelling, or difficulty breathing.** (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

- 11.3.3.3 The recommended dose is 0.2 to 0.5 mg (1:1000) IM to be repeated every 5 to 15 minutes in the absence of clinical improvement.** (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

This recommendation and dosing regimen relate to patients in the peri-arrest phase and is considered a crucial intervention.

- 11.3.3.4 In both anaphylaxis and cardiac arrest, the immediate use of an adrenaline autoinjector is recommended if available.** (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

It may be reasonable for all providers, including BLS providers, to administer the patient's own autoinjector if available when the patient is unable to do so themselves and clear signs of anaphylaxis are present. It is not suggested however that all emergency care providers carry autoinjectors for this purpose.

11.3.3.5 Planning for advanced airway management, including a surgical airway, is recommended. (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

11.3.3.6 Vasogenic shock from anaphylaxis may require aggressive fluid resuscitation. (Vanden Hoek et al., 2010)*

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

Fluid resuscitation in these patients should occur concomitantly with the use of adrenaline. Large fluid volumes of fluid may be required over the initial resuscitation period.

11.3.3.7 When an IV line is in place, it is reasonable to consider the IV route as an alternative to IM administration of adrenaline in anaphylactic shock. (Vanden Hoek et al., 2010) *

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

This recommendation is more applicable to cardiac arrest. The use of IV adrenaline in patients not in cardiac arrest can be dangerous. The IM route has been shown to be safe and well tolerated in most patients.

11.3.3.8 Because fatal overdose of adrenaline has been reported, close hemodynamic monitoring is recommended. (Vanden Hoek et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

11.3.3.9 IV infusion of adrenaline is a reasonable alternative to IV boluses for treatment of anaphylaxis in patients not in cardiac arrest. (Vanden Hoek et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

It may be advisable to use an initial infusion rate at the lower end of the regime (2 - 10 µg/min) and titrate to effect. It is a requirement that an infusion of this nature must be given using a syringe driver or infusion pump. The use of dropper sets or dial-a-flow devices for this purpose may lead to accidental overdose and remains a serious patient safety concern. Close haemodynamic monitoring is required if IV infusions of adrenaline are administered.

11.3.3.10 Adjuvant use of antihistamines (H1 and H2 antagonist), inhaled β-adrenergic agents, and IV corticosteroids has been successful in management of the patient with anaphylaxis and may be considered in cardiac arrest due to anaphylaxis. (Vanden Hoek et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

Patients suffering from anaphylaxis are often young and have few or no comorbidities. In such cases, especially in witnessed arrest the prospects for ROSC is reasonable with aggressive early resuscitation. If ROSC is achieved the adjunctive medication suggested in the recommendation may reduce the occurrence of biphasic reactions and possibly improve patient outcomes.

11.3.4 Resuscitation in Pregnancy

See also Section 1.7, Cardiac Arrest in Pregnancy and Section 11.1.3, BLS CPR: Pregnancy.

Pregnant patients have reduced functional residual capacity and therefore do not tolerate the same periods of apnoea as non-pregnant patients should, especially in the third trimester. During resuscitative efforts providers should also displace the gravid uterus, especially in the third trimester to avoid occlusion of venous return which would affect the quality of CPR.

11.3.4.1 Bag-mask ventilation with 100% oxygen before intubation is especially important in pregnancy. (Vanden Hoek et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

11.3.5 Resuscitation of Patients with Electrolyte Disturbances

11.3.5.1 The effect of bolus administration of potassium for cardiac arrest suspected to be secondary to hypokalaemia is unknown and ill advised. (Vanden Hoek et al., 2010)

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

11.3.5.2 Administration of calcium (calcium chloride [10%] 5 to 10 mL or calcium gluconate [10%] 15 to 30 mL IV over 2 to 5 minutes) may be considered during cardiac arrest associated with hypomagnesaemia. (Vanden Hoek et al., 2010) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.3.5.3 Hypomagnesaemia Arrest: For cardiotoxicity and cardiac arrest, IV magnesium 1 to 2 g of MgSO₄ bolus IV push is recommended. (Vanden Hoek et al., 2010) *

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

11.3.5.4 Empirical use of calcium (calcium chloride [10%] 5 to 10 mL OR calcium gluconate [10%] 15 to 30 mL IV over 2 to 5 minutes) may be considered when hyperkalaemia or hypomagnesaemia is suspected as the cause of cardiac arrest. (Vanden Hoek et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care)

11.3.6 Resuscitation of Suspected Overdose of Toxicology

11.3.6.1 Benzodiazepine Toxicity: The administration of flumazenil to patients with undifferentiated coma confers risk and is not recommended. (Vanden Hoek et al., 2010) *

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

11.3.6.2 B-Blocker Toxicity: The recommended dose of glucagon is a bolus of 3 to 10 mg, administered slowly over 3 to 5 minutes, followed by an infusion of 3 to 5 mg/h (0.05 to 0.15 mg/kg followed by an infusion of 0.05 to 0.10 mg/kg per hour). (Vanden Hoek et al., 2010)*

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.3.6.3 B-Blocker Toxicity: Administration of high-dose insulin in patients with shock refractory to other measures may be considered. (Vanden Hoek et al., 2010) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

Insulin could be justified where available.

11.3.6.4 B-Blocker Toxicity: Administration of calcium in patients with shock refractory to other measures may be considered. (Vanden Hoek et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.3.6.5 Cocaine: For cocaine-induced hypertension or chest discomfort, benzodiazepines, nitroglycerin, and/or morphine can be beneficial. (Vanden Hoek et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

11.3.6.6 Tricyclic antidepressant (TCA) toxicity: Administration of sodium bicarbonate for cardiac arrest due to cyclic antidepressant overdose may be considered. (Vanden Hoek et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.3.6.7 TCA toxicity: Sodium bicarbonate boluses of 1 mL/kg may be administered as needed to achieve hemodynamic stability (adequate mean arterial blood pressure and perfusion) and QRS narrowing. (Vanden Hoek et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

This recommendation applies to patients not in cardiac arrest. Sodium bicarbonate is considered the antidote in TCA overdose. Hypotension and arrhythmias may also complicate TCA toxicity. Fluid boluses and the use of lignocaine for arrhythmia management (for patients refractory to sodium bicarbonate) may be considered.

11.3.7 Resuscitation of Hypothermic Patients

11.3.7.1 It may be reasonable to perform further defibrillation attempts according to the standard BLS algorithm concurrent with rewarming strategies. (Vanden Hoek et al., 2010) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.3.7.2 It may be reasonable to consider administration of a vasopressor during cardiac arrest according to the standard ACLS algorithm concurrent with rewarming strategies. (Vanden Hoek et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.4 Airway Management during CPR

11.4.1 Basic Airway Manoeuvres

Oxygen

11.4.1.1 We suggest the use of the highest possible inspired oxygen concentration during CPR. (Callaway et al., 2015)

Weak recommendation, very-low quality evidence.

11.4.1.2 We suggest using either an advanced airway or a bag-mask device for airway management during CPR for cardiac arrest in any setting. (Callaway et al., 2015)

Weak recommendation, very-low quality evidence.

The use of mask ventilation and basic airway manoeuvres during cardiac arrest should only be continued as the sole strategy when mask ventilation is consistently effective in producing chest rise. It should be noted that regurgitation and aspiration risks are present during cardiac arrest in the out of hospital setting and may increase as the duration of resuscitation increases. The placement of advanced airways should however not disrupt compressions.

Supraglottic Airways

11.4.1.3 We suggest using either a supraglottic airway or tracheal tube as the initial advanced airway during CPR for cardiac arrest in any setting. (Callaway et al., 2015)

Weak recommendation, very-low quality evidence.

Supraglottic airways are considered equivalent to ETI in cardiac arrest. Supraglottic airways may be faster to place and may result in less disruption compared to ETI. The use of ETI may, however, be preferred in situations where the precipitating cause of cardiac arrest is associated to airway obstruction or lung pathology which precludes the use of supraglottic airways.

11.4.1.4 For healthcare professionals trained in its use, the esophagealtracheal tube is an acceptable alternative to both [1] bag-mask ventilation or [2] endotracheal intubation for airway management in cardiac arrest. (Neumar et al., 2010)

[1] *Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.*

[2] *Recommendation is reasonable to perform, Evidence from multiple RCTs or meta-analysis.*

- 11.4.1.5 If advanced airway placement will interrupt chest compressions, providers may consider deferring insertion of the airway until the patient fails to respond to initial CPR and defibrillation attempts or demonstrates ROSC.** (Neumar et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

Asynchronous CPR

- 11.4.1.6 Once an advanced airway is in place, 2 rescuers no longer need to pause chest compressions for ventilations. Instead, the compressing rescuer should give continuous chest compressions at a rate of at least 100 per minute without pauses for ventilation.**

(Neumar et al., 2010) *

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

Intubation

- 11.4.1.7 Frequent experience or frequent retraining is recommended for providers who perform endotracheal intubation.** (Neumar et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

- 11.4.1.8 EMS systems that perform pre-hospital intubation should provide a program of ongoing quality improvement to minimise complications.** (Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

Confirmation

- 11.4.1.9 We recommend using waveform capnography to confirm and continuously monitor the position of a tracheal tube during CPR in addition to clinical assessment.** (Callaway et al., 2015)*

Strong recommendation, low-quality evidence.

- 11.4.1.10 We recommend that if waveform capnography is not available, a non-waveform CO2 detector, oesophageal detector device, or ultrasound in addition to clinical assessment is an alternative.** (Callaway et al., 2015)

Strong recommendation, low-quality evidence.

11.5 Arrhythmia Management

11.5.1 Management of PEA/ Asystole

- 11.5.1.1 A vasopressor can be given as soon as feasible with the primary goal of increasing myocardial and cerebral blood flow during CPR and achieving ROSC.** (Neumar et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

- 11.5.1.2 Available evidence suggests that the routine use of atropine during PEA or asystole is unlikely to have a therapeutic benefit.** (Neumar et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.5.1.3 PEA or asystole: There was a worse outcome of ROSC and survival for those who received shocks. Thus, it is not useful to shock asystole. (Neumar et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

11.5.2 Management of Bradycardia

Providers should always consider reversible causes of bradycardia before initiating therapy. Providers should only manage bradycardias were the cause of instability is considered to be rate related.

Dopamine may not be available in all settings.

11.5.2.1 If bradycardia produces signs and symptoms of instability (e.g. acutely altered mental status, ischemic chest discomfort, acute heart failure, hypotension, or other signs of shock that persist despite adequate airway and breathing), the initial treatment is atropine.

(Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

11.5.2.2 If bradycardia is unresponsive to atropine, IV infusion of alpha adrenergic agonists with rate-accelerating effects (dopamine, adrenaline) or transcutaneous pacing can be effective while the patient is prepared for emergent transvenous temporary pacing if required. (Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

11.5.3 Management of Tachycardia

Adenosine should be avoided in patients with known or suspected Wolf-Parkinson-White syndrome (as it may precipitate VF) and patients known with bronchial asthma (as it may precipitate severe bronchospasm).

11.5.3.1 If the tachycardic patient is unstable with severe signs and symptoms related to a suspected arrhythmia (e.g., acute altered mental status, ischemic chest discomfort, acute heart failure, hypotension, or other signs of shock), immediate cardioversion should be performed (with prior sedation in the conscious patient). (Neumar et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

This may be patient dependant as some patients with heart failure may experience rate related symptoms at lower heart rates. Rates above 150/min are generally considered pathological, but only if sinus origin is ruled out.

