South Australian Perinatal Practice Guideline

Maternal Collapse

Note:

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate, and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements, and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

Note: The words woman/women/mother/she/her have been used throughout this guideline as most pregnant and birthing people identify with their birth sex. However, for the purpose of this guideline, these terms include people who do not identify as women or mothers, including those with a non-binary identity. All clinicians should ask the pregnant person what their preferred term is and ensure this is communicated to the healthcare team.

"**Aboriginal and Torres Strait Islander recognition statement:** We use the term 'Aboriginal' to refer to people who identify as Aboriginal, Torres Strait Islander, or both Aboriginal and Torres Strait Islander. We do this because the people indigenous to South Australia are Aboriginal and we respect that many Aboriginal people prefer the term 'Aboriginal'. We also acknowledge and respect that many Aboriginal South Australians prefer to be known by their specific language group(s)."

Australian Aboriginal Culture is the oldest living culture in the world, yet Aboriginal people continue to experience the poorest health outcomes when compared to non-Aboriginal Australians. In South Australia, Aboriginal women are 2–5 times more likely to die in childbirth and their babies are 2–3 times more likely to be of low birth weight. The accumulative effects of stress, low socio-economic status, exposure to violence, historical trauma, culturally unsafe and discriminatory health services, and health systems are all major contributors to the disparities in Aboriginal maternal and birthing outcomes. Despite these unacceptable statistics, the birth of an Aboriginal baby is a celebration of life and an important cultural event bringing family together in celebration, obligation, and responsibility. The diversity between Aboriginal cultures, language and practices differ greatly and so it is imperative that perinatal services prepare to respectfully manage Aboriginal protocol and provide a culturally positive health care experience for Aboriginal people to ensure the best maternal, neonatal and child health outcomes.

Explanation of the Aboriginal artwork: The Aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the Aboriginal culture. The horseshoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horseshoe shape depicts a pregnant woman. The smaller horseshoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.

Purpose and Scope of PPG

The purpose of this guideline is to provide a systematic approach for the management of maternal collapse in the peripartum period across maternity services. This guideline includes resuscitation algorithms, identification and treatment of amniotic fluid embolism, perimortem caesarean section (PMCS), and post-resuscitation care and management of amniotic fluid embolism.

All maternal collapse event occurring in public places fall outside the scope of this guideline and should be managed as per the **Australian Resuscitation Council basic life support (BLS)** algorithm and involved **SAAS** support via the **000 emergency line**