11.5.3.2 In select cases of regular narrow-complex tachycardia with unstable signs or symptoms, a trial of adenosine before cardioversion is reasonable. (Neumar et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.5.3.3 If not hypotensive, the patient with a regular narrow-complex supraventricular tachycardia (SVT) (likely due to suspected re-entry, paroxysmal supraventricular tachycardia, as described below) may be treated with adenosine while preparations are made for synchronised cardioversion. (Neumar et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

11.5.3.4 If paroxysmal supraventricular tachycardia does not respond to vagal manoeuvres, give 6 mg of IV adenosine as a rapid IV push through a large (e.g., antecubital) vein followed by a 20 mL saline flush. (Neumar et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs)

Adenosine has a very short half-life once injected into the bloodstream. It must be accompanied by a flush and be administered through a large vein as close to the heart as possible. It may be appropriate to attempt a second dose of 12 mg if no response to the initial dose.

11.5.4 Management of Atrial Fibrillation & Flutter

Electrical cardioversion should only be performed in unstable patients. Atrial fibrillation increases the risk of mural thrombus formation in the atria which may become dislodged when rhythm conversion occurs possibly resulting in a stroke. It is also for this reason that rhythm conversion in more stable patients using elective cardioversion or amiodarone is not appropriate in the pre-hospital setting for patients with atrial fibrillation or flutter. Stable patients should be transported to facilities where expert cardiology consultation is available.

11.5.4.1 Atrial Fibrillation: The recommended initial biphasic energy dose for cardioversion of atrial fibrillation is 120 to 200 J. (Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from multiple RCTs or meta-analysis.

11.5.4.2 Adult cardioversion of atrial fibrillation with monophasic waveforms should begin at 200 J and increase in a stepwise fashion if not successful. (Neumar et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

11.5.4.3 Treatment with an AV nodal blocking agent (including adenosine, calcium blockers, B-blockers, or digoxin) is unlikely to slow the ventricular rate and in some instances may accelerate the ventricular response. Therefore, AV nodal blocking drugs should not be used for pre-excited atrial fibrillation or flutter. (Neumar et al., 2010)

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

11.5.5 Wide Complex Tachycardia

Amiodarone may also cause prolongation of the QT interval and may not be appropriate in some irregular or polymorphic tachycardias. In cases where sodium channel blockade is part of the precipitating pathology lignocaine may be a more appropriate antiarrhythmic. The potassium blocking properties of amiodarone should also be considered in cases where hyperkalaemia exists, as amiodarone may impede the process of shifting therapies. When elective cardioversion is used patients may require procedural sedation and analgesia.

Procainamide and sotalol may not be available in all local setting and implementation may be costly. Amiodarone is considered an acceptable alternative.

11.5.5.1 If the aetiology of the rhythm cannot be determined, the rate is regular, and the QRS is monomorphic, recent evidence suggests that IV adenosine is relatively safe for both treatment and diagnosis. (Neumar et al., 2010)

Recommendation may be considered, Evidence from single RCTs or pseudo-RCTs.

It is possible in such cases that the presenting rhythm may be SVT with aberrancy.

11.5.5.2 However, adenosine should not be given for unstable or for irregular or polymorphic wide complex tachycardias, as it may cause degeneration of the arrhythmia to VF. (Neumar et al., 2010)

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

11.5.5.3 For patients who are stable with likely VT, IV antiarrhythmic drugs or elective cardioversion is the preferred treatment strategy. If IV antiarrhythmics are administered, [1] procainamide, [2] amiodarone, or sotalol can be considered. [3] Procainamide and sotalol should be avoided in patients with prolonged QT. [4] If one of these antiarrhythmic agents is given, a second agent should not be given without expert consultation. [5] If antiarrhythmic therapy is unsuccessful, cardioversion or expert consultation should be considered. (Neumar et al., 2010)

[1] *Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.*

[2] *Recommendation may be considered, Evidence from single RCTs or pseudo-RCTs.*

[3] *Recommendation may be considered, Evidence from single RCTs or pseudo-RCTs.*

[4] *Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.*

[5] *Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.*

11.6 Post Resuscitation Care

11.6.1 General Care

Neuroprotection is an important component of the post resuscitation care bundle. Aggressive management of seizures and sufficient sedation and analgesia is required. It should also be noted that the precipitating pathology which caused the initial arrest may still be present and would require further management to avoid re-arrest.

11.6.1.1 We recommend avoiding hypoxia in adults with ROSC after cardiac arrest in any setting.

(Callaway et al., 2015)

Strong recommendation, very-low-quality evidence.

Depending on care already rendered patients may require advanced airway management and artificial ventilation to be instituted or continued post cardiac arrest.

11.6.1.2 We suggest avoiding hyperoxia in adults with ROSC after cardiac arrest in any setting.

(Callaway et al., 2015)

Weak recommendation, very-low-quality evidence.

This requires titration of oxygen to FiO₂ values that maintain the patient's SpO₂ >94% although as indicated below may be best measured using blood gas analysis.

11.6.1.3 We suggest the use of 100% inspired oxygen until the arterial oxygen saturation or the partial pressure of arterial oxygen can be measured reliably in adults with ROSC after cardiac arrest in any setting. (Callaway et al., 2015)

Weak recommendation, very-low-quality evidence.

11.6.1.4 We suggest maintaining PaCO₂ within a normal physiological range as part of a post-ROSC bundle of care. (Callaway et al., 2015)

Weak recommendation, very-low-quality evidence.

11.6.1.5 We suggest hemodynamic goals (e.g., MAP, SBP) be considered during post-resuscitation care and as part of any bundle of post-resuscitation interventions. (Callaway et al., 2015)

(Callaway et al., 2015)

Weak recommendation, low-quality evidence.

This may include the initiation of inotropic support dependant on the patient's clinical presentation and comorbidities as well as the precipitating pathology. Adrenaline infusions have generally been used for this purpose immediately post cardiac arrest for patients with systolic blood pressures <70 mmHg. Post cardiac arrest myocardial dysfunction if not managed may result in patients suffering additional cardiac arrests. Arrhythmia may also be responsible for hypotension during this phase and should be managed accordingly.

11.6.1.6 There is insufficient evidence to recommend specific hemodynamic goals; such goals should be considered on an individual patient basis and are likely to be influenced by post-cardiac arrest status and pre-existing comorbidities. (Callaway et al., 2015)

Weak recommendation, low-quality evidence.

11.6.1.7 We suggest no modification of standard glucose management protocols for adults with ROSC after cardiac arrest. (Callaway et al., 2015)

Weak recommendation, moderate-quality evidence.

11.6.2 Temperature Management Post-Cardiac Arrest

Targeted temperature management is dependent on the presence of established local protocols and system capacity to implement such treatments. The ability to accurately measure core temperature in the pre-hospital setting as well as specialised cooling equipment is required.

11.6.2.1 We recommend against routine use of pre-hospital cooling with rapid infusion of large volumes of cold IV fluid immediately after ROSC. (Callaway et al., 2015)

Strong recommendation, moderate-quality evidence.

11.6.2.2 We recommend selecting and maintaining a constant target temperature between 32°C and 36°C for those patients in whom temperature control is used. (Callaway et al., 2015)

Strong recommendation, moderate-quality evidence.

11.6.2.3 Whether certain subpopulations of cardiac arrest patients may benefit from lower (32°C–34°C) or higher (36°C) temperatures remains unknown, and further research may help elucidate this. (Callaway et al., 2015)

Strong recommendation, moderate-quality evidence.

11.6.2.4 We recommend targeted temperature management as opposed to no targeted temperature management for adults with out-of-hospital cardiac arrest with an initial shockable rhythm who remain unresponsive after ROSC. (Callaway et al., 2015) *

Strong recommendation, low-quality evidence.

11.6.2.5 We suggest targeted temperature management as opposed to no targeted temperature management for adults with out-of-hospital cardiac arrest with an initial non-shockable rhythm who remain unresponsive after ROSC. (Callaway et al., 2015) *

Weak recommendation, very-low-quality evidence.

11.6.2.6 We suggest targeted temperature management as opposed to no targeted temperature management for adults with in-hospital cardiac arrest with any initial rhythm who remain unresponsive after ROSC. (Callaway et al., 2015) *

Weak recommendation, very-low-quality evidence.

12. Paediatric Resuscitation

For best survival and quality of life, paediatric BLS should be part of a community effort that includes prevention, early cardiopulmonary resuscitation, prompt access to the emergency response system, and rapid paediatric advanced life support, followed by integrated post-cardiac arrest care (Berg et al., 2010b).

In contrast to adults, cardiac arrest in infants and children does not usually result from a primary cardiac cause. More often it is the terminal result of progressive respiratory failure or shock, also called an asphyxial arrest. Asphyxia begins with a variable period of systemic hypoxaemia, hypercapnoea, and acidosis, progresses to bradycardia and hypotension, and culminates with cardiac arrest (Kleinman et al., 2010).

12.1 BLS CPR

12.1.1 Sequence & Assessment

Rapid and effective bystander CPR can be associated with successful return of spontaneous circulation (ROSC) and neurologically intact survival in children following out-of-hospital cardiac arrest (Berg et al., 2010b).

- Always make sure that the area is safe for you and the victim. Although provision of CPR carries a theoretical risk of transmitting infectious disease, the risk to the rescuer is very low (Berg et al., 2010b).
- To assess the need for CPR, the lay rescuer should assume that cardiac arrest is present if the victim is unresponsive and not breathing or only gasping (Berg et al., 2010b).
- Advanced life support providers should assess for a pulse in addition to determining unresponsiveness and lack of breathing - these recommendations relate to BLS CPR.
- If you see regular breathing, the victim does not need CPR. If there is no evidence of trauma, turn the child onto the side (recovery position), which helps maintain a patent airway and decreases risk of aspiration (Berg et al., 2010b).
- In infants and children, asphyxial cardiac arrest is more common than cardiac arrest from a primary cardiac event; therefore, ventilation may have greater importance during resuscitation of children (Atkins et al., 2015).

For the purposes of these guidelines, infant guidelines apply to infants younger than approximately 1 year of age; child guidelines apply to children approximately 1 year of age until puberty. For teaching purposes, puberty is defined as breast development in females and the presence of axillary hair in males. Adult guidelines apply at and beyond puberty (Atkins et al., 2015).

Concern has been expressed as to the conflict between guidelines from Paediatric Advanced Life Support (PALS) and Advanced Paediatric Life Support (APLS) approaches to the sequence of initiating CPR. Although evidence is thin, and can be interpreted in different ways, SA generally follows AHA guidelines and as such this approach is reflected here, although there may be little difference in the outcomes from either approach. "No human studies with clinical outcomes were identified that compared C-A-B and A-B-C approaches for initial management of cardiac arrest. The impact of time to first chest compression for C-A-B versus A-B-C sequence has been evaluated. Adult and paediatric manikin studies showed a significantly reduced time to first chest compression with the use of a C-A-B approach compared with an A-B-C approach. Data from 2 of these 3 studies demonstrated that time to first ventilation is delayed by only approximately 6 seconds when using a C-A-B sequence compared with an A-B-C sequence" (Atkins et al., 2015).

Further concern expressed over conflict between PALS and APLS recommended ratios of compressions to ventilations during paediatric CPR. Although the 2010 ILCOR recommendations state that "The ideal compression-to-ventilation ratio in infants and children is unknown." (Berg et al., 2010b), they give a rationale to support using a 30:2 ratio for children rather than 15:2. As above, SA uses a 30:2 ratio for single rescuer, and 15:2 for two trained providers in children.

- 12.1.1 Because of the limited amount and quality of the data, it may be reasonable to maintain the sequence from the 2010 Guidelines by initiating CPR with C-A-B over A-B-C sequence.** (Atkins et al., 2015)*

Recommendation may be considered, Evidence from consensus opinion.

- 12.1.2 Formal training as well as "just in time" training, such as that provided by an emergency response system dispatcher, should emphasise how to recognise the difference between gasping and normal breathing; rescuers should be instructed to provide CPR even when the unresponsive victim has occasional gasps.** (Berg et al., 2010b)

Recommendation is reasonable to perform; Evidence from expert consensus, case studies or series or standard of care.

- 12.1.3 If you are the only rescuer, provide 2 effective ventilations using as short a pause in chest compressions as possible after each set of 30 compressions.** (Berg et al., 2010b) *

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

- 12.1.4 It is reasonable for healthcare providers to tailor the sequence of rescue actions to the most likely cause of arrest. (For example, if the arrest is witnessed and sudden (e.g., sudden collapse in an adolescent or a child identified at high risk for arrhythmia or during an athletic event), the healthcare provider may assume that the victim has suffered a sudden VF–cardiac arrest and as soon as the rescuer verifies that the child is unresponsive and not breathing (or only gasping) the rescuer should immediately phone the emergency response system, get the AED and then begin CPR and use the AED).** (Berg et al., 2010b)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

- 12.1.5 If the infant or child is unresponsive and not breathing (gasps do not count as breathing), healthcare providers may take up to 10 seconds to attempt to feel for a pulse (brachial in an infant and carotid or femoral in a child) as well as looking for any signs of life. If, within 10 seconds, you don't feel a pulse or are not sure if you feel a pulse, and there is no sign of life, begin chest compressions.** ^{adapted}

- 12.1.6 Reassess the pulse about every 2 minutes but spend no more than 10 seconds doing so.** (Berg et al., 2010b)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

- 12.1.7 A lone rescuer uses a compression-to-ventilation ratio of 30:2. For 2-rescuer infant and child CPR, one provider should perform chest compressions while the other keeps the airway open and performs ventilations at a ratio of 15:2. Deliver ventilations with minimal interruptions in chest compressions.** (Berg et al., 2010b) *

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

- 12.1.8 All rescuers should perform chest compressions in all victims who are unresponsive and not breathing normally.** (Beygui et al., 2015) *

Recommended; Evidence from at least one RCT, pseudo-randomised trials, comparative studies with concurrent controls with historical controls.

12.1.2 Airway & Breathing

Rate

ILCOR recommends a compression rate of 100-120 per minute which conflicts with APLS recommendation of >120 for children. This is retained for simplicity of learning and SA unified approach.

- 12.1.2.1 For simplicity in CPR training, in the absence of sufficient paediatric evidence, it is reasonable to use the adult BLS recommended chest compression rate of 100/min to 120/min for infants and children.** (Atkins et al., 2015) *

Recommendation is reasonable to perform, Evidence from consensus opinion.

- 12.1.2.2 There is no evidence that a compression rate over 120 / minute offers any advantage.** (Australian Resuscitation Council, 2014c)

Recommended; Expert Consensus Opinion.

12.1.2.3 Then performing compressions, if feasible, change rescuers at least every two minutes to prevent rescuer fatigue and deterioration in chest compression quality, particularly depth. (Australian Resuscitation Council, 2014c)

Acceptable, Evidence obtained from case series, either post-test or pre-test and post-test, extrapolated evidence.

12.1.3 CPR Depth

- The 5 components of high quality CPR are (Atkins et al., 2015):
 - Ensuring chest compressions of adequate rate
 - Ensuring chest compressions of adequate depth
 - Allowing full chest recoil between compressions
 - Minimizing interruptions in chest compressions
 - Avoiding excessive ventilation

- There is insufficient evidence for or against a specific hand position for chest compressions during CPR. For victims receiving chest compressions, place the fingers or hand on the lower half of the sternum (Australian Resuscitation Council, 2014c).

12.1.3.1 It is reasonable that for paediatric patients (birth to the onset of puberty) rescuers provide chest compressions that depress the chest at least one third the anterior-posterior diameter of the chest. This equates to approximately 1.5 inches (4 cm) in infants to 2 inches (5 cm) in children. (Atkins et al., 2015)

Recommendation is reasonable to perform, Evidence from limited data.

12.1.3.2 Once children have reached puberty, the recommended adult compression depth of at least 5 cm, but no more than 6 cm, is used for the adolescent of average adult size.

(Atkins et al., 2015)

Recommendation is reasonable to perform, Evidence from limited data.

12.1.3.3 For an infant, lone rescuers (whether lay rescuers or healthcare providers) should compress the sternum with 2 fingers placed just below the intermammary line. (Berg et al., 2010b) *

Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

12.1.3.4 For a child, lay rescuers and healthcare providers should compress the lower half of the sternum at least one third of the AP dimension of the chest or approximately 5 cm (2 inches) with the heel of 1 or 2 hands. Do not press on the xiphoid or the ribs. There are no data to determine if the 1- or 2-hand method produces better compressions and better outcome. (Berg et al., 2010b)

Recommendation may be considered; Evidence from expert consensus, case studies or series or standard of care.

12.1.3.5 After each compression, allow the chest to recoil completely. (Berg et al., 2010b)

Recommendation may be considered; Evidence from single RCTs or pseudo-RCTs.

12.1.4 Compression Only CPR

12.1.4.1 Conventional CPR (chest compressions and rescue breaths) should be provided for paediatric cardiac arrests. (Atkins et al., 2015) *

Recommendation should be performed, Evidence from non-randomised studies.

Optimal CPR in infants and children includes both compressions and ventilations, but compressions alone are preferable to no CPR. (Berg et al., 2010b)

Recommendation should be performed; Evidence from single RCTs or pseudo-RCTs.

12.1.4.2 The asphyxial nature of the majority of paediatric cardiac arrests necessitates ventilation as part of effective CPR. However, because compression-only CPR is effective in patients with a primary cardiac event, if rescuers are unwilling or unable to deliver breaths, we recommend rescuers perform compression-only CPR for infants and children in cardiac arrest. (Atkins et al., 2015)

Recommendation should be performed, Evidence from non-randomised studies.

12.1.5 CPR Sequence

These guidelines delineate a series of skills as a sequence of distinct steps, but they should be performed simultaneously (e.g. starting CPR and activating the emergency response system) when there is more than one rescuer (Berg et al., 2010b).

If the infant or child is unresponsive and not breathing (gasps do not count as breathing), healthcare providers may take up to 10 seconds to attempt to feel for a pulse (brachial in an infant and carotid or femoral in a child) (Berg et al., 2010b).

12.1.5.1 Chest compressions should be immediately started by one rescuer, while a second rescuer prepares to start ventilations with a bag and mask. (Kleinman et al., 2010) *

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

12.1.5.2 In the victim with a perfusing rhythm but absent or inadequate respiratory effort, give 1 breath every 3 to 5 seconds (12 to 20 breaths per minute), using the higher rate for the younger child. (Kleinman et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

12.2 IV/IO Access in Resuscitation & Weight Calculation

- All IV medications can be administered IO, including adrenaline, adenosine, fluids, blood products, and catecholamines. Onset of action and drug levels for most drugs are comparable to venous administration (Kleinman et al., 2010).
- Peripheral IV access is acceptable during resuscitation if it can be placed rapidly, but placement may be difficult in a critically ill child (Kleinman et al., 2010).
- Vascular access (IO or IV) is the preferred method for drug delivery during CPR, but if it is not possible, lipid-soluble drugs, such as lidocaine, adrenaline, atropine, and naloxone (mnemonic "LEAN") can be administered via an endotracheal tube. However, the effects may not be uniform with tracheal as compared with IV administration (Kleinman et al., 2010).
- Optimal endotracheal doses of medications are unknown; in general expert consensus recommends doubling or tripling the dose of lidocaine, atropine or naloxone given via the ETT. For adrenaline, a dose ten times the IV dose (0.1 mg/kg or 0.1 mL/kg of 1:1000 concentration) is recommended (Kleinman et al., 2010).

12.2.1 IO access is a rapid, safe, effective, and acceptable route for vascular access in children, and it is useful as the initial vascular access in cases of cardiac arrest. (Kleinman et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

12.2.2 To calculate the dose of resuscitation medications, use the child's weight if it is known. If the child's weight is unknown, it is reasonable to use a body length tape with pre-calculated doses. (Kleinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

12.2.3 Regardless of the patient's habitus, use the actual body weight for calculating initial resuscitation drug doses or use a body length tape with pre-calculated doses. (Kleinman et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

12.3 Advanced Life Support Medications in Resuscitation

Sodium bicarbonate should be administered only in specific cases according to the suspected aetiology of arrest (e.g. hyperkalaemia).

12.3.1 Calcium administration is not recommended for paediatric cardiopulmonary arrest in the absence of documented hypocalcaemia, calcium channel blocker overdose, hypomagnesaemia, or hyperkalaemia. (Kleinman et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

12.3.2 Infants: Check blood glucose concentration during the resuscitation and treat hypoglycaemia promptly. (Kleinman et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

12.3.3 Routine administration of sodium bicarbonate is not recommended in cardiac arrest. (Kleinman et al., 2010)

Recommendation should not be performed; Evidence from single RCTs or pseudo-RCTs.

12.3.4 For shock-refractory VF or pulseless VT, either amiodarone or lidocaine may be used. (van der Jagt et al., 2015) *

Recommendation may be considered; Evidence from limited data.

Adrenaline in Resuscitation

12.3.5 It is reasonable to administer adrenaline in paediatric cardiac arrest. (van der Jagt et al., 2015)

Recommendation is reasonable to perform, Evidence from limited data.

12.3.6 Adrenaline in Non-Shockable Arrest Rhythms: A second rescuer obtains vascular access and delivers adrenaline, 0.01 mg/kg (0.1 mL/kg of 1:10 000 solution) maximum of 1 mg (10 mL), while CPR is continued. The same adrenaline dose is repeated every 3 to 5 minutes. (Kleinman et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

12.3.7 There is no survival benefit from high-dose adrenaline, and it may be harmful, particularly in asphyxia. (Kleinman et al., 2010)

Recommendation should not be performed, Evidence from single RCTs or pseudo-RCTs.

12.3.8 Adrenaline for shockable rhythms: During CPR give adrenaline 0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration), maximum of 1 mg. (Kleinman et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

12.4 Bag Valve Mask Ventilation & Cricoid

See Section 10.1.4, Paediatric BLS Airway

12.5 Bag Valve Tube Ventilation (Asynchronous Ventilation)

See also Section 10.7, Paediatric Advanced Airway Management

12.5.1 If the infant or child is intubated, ventilate at a rate of about 1 breath every 6 to 8 seconds (8 to 10 times per minute) without interrupting chest compressions. It may be reasonable to do the same if an LMA is in place. (Kleinman et al., 2010)*

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care).