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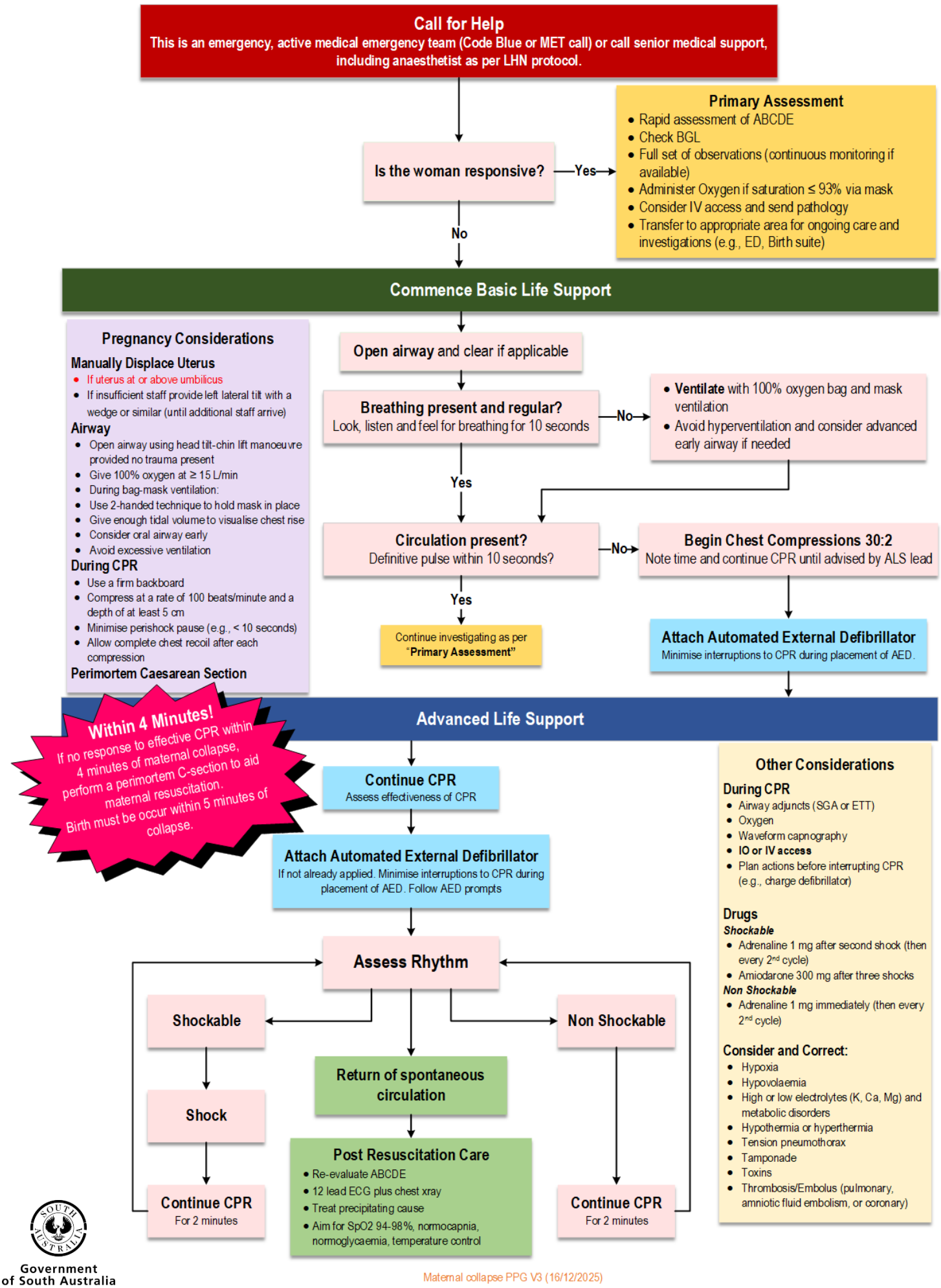
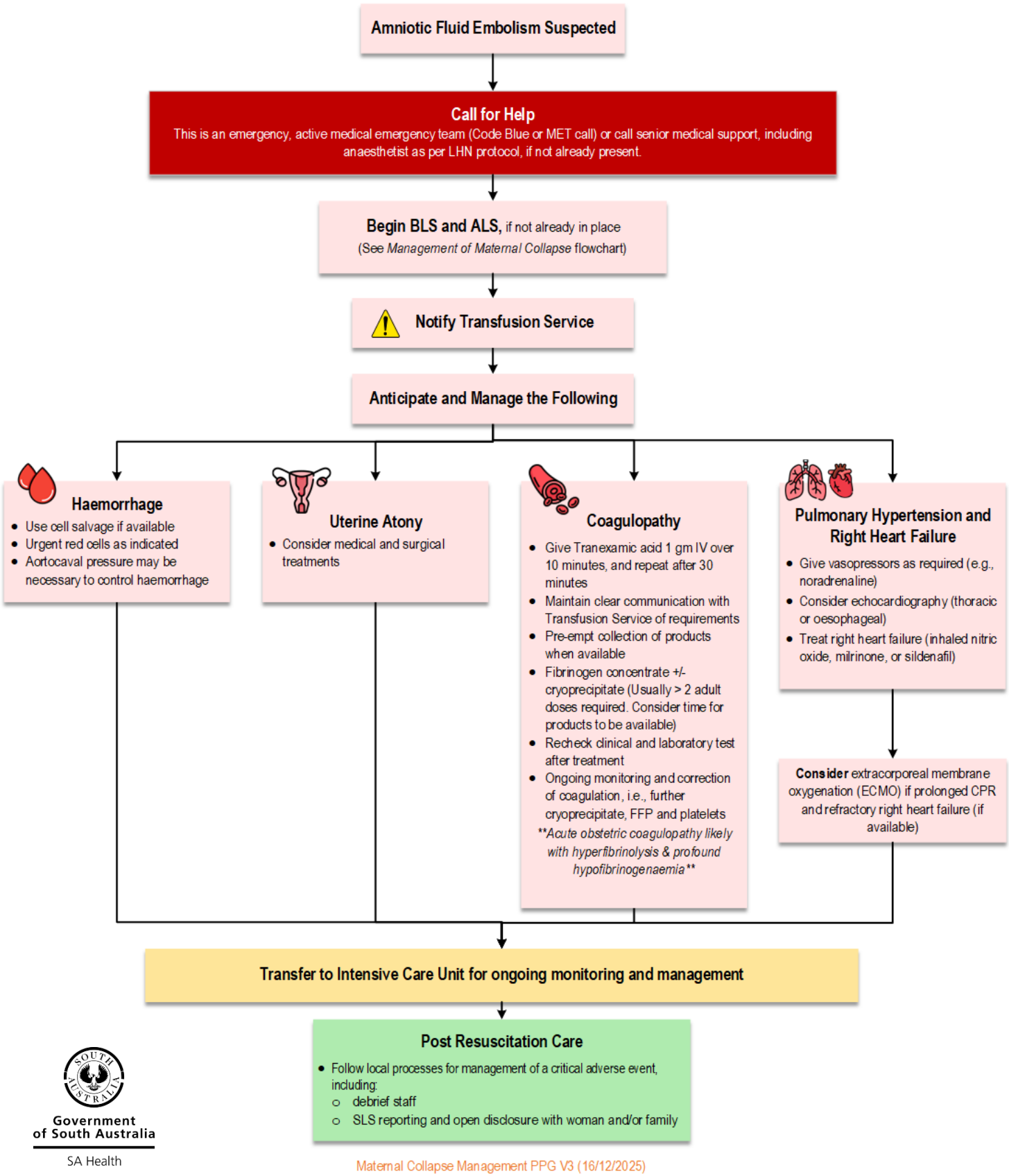
Flowchart 1| Management of Maternal Collapse



Flowchart 2| Amniotic Fluid Embolism Management



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Summary of Practice Recommendations

The use of Rapid Detection and Response (RDR) charts assist in the early detection and management of deteriorating patients.

In a rapidly deteriorating woman, urgent referral, and **escalation of care** to a critical care team and obstetric consultant is important.

Maternal collapse resuscitation should follow the Australian Resuscitation Council Guidelines, using the standard **D**anger, **R**esponse, **S**end for help, **A**irway, **B**reathing, **C**ardiopulmonary resuscitation (CPR), **D**isability, **E**xposure, **F**undus and **F**etus (DRSABCDEF) approach.

A systematic approach should be used to identify the cause of maternal collapse.

Amniotic Fluid Embolism (AFE) is a rare but potentially catastrophic event and should be considered in any intrapartum or postpartum collapse where an obvious cause is not identified.

If > 20 weeks' gestation, perform manual displacement of the uterus or left tilt, depending upon staff availability and the clinical situation.

Supplemental high flow oxygen should be administered as soon as possible to counteract rapid deoxygenation.

Two wide bore cannula (minimum 16 gauge) should be inserted as soon as possible.

In the event of cardiac arrest, perimortem caesarean section should be undertaken **within 5 minutes** and should not be delayed by moving the collapse woman.

> Birth of the fetus and placenta reduces oxygen consumption, improves venous return and cardiac output, facilitates chest compressions, and makes ventilation easier.

Where available, Extracorporeal Life Support is recommenced for women developing refractory cardiac arrest with reversible causes.

Abbreviations

>	Greater than
≥	Equal to or greater than
<	Less than
≤	Equal to or less than
AED	Automated External Defibrillator
AFE	Amniotic Fluid Embolism
ALS	Advanced Life Support
ARDS	Acute Respiratory Distress Syndrome
AVPU	Alert; responsive to Voice; responsive to Painful stimuli; Unresponsive
BLS	Basic Life Support
CPR	Cardiopulmonary resuscitation
CS	Caesarean Section
CT	Computed Tomography
DIC	Disseminated Intravascular Coagulation
DRSABCDEF	Danger, Response, Send for help, Airway, Breathing, CPR, Disability, Exposure, Fundus and Fetus
ECG	Electrocardiograph
ECMO	Extracorporeal Membrane Oxygenation
ED	Emergency Department(s)
g	Gram(s)
IO	Intraosseous
IV	Intravenous
L	Litre(s)
MET	Medical emergency team
mg	Milligram(s)
mL	Millilitre(s)
Microg	Microgram(s)
MRI	Magnetic Resonance Imaging
O_2	Oxygen
PAL	Perinatal Advice Line
PMCS	Perimortem caesarean section
PPH	Postpartum Haemorrhage
PPG	Perinatal Practice Guideline
SLS	Safety Learning System
SpO_2	Oxygen saturation measured by pulse oximetry
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

Definitions

Maternal collapse	An acute event involving the cardiorespiratory systems and / or brain, resulting in a reduced or absent conscious level (and potentially death), at any stage in pregnancy and up to six weeks after birth.[1]
Shared decision making	Shared decision making involves discussion and collaboration between a consumer and their healthcare providers. It is about bringing together the consumer's values, goals, and preferences with the best available evidence about benefits, risks and uncertainties of screening, investigations, and treatment, to reach the most appropriate healthcare decisions for that person.