- 12.5.2 In the victim with a perfusing rhythm but absent or inadequate respiratory effort, give 1 breath every 3 to 5 seconds (12 to 20 breaths per minute), using the higher rate for the younger child.** (Kleinman et al., 2010)

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

12.6 Paediatric Defibrillation

In general, manual defibrillators have two sizes of hand-held paddles: adult and infant. The infant paddles may slide over or be located under the adult paddles. Manual defibrillators can also be used with hands-free pads that are self-adhesive. Use the largest paddles or self-adhering electrodes that will fit on the child's chest without touching (Kleinman et al., 2010).

Place manual paddles over the right side of the upper chest and the apex of the heart (to the left of the nipple over the left lower ribs) so the heart is between the two paddles. Apply firm pressure. There is no advantage to an anterior-posterior position of the paddles (Kleinman et al., 2010).

- 12.6.1 For infants a manual defibrillator is preferred when a shockable rhythm is identified by a trained healthcare provider.** (Berg et al., 2010b)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

- 12.6.2 In infants 1 year of age a manual defibrillator is preferred. If a manual defibrillator is not available, an AED with a dose attenuator may be used. An AED without a dose attenuator may be used if neither a manual defibrillator nor one with a dose attenuator is available.**

(Kleinman et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

- 12.6.3 An AED with a paediatric attenuator is also preferred for children 8 year of age. If neither is available, an AED without a dose attenuator may be used.** (Berg et al., 2010b)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

- 12.6.4 VF: It is acceptable to use an initial dose of 2 to 4 J/kg, but for ease of teaching an initial dose of 4 J/kg may be considered.** ^{adapted}

- 12.6.5 For refractory VF, it is reasonable to use to 4 J/kg. Subsequent energy levels should be at least 4 J/kg, and higher energy levels may be considered, not to exceed 10 J/kg or the adult maximum dose.** ^{adapted}

12.7 Hypovolaemic Shock

- 12.7.1 Use an isotonic crystalloid solution (e.g. Ringer's lactate solution or normal saline) as the initial fluid for the treatment of shock.** (Kleinman et al., 2010)

Recommendation should be performed, Evidence from multiple RCTs or meta-analysis.

- 12.7.2 Treat signs of shock with a bolus of 10-20 mL/kg of isotonic crystalloid even if blood pressure is normal.** *adapted*

12.8 Paediatric Trauma

Common errors in paediatric trauma resuscitation include failure to open and maintain the airway, failure to provide appropriate fluid resuscitation, and failure to recognize and treat internal bleeding. Involve a qualified surgeon early and, if possible, transport a child with multisystem trauma to a trauma centre with paediatric expertise (Kleinman et al., 2010).

Consider intra-abdominal haemorrhage, tension pneumothorax, pericardial tamponade, and spinal cord injury in infants and children, and intracranial haemorrhage in infants, as causes of shock (Kleinman et al., 2010).

- 12.8.1 Do not routinely hyperventilate even in case of head injury.** (Kleinman et al., 2010)*

Recommendation should not be performed, Evidence from expert consensus, case studies or series or standard of care.

12.9 Paediatric CPR: Oxygenation

See also Section 7.3, Paediatric Asthma

Note that blood pressure may be a late sign of shock in paediatric patients, and difficult to measure. Identification and treatment of shock should take other clinical signs into account, not just blood pressure.

Ventilation for head injured children should ideally be guided by end tidal capnography readings and maintained at the lower end of the range but not below.

12.10 Paediatric CPR: Family Presence

12.9.1 Whenever possible, provide family members with the option of being present during resuscitation of an infant or child. (Kleinman et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

12.11 Asystole/ Severe Bradycardia During Cardiac Arrest

12.11.1 Asystole or pulseless severe bradycardia less than 60 bpm which is unresponsive to oxygen and mechanical ventilation should be treated with adrenaline 10mcg/kg via IV or IO routes. (Australian Resuscitation Council, 2010) *

Expert Consensus Opinion.

12.11.2 If these routes are not available, adrenaline 100 mcg/kg should be administered via the endotracheal tube, but this route is the least desirable. (Australian Resuscitation Council, 2010)

Expert Consensus Opinion.

12.11.3 If after adrenaline sinus rhythm cannot be restored, sodium bicarbonate 1mmol/kg IV or IO with additional doses of adrenaline may be considered. (Australian Resuscitation Council, 2010) *

Expert Consensus Opinion.

12.12 Bradycardia

Emergency treatment of bradycardia is indicated when the rhythm results in hemodynamic compromise (Kleinman et al., 2010).

Pacing is not useful for asystole or bradycardia due to post-arrest hypoxic/ ischemic myocardial insult or respiratory failure (Kleinman et al., 2010).

12.12.1 Bradycardia: Continue to support airway, ventilation, oxygenation, and chest compressions (Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs). If bradycardia persists or responds only transiently, give ep adrenaline inephrine IV (or IO) 0.01 mg/kg (0.1 mL/kg of 1:10,000 solution) or if IV/IO access not available, give endotracheally 0.1 mg/kg (0.1 mL/kg of 1:1,000 solution). (Kleinman et al., 2010) *

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

12.12.2 If bradycardia is due to increased vagal tone or primary AV conduction block (i.e. not secondary to factors such as hypoxia), give IV/IO atropine 0.02 mg/kg or an endotracheal dose of 0.04 to 0.06 mg/kg. (Kleinman et al., 2010) *

Recommendation should be performed, Evidence from expert consensus, case studies or series or standard of care.

12.12.3 Emergency transcutaneous pacing may be lifesaving if the bradycardia is due to complete heart block or sinus node dysfunction unresponsive to ventilation, oxygenation, chest compressions, and medications, especially if it is associated with congenital or acquired heart disease. (Kleinman et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

12.13 Ventricular Fibrillation & Pulseless Ventricular Tachycardia

12.13.1 If the onset of VF or pulseless VT is witnessed on an ECG monitor, such as in the ICU environment (see below), defibrillation should be attempted before any other treatment. In this circumstance also, a precordial thump may be given as a safe action, although its efficacy in children has not been proven. (Australian Resuscitation Council, 2010) *

Expert Consensus Opinion.

12.13.2 The ideal energy dose for safe and effective paediatric defibrillation is unknown. The recommended initial monophasic or biphasic shock treatment of VF or pulseless VT is a single shock of 4 joules per kilogram (J/kg) followed immediately by 2 minutes of CPR without waiting to analyse the rhythm and then by another monophasic or biphasic shock of 4 J/kg if VF or pulseless VT continues, followed by CPR for 2 minutes. (Australian Resuscitation Council, 2010)

Recommended; Evidence from case series, either post-test or pre-test and post-test.

12.14 Tachycardia

SVT: Attempt vagal stimulation first, unless the patient is hemodynamically unstable. In infants and young children, apply ice to the face without occluding the airway. In older children, carotid sinus massage or Valsalva manoeuvres are safe (Kleinman et al., 2010).

Because all arrhythmia therapies have a potential for serious adverse effects, consultation with an expert in paediatric arrhythmias is strongly recommended before treating children who are hemodynamically stable (Kleinman et al., 2010).

12.14.1 SVT: Attempt vagal stimulation first, unless the patient is hemodynamically unstable, or the procedure will unduly delay chemical or electric cardioversion. (Kleinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

12.14.2 SVT: If IV/IO access is readily available, adenosine is the drug of choice. (Kleinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

12.14.3 SVT: If the patient is hemodynamically unstable or if adenosine is ineffective, perform electric synchronised cardioversion. Use sedation, if possible. Start with a dose of 0.5 to 1 J/kg. If unsuccessful, increase the dose to 2 J/kg. (Kleinman et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

12.14.4 SVT: Consider amiodarone 5 mg/kg IO/IV for a patient with SVT unresponsive to vagal manoeuvres and adenosine and/or electric cardioversion; for hemodynamically stable patients, expert consultation is strongly recommended prior to administration. (Kleinman et al., 2010) *

*2010) **

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

- 12.14.5 Wide Complex Tachycardia: Consider electric cardioversion after sedation using a starting energy dose of 0.5 to 1 J/kg. If that fails, increase the dose to 2 J/kg.** (Kleinman et al., 2010) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

12.15 Post Resuscitation Care

The goals of post-resuscitation care are to preserve neurologic function, prevent secondary organ injury, diagnose and treat the cause of illness, and enable the patient to arrive at a paediatric tertiary-care facility in an optimal physiologic state (Kleinman et al., 2010).

Control pain and discomfort with analgesics (e.g., fentanyl or morphine) and sedatives (e.g., lorazepam or midazolam) (Kleinman et al., 2010).

Insert a gastric tube to relieve and help prevent gastric inflation (Kleinman et al., 2010).

- 12.15.1 Monitor exhaled CO₂ (PETCO₂), especially during transport and diagnostic procedures.** (Kleinman et al., 2010)

Recommendation is reasonable to perform, Evidence from single RCTs or pseudo-RCTs.

- 12.15.2 It is reasonable for practitioners to target a PaCO₂ after ROSC that is appropriate to the specific patient condition, and limit exposure to severe hypercapnia or hypocapnia.** (van der Jagt et al., 2015)

Recommendation may be considered, Evidence from limited data.

- 12.15.3 After ROSC, we recommend that parenteral fluids and/or inotropes or vasoactive drugs be used to maintain a systolic blood pressure greater than fifth percentile for age.** (van der Jagt et al., 2015)

Recommendation may be considered, Evidence from limited data.

- 12.15.4 When appropriate resources are available, continuous arterial pressure monitoring is recommended to identify and treat hypotension.** (van der Jagt et al., 2015)

Recommendation should be performed, Evidence from consensus opinion.

- 12.15.5 Therapeutic hypothermia (32°C to 34°C) may be considered for children who remain comatose after resuscitation from cardiac arrest (only in the setting where specifically authorised and supported by receiving hospital). It is reasonable for adolescents resuscitated from sudden, witnessed, out-of-hospital VF cardiac arrest.** ^{adapted}

- 12.15.6 Monitor temperature continuously, if possible, and treat fever (38°C) aggressively with antipyretics and cooling devices because fever adversely influences recovery from ischemic brain injury.** (Kleinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

12.16 Termination of Resuscitation

- Family presence during CPR is increasingly common, and most parents would like to be given the opportunity to be present during resuscitation of their child (Kleinman et al., 2010).
- Members of the resuscitation team must be sensitive to the presence of family members, and one person should be assigned to remain with the family to comfort, answer questions, and support the family (Kleinman et al., 2010).
- There are no reliable predictors of outcome to guide when to terminate resuscitative efforts in children (Kleinman et al., 2010).

12.16.1 **Whenever possible, provide family members with the option of being present during resuscitation of an infant or child.** (Kleinman et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

12.16.2 **If the presence of family members creates undue staff stress or is considered detrimental to the resuscitation, then family members should be respectfully asked to leave.** (Kleinman et al., 2010)

Recommendation is reasonable to perform, Evidence from expert consensus, case studies or series or standard of care.

12.16.3 **Multiple variables should be used when attempting to prognosticate outcomes during cardiac arrest. Although there are factors associated with better or worse outcomes, no single factor studied predicts outcome with sufficient accuracy to recommend termination or continuation of CPR.** (van der Jagt et al., 2015)

Recommendation should be performed, Evidence from limited data.

13. Neonatal Resuscitation

13.1 Chest Compressions

Monitoring equipment for neonates and infants may not be uniformly available to all EMS providers. All ALS providers should have monitoring equipment appropriate for neonates.

- 13.1.1 Compressions are delivered on the lower third of the sternum to a depth of approximately one third of the anterior-posterior diameter of the chest.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

- 13.1.2 Because the 2-thumb technique generates higher blood pressures and coronary perfusion pressure with less rescuer fatigue, the 2 thumb–encircling hands technique is suggested as the preferred method.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

- 13.1.3 It is still suggested that compressions and ventilations be coordinated to avoid simultaneous delivery. The chest should be allowed to re-expand fully during relaxation, but the rescuer's thumbs should not leave the chest. The Neonatal Resuscitation ILCOR and Guidelines Task Forces continue to support use of a 3:1 ratio of compressions to ventilation, with 90 compressions and 30 breaths to achieve approximately 120 events per minute to maximise ventilation at an achievable rate.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

- 13.1.4 Respirations, heart rate, and oxygenation should be reassessed periodically, and coordinated chest compressions and ventilations should continue until the spontaneous heart rate is >60 per minute.** ^{adapted}

- 13.1.5 A 3:1 compression-to-ventilation ratio is used for neonatal resuscitation where compromise of gas exchange is nearly always the primary cause of cardiovascular collapse, but rescuers may consider using higher ratios (e.g., 15:2) if the arrest is believed to be of cardiac origin.** (Wyckoff et al., 2015) *

Recommendation may be considered, Evidence from consensus opinion.

Older infants still within first 28 days of life may require compression to ventilation ratios of 15:2.

- 13.1.6 The Neonatal Guidelines Writing Group endorses increasing the oxygen concentration to 100% whenever chest compressions are provided.** (Wyckoff et al., 2015)

Recommendation is reasonable to perform, Evidence from consensus opinion.

- 13.1.7 To reduce the risks of complications associated with hyperoxia the supplementary oxygen concentration should be weaned as soon as the heart rate recovers.** (Wyckoff et al., 2015)

Recommendation should be performed, Evidence from limited data.

- 13.1.8 The current measure for determining successful progress in neonatal resuscitation is to assess the heart rate response. Other devices, such as end-tidal CO₂ monitoring and**

pulse oximetry, may be useful techniques to determine when return of spontaneous circulation occurs. However, in asystolic/bradycardic neonates, we suggest against the routine use of any single feedback device such as ETCO₂ monitors or pulse oximeters for detection of return of spontaneous circulation, as their usefulness for this purpose in neonates has not been well established. (Wyckoff et al., 2015) *

Recommendation may be considered, Evidence from limited data.

The above mentioned equipment should be available on all units transporting and resuscitating neonates.

- 13.1.9 **During resuscitation of term and preterm newborns, the use of 3-lead ECG for the rapid and accurate measurement of the newborn's heart rate may be reasonable.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

13.2 Airway Management & Ventilation During Neonatal Resuscitation

13.2.1 Oxygen Administration

- 13.2.1.1 **It is recommended that oximetry be used when resuscitation can be anticipated, when PPV is administered, when central cyanosis persists beyond the first 5 to 10 minutes of life, or when supplementary oxygen is administered.** (Kattwinkel et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

- 13.2.1.2 **It is reasonable to initiate resuscitation with air (21% oxygen at sea level).** (Kattwinkel et al., 2010)*

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

This recommendation applies to term infants.

- 13.2.1.3 **Supplementary oxygen may be administered and titrated to achieve a preductal oxygen saturation approximating the interquartile range measured in healthy term infants after vaginal birth at sea level.** (Kattwinkel et al., 2010)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

- 13.2.1.4 **In all studies, irrespective of whether air or high oxygen (including 100%) was used to initiate resuscitation, most infants were in approximately 30% oxygen by the time of stabilisation. Resuscitation of preterm newborns of less than 35 weeks of gestation should be initiated with low oxygen (21% to 30%), and the oxygen concentration should be titrated to achieve preductal oxygen saturation approximating the interquartile range measured in healthy term infants after vaginal birth at sea level.** (Wyckoff et al., 2015)*

Recommendation should be performed, Evidence from randomised studies.

If no blending is available, consider 21%. Another option is to use a self-inflating bag with 1 L/min of oxygen flow. This will provide less than 100% O₂ but still greater than 40% O₂ and can be used as an intermediate step before weaning to air (Thio et al., 2014).

13.2.1.5 Initiating resuscitation of preterm newborns with high oxygen (65% or greater) is not recommended. (Wyckoff et al., 2015)

Recommendation should not be performed: No Benefit, Evidence from randomised studies.

It should be noted that resuscitation in neonates is initiated with ventilation before chest compression, as mentioned before in this CPG, it is considered appropriate to increase the FiO₂ to 1.0 when chest compressions are required.

13.2.2 Positive Pressure Ventilation

13.2.1.6 Inflation pressure should be monitored; an initial inflation pressure of 20 cm H₂O may be effective, but ≥ 30 to 40 cm H₂O may be required in some term babies without spontaneous ventilation. (Kattwinkel et al., 2010) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

It is rare that inflation pressures greater than 30 cm H₂O are needed.

13.2.1.7 In summary, assisted ventilation should be delivered at a rate of 40 to 60 breaths per minute to promptly achieve or maintain a heart rate of 100 per minute. (Kattwinkel et al., 2010) *

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.2.1.8 Target inflation pressures and long inspiratory times are more consistently achieved in mechanical models when T-piece devices are used rather than bags, although the clinical implications of these findings are not clear. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.2.1.9 Resuscitators are insensitive to changes in lung compliance, regardless of the device being used. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.1.10 There is insufficient data regarding short and long-term safety and the most appropriate duration and pressure of inflation to support routine application of sustained inflation of greater than 5 seconds' duration to the transitioning newborn. (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from randomised studies.

- 13.1.11 In 2015, the Neonatal Resuscitation ILCOR and Guidelines Task Forces repeated their 2010 recommendation that, when PPV is administered to preterm newborns, approximately 5 cm H₂O PEEP is suggested.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from randomised studies.

- 13.1.12 PPV can be delivered effectively with a flow-inflating bag, self-inflating bag, or T-piece resuscitator.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from randomised studies.

- 13.2.2.1 Use of respiratory mechanics monitors have been reported to prevent excessive pressures and tidal volumes and exhaled CO₂ monitors may help assess that actual gas exchange is occurring during face-mask PPV attempts. Although use of such devices is feasible, thus far their effectiveness, particularly in changing important outcomes, has not been established.** (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from limited data.

- 13.1.13 Laryngeal masks, which fit over the laryngeal inlet, can achieve effective ventilation in term and preterm newborns at 34 weeks or more of gestation. Data are limited for their use in preterm infants delivered at less than 34 weeks of gestation or who weigh less than 2000g. A laryngeal mask may be considered as an alternative to tracheal intubation if face-mask ventilation is unsuccessful in achieving effective ventilation.** (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from randomised studies.

- 13.1.14 A laryngeal mask is recommended during resuscitation of term and preterm newborns at 34 weeks or more of gestation when tracheal intubation is unsuccessful or is not feasible.** (Wyckoff et al., 2015)

Recommendation should be performed, Evidence from consensus studies.

The use mechanical resuscitation devices (such as the neopuff) is recommended however the cost and availability of implementing the use of these devices may be limiting. It may be considered particularly important for specialised units regularly transporting neonates in the case of interfacility transfers.

13.2.3 Continuous Positive Airway Pressure (CPAP)

Whilst it would be ideal when resources permit to have a neopuff or ventilator capable of performing nasal CPAP, this may not be possible in all settings. Dedicated neonatal intensive care unit (NICU)/ICU vehicles however need to have the facility/skills to perform CPAP. High flow nasal oxygen may present a more feasible alternative in some resource limited settings. High flow nasal oxygen use has similar rates of efficacy to other forms of non-invasive respiratory support in preterm infants for preventing treatment failure, death and chronic lung disease. Most evidence is available for the use of high flow nasal oxygen as post-extubation support. Following extubation, use of high flow nasal oxygen is associated with less nasal trauma, and may be associated with reduced pneumothorax rates compared with nasal CPAP. Further adequately powered randomised controlled trials should be undertaken in preterm infants comparing high flow nasal oxygen with other forms of primary non-invasive support after birth and for weaning from non-invasive support. Further evidence is also required for evaluating the safety and efficacy of high flow nasal oxygen in extremely preterm and mildly preterm subgroups, and for comparing different high flow nasal oxygen devices (Wilkinson et al., 2016).

13.2.3.1 Based on this evidence, spontaneously breathing preterm infants with respiratory distress may be supported with CPAP initially rather than routine intubation for administering PPV.

(Wyckoff et al., 2015) *

Recommendation may be considered, Evidence from randomised studies.

13.3.4 Airway Management and Suctioning

13.2.1.10 Suctioning immediately after birth, whether with a bulb syringe or suction catheter, may be considered only if the airway appears obstructed or if NIPPV is required. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.2.1.11 Although last reviewed in 2010, exhaled CO₂ detection remains the most reliable method of confirmation of endotracheal tube placement. (Kattwinkel et al., 2010) *

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

It may be available to use a constellation of confirmation techniques including ETCO₂ as opposed to relying on one technique.

13.2.1.12 However, if the infant born through meconium-stained amniotic fluid presents with poor muscle tone and inadequate breathing efforts, the initial steps of resuscitation should be completed in a warmed environment where possible (If in the out of hospital setting). PPV should be initiated if the infant is not breathing or the heart rate is less than 100/min after the initial steps are completed. Routine intubation for tracheal suction in this setting is not suggested, because there is insufficient evidence to continue recommending this practice. ^{adapted}

13.3 Management of the Umbilical Cord and Temperature Regulation

13.3.1 Umbilical Cord Management

13.3.1.1 In summary, from the evidence reviewed in the 2010 CoSTR and subsequent review of delaying cord clamping and cord milking in preterm newborns in the 2015 ILCOR systematic review, delaying cord clamping for longer than 30 seconds is reasonable for both term and preterm infants who do not require resuscitation at birth. (Wyckoff et al., 2015)
Recommendation is reasonable to perform, Evidence from limited data.

13.3.1.2 There is insufficient evidence to recommend an approach to cord clamping for infants who require resuscitation at birth and more randomised trials involving such infants are encouraged. In light of the limited information regarding the safety of rapid changes in blood volume for extremely preterm infants, we suggest against the routine use of cord milking for infants born at less than 29 weeks of gestation outside of a research setting. Further study is warranted because cord milking may improve initial mean blood pressure, hematologic indices, and reduce intracranial haemorrhage, but thus far there is no evidence for improvement in long-term outcomes. (Wyckoff et al., 2015)
Recommendation may be considered, Evidence from limited data.

13.3.2 Temperature Management

13.3.2.1 Preterm infants are especially vulnerable. Hypothermia is also associated with serious morbidities, such as increased respiratory issues, hypoglycaemia, and late-onset sepsis. Because of this, admission temperature should be recorded as a predictor of outcomes as well as a quality indicator. (Wyckoff et al., 2015) (Wyckoff et al., 2015)
Recommendation should be performed, Evidence from non-randomised studies.

13.3.2.2 It is recommended that the temperature of newly born non-asphyxiated infants be maintained between 36.5°C and 37.5°C after birth through admission and stabilisation. (Wyckoff et al., 2015)
Recommendation should be performed, Evidence from non-randomised studies.

13.3.1.3 The use of radiant warmers and plastic wrap with a cap has improved but not eliminated the risk of hypothermia in preterms in the delivery room. Other strategies have been introduced, which include increased room temperature, thermal mattresses, and the use of warmed humidified resuscitation gases. Various combinations of these strategies may

be reasonable to prevent hypothermia in infants born at less than 32 weeks of gestation.

(Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

13.3.1.4 Compared with plastic wrap and radiant warmer, the addition of a thermal mattress, warmed humidified gases and increased room temperature plus cap plus thermal mattress were all effective in reducing hypothermia. For all the studies, hyperthermia was a concern, but harm was not shown. Hyperthermia (greater than 38.0°C) should be avoided due to the potential associated risks. (Wyckoff et al., 2015) *

Recommendation should not be performed: Harm, Evidence from consensus opinion.

In the pre-hospital environment, the minimum warming measures should consist of a cap, plastic wrap, kangaroo mother care, and/ or warmed room (ambulance) temperature. Other interventions such as thermal mattresses, incubators and warmed humidified ventilation gases may be limited to dedicated NICU/ICU vehicles due to resource implications.

13.3.1.5 The traditional recommendation for the method of rewarming neonates who are hypothermic after resuscitation has been that slower is preferable to faster rewarming to avoid complications such as apnoea and arrhythmias. However, there is insufficient current evidence to recommend a preference for either rapid (0.5°C/h or greater) or slow rewarming (less than 0.5°C/h) of unintentionally hypothermic newborns (temperature less than 36°C) at hospital admission. Either approach to rewarming may be reasonable.

(Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

13.3.1.6 In resource-limited settings, to maintain body temperature or prevent hypothermia during transition (birth until 1 to 2 hours of life) in well newborn infants, it may be reasonable to put them in a clean food-grade plastic bag up to the level of the neck and swaddle them after drying. (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

13.3.1.7 Another option that may be reasonable is to nurse such newborns with skin-to-skin contact or kangaroo mother care. (Wyckoff et al., 2015)

Recommendation may be considered, Evidence from limited data.

13.3.2.3 All resuscitation procedures, including endotracheal intubation, chest compression, and insertion of IV lines, can be performed with these temperature-controlling interventions in place. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.4 Pharmacological Interventions and Volume Expansion

13.4.1 Pharmacological Administration

13.4.2.1 Dosing recommendations remain unchanged from 2010. IV administration of adrenaline may be considered at a dose of 0.01 to 0.03 mg/kg of 1:10 000 adrenaline. If an

endotracheal administration route is attempted while IV access is being established, higher dosing will be needed at 0.05 to 0.1 mg/kg. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.4.2.2 Given the lack of supportive data for endotracheal adrenaline, it is reasonable to provide drugs by the IV route as soon as IV access is established. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.4.3 Volume Expansion

13.4.3.1 Volume expansion may be considered when blood loss is known or suspected (pale skin, poor perfusion, weak pulse) and the infant's heart rate has not responded adequately to other resuscitative measures. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.4.3.2 An isotonic crystalloid solution or blood may be useful for volume expansion in the delivery room. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

Local expert opinion suggests that blood administration should be reserved for the hospital setting.

13.4.3.3 The recommended dose is 10 mL/kg, which may need to be repeated. When resuscitating premature infants, care should be taken to avoid giving volume expanders rapidly, because rapid infusions of large volumes have been associated with IVH. (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

13.5 Post Resuscitation Care

13.5.1 Evidence suggests that use of therapeutic hypothermia in resource-limited settings (i.e. lack of qualified staff, inadequate equipment, etc.) may be considered and offered under clearly defined protocols similar to those used in published clinical trials and in facilities with the capabilities for multidisciplinary care and longitudinal follow-up. (Wyckoff et al., 2015) *

Recommendation may be considered.

Targeted temperature management required specific equipment and well established systems and protocol and system wide clinical governance. In neonates it may also require the establishment of dedicated, specialized and equipped retrieval teams.

13.6 Withholding & Discontinuing Resuscitation

- 13.6.1 **We suggest that, in infants with an Apgar score of 0 after 10 minutes of resuscitation, if the heart rate remain undetectable, it may be reasonable to stop assisted ventilations; however, the decision to continue or discontinue resuscitative efforts must be individualised. Variables to be considered may include whether the resuscitation was considered optimal; availability of advanced neonatal care, such as therapeutic hypothermia; specific circumstances before delivery (e.g., known timing of the insult); and wishes expressed by the family.** (Wyckoff et al., 2015) *

Recommendation may be considered, Evidence from limited data.

Consideration must be given to the use of opiates for the mother in the event of the newborn who is not breathing (and therefore has a decreased HR).

- 13.6.2 **The 2010 Guidelines provide suggestions for when resuscitation is not indicated, when it is nearly always indicated, and that under circumstances when outcome remains unclear, that the desires of the parents should be supported.** (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

- 13.6.3 **It is still suggested that briefing and debriefing techniques be used whenever possible for neonatal resuscitation.** (Kattwinkel et al., 2010)

Recommendation may be considered, Evidence from expert consensus, case studies or series or standard of care.

14. CVA (STROKE) & TIA

There is growing evidence that good early stroke management can reduce damage to the brain and minimise the effects of stroke. Because of this early recognition of stroke, the subsequent response of individuals to having a stroke, and the timing and method by which people are transferred to hospital are important to ensure optimal outcomes. In this hyperacute phase of care, the ambulance service provides a central, coordinating role (Australian Government Health and Medical Research Council, 2007).

14.1 Ambulance Dispatch & Prioritisation for Stroke Patients

14.1.1 General plans and urgency

14.1.1.1 Local protocols developed jointly by staff from pre-hospital emergency services, the hospital emergency centre and the acute stroke team should be used for all people with suspected stroke. Such protocols should include systems to receive early notification by paramedic staff, high priority transportation and triage, rapid referrals from emergency centre staff to stroke specialists and rapid access to imaging. (Stroke Foundation of New Zealand, 2010)

Body of evidence provides some support for recommendation, but care should be taken in its application.

14.1.1.2 Stroke is a medical emergency that requires urgent neurological care so patients who are suspected of having an acute stroke must be sent to hospital in the least possible time. (Spanish NHS Ministry of Science and Innovation, 2009)

Body of evidence can be trusted to guide practice in most situations.

14.1.1.3 All community medical services and ambulance services (including call handlers) should be trained to treat patients with symptoms suggestive of an acute stroke as an emergency requiring urgent transfer to a centre with specialised hyperacute stroke services. (Royal College of Physicians, 2012)

Grading embedded in recommendation.

14.1.2 Activation

SA stroke services are not universal across institutions, with a minority of facilities, largely in the private sector, offering a dedicated stroke service with the potential for early imaging and reperfusion strategies. Local resources and policies should dictate where stroke patients are transported to, but EMS practitioners will often be the primary decision maker on the destination facility and need to make appropriate decisions based on the clinical assessment and local resources.

14.1.2.1 Activation of the EMS system by patients or other members of the public is strongly recommended. Dispatchers should make stroke a priority dispatch, and transport times should be minimised. (Jauch et al., 2013)

Evidence from single RCTs or pseudo-RCTs.

14.1.3 Evaluation & Scales

- The Cincinnati Prehospital Stroke Scale (CPSS) looks for the presence of one or several of the following symptoms is evaluated:
 - Facial asymmetry
 - loss of strength in arms
 - dysarthria
- Its aim is to identify stroke patients who may be candidates for receiving thrombolysis (Spanish NHS Ministry of Science and Innovation, 2009).
- The Los Angeles Prehospital Stroke Screen (LAPSS) requires that the provider rule out other causes of altered level of consciousness (e.g. history of seizures, hypoglycaemia) and then identify asymmetry in any of 3 examination categories: facial smile or grimace, grip, and arm strength (Jauch et al., 2010).

There are a large number of assessment tools that have been developed for use in acute stroke management (examples include National Institutes of Health Stroke Scale, Modified Rankin Score, Scandinavian Stroke Scale). However, given the enormous variety of assessment tools and measures it is beyond the scope of this guideline to make specific recommendations regarding which measures or tools should be used in each circumstance. It is important that all services carefully chose a specific tool based on the validity, reliability and availability of such tools and be trained in the use of the chosen tool. It is also important to balance the use of a detailed assessment (which may take considerable time) with the need to provide early and active interventions (Australian Government Health and Medical Research Council, 2007). Specific training for ambulance staff improves diagnostic accuracy and reduces pre-hospital delays (Stroke Foundation of New Zealand, 2010).

14.1.3.1 Stroke patients should be assigned a high priority by ambulance services. (National Stroke Foundation, 2010)

Body of evidence provides some support for recommendation, but care should be taken in its application.

14.1.3.2 Ambulance services should use a validated rapid pre-hospital stroke-screening tool and incorporate such tools into pre-hospital assessment of people with suspected stroke. (National Stroke Foundation, 2010)

Body of evidence provides some support for recommendation, but care should be taken in its application.

14.1.3.3 Pre-hospital care providers should use pre-hospital stroke assessment tools, such as the Los Angeles Prehospital Stroke Screen or Cincinnati Prehospital Stroke Scale). (Jauch et al., 2013)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

14.1.4 Pre-Notification & Transfer Destination

Advance notification of stroke patient arrival by EMS shortens the time to initial evaluation by an emergency physician, shortens the time to brain imaging, and leads to faster care (Jauch et al., 2013).

EMS providers should consider transporting a witness, family member, or caregiver with the patient to verify the time of stroke symptom onset. En route to the facility, providers should continue to support cardiopulmonary function, monitor neurologic status, check blood glucose if possible, and provide pre-hospital notification (Jauch et al., 2010).

As detailed above, SA stroke services are scattered and may not be locally available. Local protocols should be in place to aid decision making as to the most appropriate destination, and systems in place where pre-notification is logistically possible. These recommendations have major implications for the organisation of acute medical services within hospitals. Systems need to be adapted to ensure both rapid transport into the acute stroke unit and also rapid discharge from the acute stroke unit once acute management is complete (to allow further admissions) (Royal College of Physicians, 2012).

14.1.4.1 EMS personnel should provide pre-hospital notification to the receiving hospital that a potential stroke patient is en route so that the appropriate hospital resources may be mobilised before patient arrival. (Jauch et al., 2013)

Recommendation should be performed, Evidence from single RCTs or pseudo-RCTs.

14.1.4.2 Ambulance services should preferentially transfer suspected stroke patients to a hospital with stroke unit care. (Stroke Foundation of New Zealand, 2010)

Body of evidence provides some support for recommendation, but care should be taken in its application.

14.1.4.3 Patients presenting with acute stroke (within 3 hours of onset of symptoms) should be transported rapidly to the closest available stroke centre or, if no such centres exist, the most appropriate institution that provides emergency stroke care. In some instances, this may involve air medical transport and hospital bypass. ^{adapted}

14.1.5 Service Organisation

14.1.5.1 Ambulance services, health care professionals and the general public should receive education concerning the importance of early recognition of stroke, emphasising stroke is a medical emergency. (Australian Government Health and Medical Research Council, 2007)

Body of evidence provides some support for recommendation(s) but care should be taken in its application; Evidence from comparative studies without concurrent controls or case series.

14.1.5.2 All health services caring for people with stroke should use networks which link large stroke specialist centres with smaller regional and rural centres. (Australian Government Health and Medical Research Council, 2007)

Body of evidence is weak, and recommendation must be applied with caution; Evidence from case series.

14.1.5.3 If people with suspected stroke present to non-stroke unit hospitals, transfer protocols should be developed and used to guide urgent transfers to the nearest stroke unit hospital. (Stroke Foundation of New Zealand, 2010)

Body of evidence provides some support for recommendation, but care should be taken in its application.