Regional Considerations

Seek early consultation and advice via the **Perinatal Advice Line** (PAL): **137 827**. Coordination of maternal transfer or retrieval by MedSTAR should be made in consultation with the PAL obstetrician.

Introduction

Maternal collapse is a rare but life-threatening event with a wide range of causes. The incidence of maternal collapse is unknown as data is not universally collected. The incidence of cardiac arrest in pregnancy is found to be much rarer than maternal collapse. A UK study reports an incidence of maternal cardiac arrest of 1 in 36,000 maternities, with a case fatality rate of 42%.[2] Therefore, management of maternal collapse, similar to any other medical emergency, should follow the Australian Resuscitation Council's (ARC) **basic life support (BLS)** and **advanced life support (ALS)** guidelines as a systematic approach to ensuring effective and timely interventions.

The **DR S ABC DEF** (danger, response, send for help, airway, breathing, cardiopulmonary resuscitation (CPR), disability, exposure, fundus and fetus) approach can be used to structure the emergency response in a clear and organised manner. Each of these steps must be adjusted to account for the unique physiological changes associated with pregnancy, such as increased blood volume and cardiac output, and the compressive effect of the enlarged uterus on the inferior vena cava.[3]

Note: *The flowchart for the management of maternal collapse used in this guideline has been adapted to include BLS and ALS algorithms and the maternal considerations that need to be considered during the emergency (Flowchart 1).*

Causes of Maternal Collapse

Maternal collapse can occur due to various causes; therefore, a **systematic approach** should be undertaken to identify the underlying reason (see Table 1).

Reducing the Risk of Maternal Collapse

- Maternal collapse can occur without warning, though certain risk factors (e.g., pre-existing significant medical conditions) may increase its likelihood.
  - Undertaking a comprehensive antenatal assessment will help identify women at risk, allowing for early multidisciplinary support and appropriate care plan.
- Women with significant medical conditions or at risk of maternal collapse should receive multidisciplinary care with a clearly defined pregnancy and birth management plan.
- In many cases, clinical signs precede collapse, allowing for early intervention.
  - Use correct RDR chart and escalate concerns in a timely manner (See Maternal Rapid Detection and Response Charts section of this document).

Pre-existing Significant Medical Conditions

- Optimise care with referral and multidisciplinary team management for women of concern.
- Document a multidisciplinary plan as early as possible. This should include:
  - frequency of investigations for monitoring
  - identify conditions and symptoms requiring urgent specialist review
  - plan for birth (place of birth, gestation, and mode)
  - special care required in the puerperium.

Table 1: Common causes of maternal collapse (classify using the 4Hs and 4Ts approach of the ALS algorithm)

Reversible Causes		Causes in Pregnancy
4Hs	**Hypovolaemia**	• **Obstetric haemorrhage** (e.g., placental abruption, uterine atony, genital tract trauma, uterine rupture, uterine inversion) ○ see *Antepartum Haemorrhage PPG* and *Postpartum Haemorrhage PPG* • **Non-obstetric haemorrhage** (e.g., Major vessel aneurysm (e.g., splenic artery), hepatic rupture, trauma) • **Relative hypovolaemia.** E.g., Septic shock (see *Sepsis PPG*), anaphylaxis (see A*naphylaxis PPG*), dense spinal block, neurogenic shock.
	Hypoxia	• **Airway obstruction** (e.g., post-seizure) • **Failed intubation** • **Pulmonary disease** (e.g., Asthma, aspiration, pneumonia, acute respiratory distress syndrome (ARDS)) • **Cardiac** (e.g., cardiomyopathy, congenital heart disease, acquired valvular heart disease, dissection of thoracic aorta, myocardial infarction, arrythmia.
	Hypo/hyperkalaemia and other electrolyte disturbances	• Hyponatraemia can be a cause of oxytocin
	Hypothermia	
4Ts	**Thromboembolism** (include all causes of embolism)	• Pulmonary embolism • AFE • Myocardial infarction • Air embolism
	Toxicity (including drugs)	• Drug Error/Overdose (e.g., Magnesium, local anaesthetic, insulin, opioids, illicit drugs.
	Tension pneumothorax	• Following trauma, suicide attempt, nitrous oxide with pre-existing pneumothorax.
	Tamponade (cardiac)	• Following trauma, suicide attempt.
Eclampsia, Pre-Eclampsia and other intracranial causes of collapse:		• Eclampsia +/- intracranial haemorrhage • Epilepsy (post-ictal) • Cerebral vein thrombosis • Subarachnoid haemorrhage • Posterior reversible encephalopathy • Stroke • Subdural haematoma • Reversible cerebral vasoconstriction syndrome • Meningitis/encephalitis

⚠ Amniotic Fluid Embolism (AFE) is a rare but potentially catastrophic event and should be considered in any intrapartum or postpartum collapse where an obvious cause is not identified.[1]

Maternal Rapid Detection and Response Charts

- Maternal Rapid Detection and Response (RDR) charts must be used for recording observations to assist in the early detection of a deteriorating woman and escalation of care.
  - Escalation may involve consultation and assessment by senior medical staff (e.g., obstetric consultant, intensivist, anaesthetist, or physician).
  - In addition to the clinical observations, it is important to consider red flags in pregnant women presenting with chest pain, palpitations, breathlessness, or headache (Table 2).[4]
  - In a rapidly deteriorating woman, urgent referral, and escalation of care to a critical care team and obstetric consultant is important.

Table 2: Clinical red flags in pregnancy

Red flags in a pregnant woman presenting with chest pain:
• Pain requiring opioids • Pain radiating to arm, shoulder, back or jaw • Sudden-onset tearing or exertional chest pain • Associated haemoptysis, breathlessness, syncope, or abnormal neurology • Abnormal observations
Red flags in a pregnant woman presenting with palpitations:
• Palpitations in a woman with a family history of sudden cardiac death • Palpitations in a woman who has structural heart disease or previous cardiac surgery • Palpitations with syncope • Palpitations with chest pain • Persistent, severe tachycardia
Red flags in a pregnant woman presenting with breathlessness:
• Sudden-onset breathlessness • Orthopnea • Breathlessness with chest pain or syncope • Respiratory rate > 20 breaths per minute • Oxygen saturation < 94% or fall to < 94% on exertion • Breathlessness associated with tachycardia
Red flags in the history and examination of a pregnant woman presenting headaches:
• Sudden-onset headache/thunderclap or worst headache ever • Headache that takes longer than usual to resolve or persists for more than 48-hours • Has associated symptoms – fever seizures, focal neurology, photophobia, diplopia • Excessive use of opioids

In Hospital Care (Including Emergency Departments (ED) and Outpatients)

- All women who develop significant medical complications in pregnancy should have urgent referral to appropriate specialist/multidisciplinary team for management.
- All LHNs must develop local algorithms for the investigation of symptoms such as chest pain, calf tenderness and breathlessness. See:
- *Thromboprophylaxis and Thromboembolic Disease in Pregnancy PPG*
- *Abdominal Pain and Trauma in Pregnancy PPG*
- *Cardiac Disease in Pregnancy PPG*
- *Asthma in Pregnancy PPG*
- *Anaphylaxis (Maternal) PPG*
- *Local Anaesthetic Systemic Toxicity PPG*

All PPGs listed above can be found in the A-to-Z index at www.sahealth.sa.gov.au/perinatal for management of possible causes based on symptoms.

General Considerations of Maternal Collapse

Common reversible causes of maternal cardiopulmonary arrest should be considered throughout the resuscitation (see Table 1). It is essential that anyone involved in resuscitation of a pregnant woman is aware of the physiological differences in pregnancy.

Left Manual Displacement of the Uterus

Aortocaval compression significantly reduces cardiac output from 20 weeks' gestation onwards and the efficacy of chest compressions during pregnancy.[1]

- Perform **manual displacement of the uterus or left tilt**, if > 20 weeks' gestation, depending upon staff availability and the clinical situation.

Manual displacement of the uterus to the left is effective in relieving aortocaval compression and allows effective chest compressions in the supine position in the event of cardiac arrest.[1]

Oxygenation and Intubation

Changes in lung function, diaphragmatic splinting and increased oxygen consumption result in pregnant women becoming hypoxic more readily and make ventilation more difficult. Furthermore, pregnant women are at an increased risk of gastroesophageal reflux and aspiration due to relaxation of the lower oesophageal sphincter, lower gastric pH, and delay gastric emptying during pregnancy increasing the risk of aspiration and difficult intubation.[5]

Supplemental high flow oxygen should be administered as soon as possible to counteract rapid deoxygenation.

Circulation

- **Two wide bore cannula** (minimum 16 gauge) should be inserted as soon as possible.
- If not possible, early consideration of central venous access, intraosseous access should be considered.
- Obtaining intravenous (IV) or interosseous access above the diaphragm is recommended to avoid the potentially deleterious effects of vena cava compression.