14.2 Diagnosis

Appropriate diagnosis of stroke and immediate referral to a stroke team is vital given advances in hyperacute treatments (Australian Government Health and Medical Research Council, 2007).

14.2.1 General

14.2.1.1 Paramedics should obtain a history of the stroke event, including time of onset, signs and symptoms, and previous medical and drug history from the patient if able or informant when available. (Heart and Stroke Foundation of Canada and Canadian Stroke Network, 2010)

Evidence from at least one well-designed, non-experimental descriptive study (e.g., comparative studies, correlation studies, case studies) or expert committee reports, opinions and/or experience of respected authorities, including consensus from development and/or reviewer groups.

14.2.2 Stroke & Transient Ischaemic Attack (TIA)

Once the initial patient assessment and stabilisation are complete, EMS personnel may obtain a focused history from the patient or bystanders. The most important piece of information necessary is symptom onset, defined as the time the patient was last known normal. It is critical for EMS personnel to establish the time the patient was last known normal from those at the scene (Jauch et al., 2013).

There are strong similarities between minor ischaemic stroke and TIA and hence principles of assessment and management should follow that outlined for people with ischaemic stroke including secondary prevention (Australian Government Health and Medical Research Council, 2007).

Pre-hospital clinicians are likely to assess people whose sudden onset neurological symptoms have already resolved or resolve before reaching hospital, suggesting a diagnosis of TIA rather than stroke. It is crucial these people are referred for further investigation, since the risk of subsequent stroke is greatest in the first few days (Royal College of Physicians, 2012).

Hypoglycaemia is frequently found in patients with stroke-like symptoms; thus, pre-hospital glucose testing is critical (Jauch et al., 2013).

In a well-resourced setting, although there remains some uncertainty over the risks and benefits, many centres advocate early brain imaging (CT scan) as soon as possible on arrival at hospital, and where indicated following imaging (ischaemic stroke) thrombolysis within a specific time window from the onset of the stroke (usually under 3-4 hours).

- 14.2.2.1 A stroke must be suspected in patients with focal neurological deficits, with sudden appearance of the symptoms, especially if the patient has acute facial palsy, language alteration or fall or sudden loss of strength in the arm and does not refer to a previous history of cranial traumatism.** (Spanish NHS Ministry of Science and Innovation, 2009)

Evidence from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship or evidence extrapolated from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship.

- 14.2.2.2 The differential diagnosis of acute stroke must include comitial crises/convulsions, migraines with aura, hypoglycaemia, hypertensive encephalopathy and conversion disorder/simulation, among others.** (Spanish NHS Ministry of Science and Innovation, 2009)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

- 14.2.2.3 Hypoglycaemia must be ruled out as a cause of the symptoms and the glycaemia level must be corrected if the former exists.** (Spanish NHS Ministry of Science and Innovation, 2009)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

- 14.2.2.4 TIA must only be suspected when the symptomatology described in the previous recommendation is not present at the time of the consultation and the symptoms have lasted for less than 24 hours (normally less than one hour).** (Spanish NHS Ministry of Science and Innovation, 2009)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

- 14.2.2.5 TIA must not be considered in the first place when the following symptoms appear in an isolated manner: confusion, vertigo, dizziness, amnesia, dysphagia, dysarthria, scintillating scotoma, urinary or faecal incontinence, loss of sight plus alteration of consciousness, focal symptoms associated with migraine, loss of consciousness including syncope, tonic and/or clonic activity, gradual progression of symptoms (in particular sensorial ones) affecting several parts of the body.** (Spanish NHS Ministry of Science and Innovation, 2009)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

- 14.2.2.6 Ask the person who has had the suspected Transient Loss of Consciousness, and any witnesses, to describe what happened before, during and after the event. Try to contact by telephone witnesses who are not present. Record details about: circumstances of the event; person's posture immediately before loss of consciousness; prodromal symptoms (such as sweating or feeling warm/hot); appearance (for example, whether eyes were open or shut) and colour of the person during the event; presence or absence of movement during the event (for example, limb-jerking and its duration); any tongue-biting (record whether the side or the tip of the tongue was bitten) injury occurring during the event (record site and severity); duration of the event (onset to regaining consciousness); presence or absence of confusion during the recovery period; weakness down one side during the recovery period.** (National Institute for Health and Care Excellence, 2010c)

Grading embedded in recommendation.

14.3 Specific Management

As in all scene responses, EMS personnel must assess and manage the patient's airway, breathing, and circulation. Most patients with acute ischemic stroke do not require emergency airway management or acute interventions for respiratory and circulatory support (Jauch et al., 2013).

Although the routine use of supplemental oxygen remains unproven, supplemental oxygen to maintain oxygen saturations >94% is recommended after cardiac arrest and is reasonable for patients with suspected stroke (Jauch et al., 2013).

In patients who are hypertensive (systolic blood pressure ≥ 140 mm Hg), the benefit of routine pre-hospital blood pressure intervention is not proven; consultation with medical control may assist in making treatment decisions regarding patients with extreme hypertension (systolic blood pressure ≥ 220 mm Hg) (Jauch et al., 2013).

14.3.1 Oxygen

- 14.3.1.1 The routine use of supplemental oxygen is NOT recommended in people with acute stroke who are not hypoxic.** (Stroke Foundation of New Zealand, 2010)

Body of evidence provides some support for recommendation, but care should be taken in its application.

- 14.3.1.2 Both out-of-hospital and in-hospital medical personnel should administer supplemental oxygen to hypoxemic (i.e. oxygen saturation <94%) stroke patients or those with unknown oxygen saturation.** (Jauch et al., 2010)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

14.3.2 Blood Pressure

14.3.2.1 **Unless the patient is hypotensive (systolic blood pressure 90 mm Hg), pre-hospital intervention for blood pressure is not recommended.** (Jauch et al., 2010)

Recommendation should not be performed; Evidence from expert consensus, case studies or series or standard of care.

14.3.2.2 **In those cases, where there is low blood pressure, the presence of another serious concomitant disease will be ruled out and it will be treated according to the aetiology.**

(Spanish NHS Ministry of Science and Innovation, 2009)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

14.3.2.3 **Hypovolemia should be corrected with IV normal saline, and cardiac arrhythmias that might be reducing cardiac output should be corrected.** (Jauch et al., 2013)*

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

14.3.3 Pyrexia

14.3.3.1 **Sources of hyperthermia (temperature >38°C) should be identified and treated, and antipyretic medications should be administered to lower temperature in hyperthermic patients with stroke.** (Stroke Foundation of New Zealand, 2010)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

14.3.4 Coagulation

14.3.4.1 **The routine use of anticoagulation (e.g. IV unfractionated heparin) in unselected patients following ischaemic stroke/TIA is not recommended.** (Australian Government Health and Medical Research Council, 2007)

Body of evidence can be trusted to guide practice; Evidence from systematic reviews of RCTs.

14.3.5 Glucose

14.3.5.1 **Hypoglycaemia (blood glucose <60 mg/dL) should be treated in patients with acute ischemic stroke. The goal is to achieve normoglycemia.** (Jauch et al., 2013)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

14.3.5.2 **Intensive, early maintenance of euglycaemia is currently not recommended.** (Australian Government Health and Medical Research Council, 2007)

Body of evidence can be trusted to guide practice in most situations; Evidence from RCTs or prospective cohort studies.

14.3.6 Monitoring

Hypovolaemia may be corrected using any available crystalloid fluid. If a patient is found to have blood glucose levels <60 mg/dL, IV administration of glucose may resolve the neurological deficits. For non-hypoglycaemic patients, excessive dextrose-containing fluids have the potential to exacerbate cerebral injury; thus, normal saline is more appropriate if rehydration is required (Jauch et al., 2013).

14.3.6.1 Patients should have their neurological status (including Glasgow Coma Scale) and vital signs including pulse, blood pressure, temperature, oxygen saturation, glucose, and respiratory pattern monitored and documented regularly during the acute phase, the frequency of such observations being determined by the patient's status. (Australian Government Health and Medical Research Council, 2007)

Body of evidence provides some support for recommendation, but care should be taken in its application, Evidence from RCTs and comparative studies with concurrent controls.

14.3.6.2 Airway support and ventilatory assistance are recommended for the treatment of patients with acute stroke who have decreased consciousness or who have bulbar dysfunction that causes compromise of the airway. (Jauch et al., 2013)

Recommendation should be performed; Evidence from expert consensus, case studies or series or standard of care.

15. Environmental Emergencies

15.1 Exposure

See Section 8.2.3, Temperature & Haemorrhage Control.

15.2 Burns

See Section 8.9, Burns.

15.3 Drowning

See Section 11.1.2, Drowning.

15.4 Foreign Body Airway Obstruction

See Section 11.2.3, Foreign Body Airway Obstruction.

16. Toxicological Emergencies

16.1 Non-Arrest Emergencies

16.1.1 No deviation from current practice can be recommended at this time.

16.2 Cardiac Arrest Due to Poisoning & Overdose

See Section 11.3, Cardiac Arrest in Special Circumstances

17. General Care in Emergencies

17.1 Sanitation & Safety

17.1.1 Hands should be washed immediately before any direct contact with the patient and after any activity or contact that might lead to potential contamination of the hands.

(Australian Resuscitation Council, 2011)

Evidence from high quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and with high probability of establishing a causal relationship or extrapolated evidence from high quality or well-conducted meta-analyses, systematic reviews of clinical trials or high quality clinical trials.

17.1.2 Gloves must be used for invasive procedures; contact with sterile locations, mucous membranes and non-intact skin; and all activities with a risk of exposure to blood, bodily fluids, secretions or excretions, or cutting or contaminated instruments. (Australian Resuscitation Council, 2011)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

17.1.3 Gloves must always be disposable. They must be put on immediately before an episode involving contact with a patient and removed as soon as the activity has ended. Gloves must always be changed between patients and between different activities for a single patient. (Australian Resuscitation Council, 2011)

Evidence from non-analytical studies such as case reports and case series or expert opinion or evidence extrapolated from well-conducted cohort or case and control studies with low risk of bias and a moderate probability of establishing a causal relationship.

17.2 On-Scene Discharge Practices

17.2.1 No deviation from current practice can be recommended at this time.

Stringent CQI measures must be in place if a service implements on-scene discharge practices.