Emergency Response Team

- **Early** involvement of senior experienced staff where possible, including obstetrician, anaesthetist, physician, midwife(s), neonatologist/paediatrician, haematologist and intensivist, depending on the nature of the suspected diagnosis, is essential to optimise outcome.
- The resuscitation team leader is usually the most senior person and should take charge and coordinate the resuscitation, delegate tasks, and assign roles and responsibilities to other individuals within the team.
- **Tasks and roles** include:
  - **Airway:** management (doctor and ALS nursing assistant)
  - **Circulation:** chest compressions – rotate clinicians regularly
  - **Vascular** access
  - **Scribe:** record events and regularly call out time elapsed
  - **Medication:** Two midwifery/nursing staff to draw up medications
  - **Liaison** with other services/departments (e.g., Theatre, ICU, HDU)
  - Organise **urgent transport** of laboratory samples
  - **Transport** blood products
  - possible transfer of the woman to **operating theatre** for surgery, intensive care or radiology
  - support family members.

Management of Maternal Collapse

Maternal collapse is a **medical emergency**

Call for help immediately

- Maternal collapse can occur for various reasons, and until the cause is determined and treated, all such events should be treated as emergencies.
- **Activate medical emergency team** (Code Blue or MET call), or senior medical support, including anaesthetics as per LHN protocol.
- **Alert** neonatal and theatre teams
- Assessment is carried out by **primary survey** to identify and prioritise life-threatening complications during initial resuscitation.[6] See Flowchart 1.
- **Check for danger**.
- **Assess** woman's responsiveness to voice and/or pain.

If Responsive

- Lie the woman flat.
- If > 20 weeks' gestation, apply manual uterine displacement to the left (or left lateral tilt until second person arrives).
- Begin **primary assessment** using the **A**irway, **B**reathing, **C**irculation, **D**isability, **E**xposure, **F**undus and **F**etus approach (Table 3)
- **Perform a full set of observations** (e.g., heart rate (HR), blood pressure (BP), respiration rate (RR), temperature (T), oxygen saturation (SpO_2).
  - Maintain continuous monitoring if available.
- Administer **oxygen** via non-rebreather mask if $SpO_2 \leq 93\%$.
- Consider **intravenous (IV) access** and send relevant pathology – consult with emergency leader regarding which tests to undertake.
- Check **blood glucose levels** (BGL)
- **Transfer** to appropriate area for ongoing care and investigations (e.g., emergency department (ED), birth suite)
- Perform secondary Obstetric survey:
  - **History:** Revisit the history of the collapse, including from the notes, partner or family and the previous history of the woman.
  - **Examine:** Repeat head to toes examination, including abdominal and vaginal examination (if appropriate and with consent).
    - Abdominal ultrasound can assist the diagnosis of concealed haemorrhage.
  - Subsequent diagnosis, management, and Investigation: Ongoing management directed at cause of collapse (see Table 2).
  - **Consider** echocardiography and CT/MRI scans.
- **Escalate** to other specialties as indicated by the woman's condition and probable causes.

If Unresponsive:

- Lie woman flat and manually displace the uterus to the left if second person present, otherwise apply left lateral tilt until help arrives.
- Begin basic life support (BLS)
- **Check Airway:**
  - Open airway, check for obstruction.
    - If airway obstructed, apply head tilt, chin lift or jaw thrust to keep the airway open.
  - Ventilate with 100% oxygen bag and mask.
    - Avoid hyperventilation and consider advanced airway, early, if needed.
  - Add high flow oxygenation (15 L/min) as soon as possible and early intubation when a skilled person is available (use effective cricoid pressure).

Table 3: ABCDEF Assessment

System	Assess	Consider
Airway	• Is the woman talking? • Are there abnormal breath sounds, e.g., stridor, gurgling	• Oxygen therapy • Suctioning • Airway manoeuvres and/or adjuncts as indicated
Breathing	• Respiratory rate • Oxygen saturation • Chest movement and effort of breathing	• Auscultation and chest x-ray • Oxygen therapy • Supplemental breaths using a bag and mask
Circulation	• Pulse, rate/rhythm, blood pressure • Colour/capillary refill time • Blood/fluid loss	• Large bore IV access and blood samples as indicated, including assessment of coagulation • IV fluids/medications as prescribed • Cardiac monitoring
Disability	• Level of consciousness using alert, voice pain, unresponsive (AVPU) scale • Pupillary response • Drug chart and relevant documentation	• Monitoring blood glucose • Glasgow Coma Scale
Exposure	• Temperature • Head to toe examination, including introitus	• Urine output • Checking peripheral pulses, wounds/drains etc • Pain score
Fundus and Fetus	• If uterus at or above umbilicus • Fetal heart	• Left lateral uterine displacement • CTG monitoring

- **Assess Breathing:**
  - Keeping the airway open, look, listen and feel to determine if breathing normally. This is a rapid check and should take less than 10 seconds:
  - If trained and experienced in assessment of circulation in collapsed women, check for breathing and carotid pulse at the same time.
  - If there is any question over the presence or absence of a pulse, treat as if absent.
- **Check for Pulse:**
  - Determine definitive pulse within 10 seconds. Do not delay CPR.
  - If pulse present continue investigating as per primary assessment (see table 3) and treat the cause (see table 1).
  - If no pulse, begin chest compressions
    - Note the time
    - Perform chest compressions at the rate of 100–120 per minute and a depth of 5–6 cm on the lower half of the sternum.
    - Use a ratio of 30 chest compressions followed by 2 ventilations with facemask.
    - Minimise interruptions. Change rescuer every 2 minutes if possible, to prevent ineffective compressions due to exhaustion.
    - Plan actions before interrupting CPR (e.g., charge defibrillator)
    - Continue CPR until advised by ALS team/or emergency team lead.
  - Establish intravenous (IV) or intraosseous (IO) access if not already done.
- **Attach defibrillator**
  - Preferably automated external defibrillator (AED) or semi-automated ED in AED mode.
  - Minimise interruptions to CPR during AED placement.
- **Begin advanced life support (ALS)**
  - Assess rhythm and manage as per Table 3.

Table 3: Management of cardiac rhythm in ALS

Rhythm	Shock?	Management
VF **Pulseless VT**	**Yes**	• Give **adrenaline 1 mg IV** after second shock then repeat dose every second cycle. • Give **amiodarone 300 mg IV** after three shocks
PEA **Asystole**	**No**	• Resume CPR and give **adrenaline 1 mg IV** immediately then repeat every second cycle.

- Continue with CPR for two minutes, followed by assessment of the rhythm (1 cycle).
- Consider airway adjuncts (SGA or ETT) and waveform capnography.

➢ Consider and correct hypoxia, hypovolaemia, high or low electrolytes (potassium, calcium, magnesium and metabolic disorders, hypo/hyperthermia, tension pneumothorax, tamponade, toxins, thrombosis/embolus.

Perimortem Caesarean Section

Birth of the fetus and placenta reduces maternal oxygen consumption, improves venous return and cardiac output, facilitates chest compressions and makes ventilation easier.[1]

In cases where there is no response to correctly performed CPR within 4 minutes of maternal collapse, and the pregnancy is greater than 20 weeks' gestation a **perimortem caesarean section** (PMCS) should be undertaken to assist maternal resuscitation. This should be **achieved within 5 minutes** of the maternal collapse or cardiac arrest.[3]

➢ PMCS should not be delayed by moving the woman and should be performed by the obstetrician. [6]
➢ Alert neonatal team if not already present.
➢ Continue CPR during and after PMCS, to improve the chance of a successful neonatal and maternal outcome.[7]
➢ Limited equipment is required to facilitate the birth of the baby (e.g., a surgical scalpel, mayo scissors and forceps).
  - Maternity units should consider having a perimortem c-section kit readily available.
➢ Sterile preparation and drapes are unlikely to improve survival.
➢ The operator should use the incision that will facilitate the most rapid access.
➢ Once the uterus is empty, if there is ongoing intractable bleeding (coagulopathy), consider aortic compression as a temporary measure to decrease ongoing blood loss and to improve cerebral and cardiac perfusion.
  - To perform aortic compression, the operator's fist is placed over the umbilicus and pushed downward toward the spine (see Figure 1).

A PMCS kit should be available in key areas and or resuscitation trolleys to improve maternal outcome.

Extracorporeal Life Support (ECLS) and Extracorporeal Cardiopulmonary Resuscitation (ECPR)

➢ Where available, ECLS is recommenced for women developing refractory cardiac arrest with reversible causes.
➢ Starting ECLS before cardiac arrest or ECPR when traditional ALS measures are failing should be considered in pregnant women.[4]