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ANNEXURE A (Please see last page for important additional information)

The below list of capabilities and medications must be read in conjunction with the Clinical Practice Guidelines.						
Where additional interventions and medications are indicated below, the colour key below indicates the mandatory activity that must be undertaken prior to any registered person performing an intervention or administering any medication previously not on the scope of practice. Where the skill/medication is used in the absence of such activity, providers will be seen to be acting outside of their scope of practice.						
Approved PBEC-CPD Activity without formal assessment. Where a skill is involved, this may involve practical performance of the skill.						
Approved PBEC-CPD Activity with formal assessment. Where a skill is involved, this may involve practical performance of the skill.						
CAPABILITY	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
AIRWAY MANAGEMENT						
Basic manual airway manoeuvres	x	x	x	x	x	x
Suctioning of the airway – upper	x	x	x	x	x	x
Suctioning of the airway – (endotracheal)					x	x
Suctioning of the airway – (extraglottic)				x	x	x
Manual airway obstruction manoeuvres (conscious choking patient)	x	x	x	x	x	x
Use of Magill's forceps/equivalent			x	x	x	x
Oropharyngeal airway insertion	x	x	x	x	x	x
Nasopharyngeal tube airway insertion	x	x	x	x	x	x
Endotracheal intubation facilitated by induction, neuromuscular blockade, mechanical ventilation and airway adjuncts						x
Endotracheal Intubation - non-drug facilitated or via deep sedation techniques	NOT TO BE PERFORMED					
Video Laryngoscopy						x
Supraglottic/extraglottic airway devices insertion (CA - Cardiac Arrest)			x	x (CA)	x	x
Oro/nasogastric tube insertion			x		x	x
Needle cricothyroidotomy		x	x	x	x	x
Surgical cricothyroidotomy (adolescent/adult) – Commercial Device Recommended			x		x	x

OXYGENATION AND VENTILATION	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Oxygen administration	x	x	x	x	x	x
Nebulization of medications on scope of practice	x	x	x	x	x	x
Use of pulse oximetry	x	x	x	x	x	x
Needle thoracentesis (Adult and paediatric)		x	x	x	x	x
Needle thoracentesis (Neonate)						x
Bag-valve mask manual ventilation	x	x	x	x	x	x
Bag-valve tube manual ventilation	x	x	x	x	x	x
Interfacility Mechanical Ventilation (Paediatric and Adult - without cardiovascular support)					x	x
Mechanical Ventilation (Neonate)						x
Non-invasive ventilation with Mechanical Ventilator					x	x
Non-invasive ventilation – oxygen driven (without mechanical ventilator)			x	x	x	x
Mechanical Infant Resuscitator			x	x	x	x
Use of capnography/capnometry – via endotracheal tube/extraglottic device				x	x	x
Use of capnography/capnometry - via facemask/nasal cannula		x	x	x	x	x
Humidification					x	x

CIRCULATORY MANAGEMENT	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Blood pressure measurement including the use of NIBP (automated).	x	x	x	x	x	x
Peripheral intravenous cannulation as per relevant protocol – limbs and hands (All ages >1year old)		x	x	x	x	x
Peripheral intravenous cannulation as per relevant protocol – limbs and hands (<1year old)					x	x
Peripheral intravenous cannulation as per relevant protocol – (Infant scalp)						x
External jugular vein cannulation					x	x
Intra-osseous insertion All Ages			x		x	x
Intra-osseous insertion – Adult			x	x	x	x
Umbilical vein cannulation			x		x	x
Intravenous fluid therapy (for purposes other than drug administration - Adult)		x	x	x	x	x
Intravenous fluid therapy (for purposes other than drug administration – Infant and Paediatric)			x		x	x
Oral rehydration	x	x	x	x	x	x
Oral Rehydration via NGT					x	x
Intravenous/intraosseous drug administration as per scope of practice		x	x	x	x	x
Subcutaneous drug administration as per scope of practice		x	x	x	x	x
Intramuscular drug administration as per scope of practice		x	x	x	x	x

CIRCULATORY MANAGEMENT	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Endotracheal drug administration					X	X
Use of intravenous infusion devices including pressure infuser, volumetric infusion pump and syringe driver			X		X	X
External haemorrhage control including use of tourniquet	X	X	X	X	X	X
Topical Haemostatic Agents	X	X	X	X	X	X
Use of pneumatic anti-shock garment		X	X	X	X	X
Use of non-pneumatic anti-shock garment		X	X	X	X	X
Automated external defibrillation	X	X	X	X	X	X
Manual defibrillation (asynchronous)		X	X	X	X	X
Precordial thump	X	X	X	X	X	X
Synchronised cardioversion					X	X
Vagal manoeuvres					X	X
Central line management of lines in-situ					X	X
Transcutaneous cardiac pacing					X	X
3-Lead ECG monitoring and diagnosis as per scope of practice		X	X	X	X	X
12-Lead ECG Diagnosis						X
Fibrinolysis (With documented telemetry or equivalent)						X
Targeted Temperature Management (inter-facility transfer and where capabilities exist)						X

OBSTETRIC MANAGEMENT	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Normal vaginal delivery as per scope of practice	x	x	x	x	x	x
Prolapsed cord management as per scope of practice	x	x	x	x	x	x
Breech delivery management as per scope of practice	x	x	x	x	x	x
Mal-presentations management as per scope of practice	x	x	x	x	x	x
Preterm labour management as per scope of practice	x	x	x	x	x	x
Obstructed labour management as per scope of practice	x	x	x	x	x	x
Post-partum haemorrhage management as per scope of practice	x	x	x	x	x	x
DIAGNOSTIC AND CLINICAL AIDS	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Use of ultrasound					x	x
Fundoscopy						x
Use of an otoscope						x
Use of a Snellen Chart						x
Arterial blood gas sampling and analysis						x

GENERAL	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Cardiac arrest management (adult, child, infant & neonate) as per scope of practice	x	x	x	x	x	x
Clinical assessment (as per level of care)	x	x	x	x	x	x
Vital Sign Assessment	x	x	x	x	x	x
Finger prick and blood glucose measurement (manual and electronic)	x	x	x	x	x	x
Peak flow measurement and interpretation		x	x	x	x	x
Point of Care Blood Sampling (Capillary)					x	x
Cervical spinal clearance		x	x	x	x	x
Spinal Movement Restriction ¹	x	x	x	x	x	x
Application of limb splints	x	x	x	x	x	x
Application of pelvic binding devices	x	x	x	x	x	x
Application of vacuum mattress	x	x	x	x	x	x
Urinary catheterization					x	x
Emergency wound care as per scope of practice	x	x	x	x	x	x
Suturing						x
Withdrawal of resuscitation efforts		x	x	x	x	x
Withholding resuscitation ²	x ²	x	x	x	x	x
On-scene discharge ³						x
Inter-facility transfer as per relevant scope of practice	x	x	x	x	x	x
Use of an incubator	x	x	x	x	x	x

* Mandatory Senior Emergency Care Practitioner and/or Supervising Medical Officer consultation required

LIST OF MEDICATIONS (ROUTE OF ADMINISTRATION) ^{4,5}	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Acetyl Salicylic Acid	x	x	x	x	x	x
Activated Charcoal	x	x	x	x	x	x
Adenosine					x	x
Adrenaline – use in anaphylaxis and cardiac arrest		x	x	x	x	x
Adrenaline			x*		x	x
Amiodarone Hydrochloride			x		x	x
Atropine Sulphate - use in toxidrome			x	x	x	x
Atropine Sulphate			x		x	x
Betamethasone						x*
Calcium Chloride/Calcium Gluconate					x	x
Clopidogrel					x	x
Hydrocortisone (IV)		x	x	x	x	x
Methylprednisole (IV)		x	x	x	x	x
Dexamethasone						x*
Dextrose Intravenous (Adult)		x	x	x	x	x
Dextrose Intravenous (Paediatric and Neonate)		x	x		x	x
Dopamine						x*
Diazepam			x	x	x	x
Dobutamine						x*
Enoxaparin						x

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LIST OF MEDICATIONS (ROUTE OF ADMINISTRATION) ^{4,5}	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Etomidate						X
Fentanyl (Intravenous)					X*	X
Fentanyl (Intranasal)					X*	X
Flumazenil (only in cases of iatrogenic benzodiazepine overdose)			X	X	X	X
Flumazenil						X
Furosemide					X	X
Glucagon		X*	X	X	X	X
Glyceryl Trinitrate			X		X	X
Heparin Sodium						X
Hydralazine						X*
Ipratropium Bromide	X	X	X	X	X	X
Ketamine – Intravenous					X	X
Ketamine – Intramuscular					X	X
Ketamine - Intranasal					X	X
Labetalol						X
Lignocaine hydrochloride (IO Flush – Local Anaesthetic)			X	X	X	X
Lignocaine hydrochloride (systemic – arrhythmia management)						
Lorazepam			X	X	X	X
Magnesium Sulphate (Intramuscular)		X*	X	X	X	X
Magnesium Sulphate (Intravenous)			X		X	X

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LIST OF MEDICATIONS (ROUTE OF ADMINISTRATION) ^{4,5}	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Medical oxygen	x	x	x	x	x	x
Metoclopramide monohydrochloride			x		x	x
Midazolam			x	x	x	x
Morphine Sulphate			x*		x	x
Naloxone hydrochloride		x*	x	x	x	x
Neostigmine						x
Nifedipine (Oral/IV)						x*
Nitrates (Intravenous)						x*
Nitrous oxide	x	x	x	x	x	x
Ondansetron						x
Oral glucose powder/gel	x	x	x	x	x	x
Oxytocin			x*		x*	x
Paracetamol (Oral)					x	x
Paracetamol (Intravenous)					x*	x
P2Y12 Inhibitors						x*
Prednisolone (Oral)			x		x	x
Promethazine			x		x	x
Procainamide						x
Rocuronium						x
Sodium Bicarbonate 8.5%					x	x
Sotalol						x*

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LIST OF MEDICATIONS (ROUTE OF ADMINISTRATION) ^{4,5}	CATEGORY OF REGISTRATION					
	BAA	AEA	ECT	ECA	ANT	ECP
Sugammadex						X
Streptokinase						X
Suxamethonium Chloride						X
Tenecteplase						X
Thiamine		X	X	X	X	X
Tranexamic Acid					X	X
Vecuronium						X
β ₂ Stimulants (inhaled)	X	X	X	X	X	X
β ₂ Stimulants (systemic)			X		X	X
Non-Steroidal Anti-Inflammatories (non-IV)					X	X
GPIIb/IIIa Inhibitors						X*
Direct Thrombin Inhibitors						X*
Pentroxifyflurane	X	X	X	X	X	X
Cyanide antidotes (within occupational health and safety system)					X	X
Anti-emetic (oral only – within remote site medicine scenario)						X
Anti-spasmodics (oral only – within remote site medicine scenario)						X
Anti-diarrhoeals (oral only – within remote site medicine scenario)						X

IMPORTANT ADDITIONAL NOTES (also see superscripts)

1. Includes the use of all evidence-based spinal motion restriction devices.
2. In the context of decapitation, mortal disfigurement, post-mortem lividity and putrefaction.
3. This implies that a formal clinical assessment and patient information session including subsequent referral/re-entry into the health system has been discussed with the patient. This process does not refer to a "refusal of hospital transport (RHT)" scenario.
4. IMPORTANT - Use of additional medications not currently on the relevant scopes of practice is pending approval of the South African Health Products Regulatory Authority. The Professional Board will communicate to providers once this has occurred. Based on the approval, this list of medications may be subject to change.
5. CPD activities in relation to these medications may commence whilst awaiting regulatory approval
Where additional skills/medications not previously on the scope of practice, have formed part of a Higher Education Institution PBEC-approved curriculum (including a formal assessment of such skills/medications) a PBEC-approved CPD activity is not mandatory. This is still, however, recommended.
All interventions and medications are to be performed and administered within the Clinical Practice Guidelines and a locally relevant standard of care. Clinical governance structures shall support these guidelines.
Where the list of capabilities indicates "...within scope of practice", this implies in relation to the medications available to the category of registration and related PBEC- approved education/training.
In relation to PBEC - approved CPD activities - where skills are concerned, the content of the activity must include indications, contraindications, risks, benefits and a description (either diagrammatic and/or demonstration) of the skill.
In relation to PBEC - CPD activities - where medications are concerned, the content of the activity must include the class of drug, schedule of drug, packaging of drug, storage of drug, mechanism of action, indications, contraindications, side-effects, technique/route of administration and recommended dosing range.