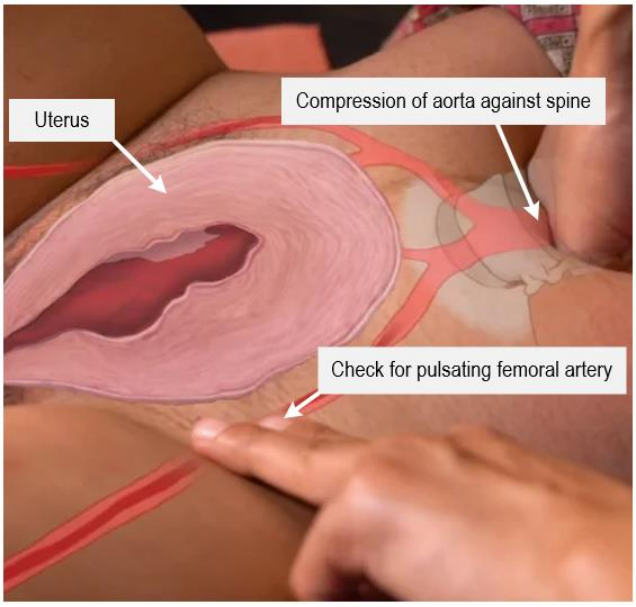

Figure 1: Aortic Compression. Image used with permission from Global Health Media Project (https://globalhealthmedia.org/videos/aortic-compression-english/)

Post Resuscitation and Perimortem Caesarean Section Care

- Ensure appropriate sedation and general anaesthetic for transfer to operating theatre to complete the operation and continue resuscitation and management.
- Continue to re-evaluate and support the airway, breathing and circulation of the woman.
- Transthoracic or transoesophageal echocardiography are quick and portable means of identifying hypovolaemia, pulmonary embolism, unrecognised heart disease, pericardial effusion, myocardial infarction, and cardiomyopathy.
- In the event resuscitation/PMCS unsuccessful:
  - do not remove any medical devices including intravenous lines
  - in the event of maternal death, notify the coroner
  - provide adequate counselling to partner/support person/family as soon as possible
  - refer to LHN policies and procedures for more information.
- Post resuscitation care should occur in a tertiary centre with adult intensive care facilities.
- Organise retrieval as required.
- Specific management will be determined by the cause and subsequent response to treatment.
- Follow local processes for management of an adverse or critical event, including:
  - Debrief staff
  - Report to Safety Learning System (SLS).
    - For more information search *Safety Learning System* at www.sahealth.sa.gov.au
  - Commence open disclosure with woman and/or family.

Documentation and Debriefing

- Contemporaneous note-keeping is difficult in an emergency resuscitation situation, unless there is a nominated person dedicated to this task.
- Detailed retrospective notes should be written by those involved in the emergency as soon as possible after the event.
- After the event, debriefing is recommended for all medical and midwifery staff involved in the management of the emergency.
- Staff should be reminded of the Employee Assistance Program (EAP) and provided with information on how to access it.

- Provide adequate counselling to the woman/family as soon as possible and arrange further follow-up.
- Notify hospital management in accordance with local Clinical Governance guidelines and complete a Safety Learning System (SLS) notification.

Amniotic Fluid Embolism (AFE)

Background

Amniotic fluid embolism (AFE) is a rare condition characterised by sudden unexpected cardiorespiratory arrest or hypotension, with respiratory compromise, hypoxia, or reduced oxygen saturation and disseminated intravascular coagulation (DIC) occurring before significant haemorrhage, during labour, delivery or immediately postpartum in the absence of maternal hyperpyrexia.[8] It is largely a diagnosis of exclusion.

The International Network of Obstetric Survey Systems consensus definition of AFE describes AFE as 'an acute cardio-respiratory collapse within six hours after labour, birth or ruptured membranes, with no other identifiable causes followed by acute coagulopathy in those women who survive the initial event'.[8]

Pathogenesis

There exact pathophysiology underlying AFE remains uncertain. Current evidence suggests a biphasic haemodynamic response, beginning with severe pulmonary hypertension caused by vasospasm. This leads to acute right ventricular failure, followed by left ventricular failure due to reduced preload and systemic hypotension. The resulting decrease in coronary perfusion may cause ischaemic myocardial injury.

Once spontaneous circulation returns, many of the survivors have an acute phase characterised by right ventricular failure because of a sudden increase in pulmonary vascular resistance induced by systemic vasoconstrictors such as endothelin-1.[9] Early identification and management of acute right ventricular failure is fundamental. Performing transthoracic echocardiography as soon as possible as a method of identifying right ventricle and acute cardiopulmonary failure, and tailoring management at improving right ventricular function in right heart failure is identified.[9, 10]

Acute coagulopathy is a feature. Recent evidence suggests that the initial coagulation disorder in AFE is driven by massive consumption and reduced function of fibrinogen, and break down of cross-linked fibrin.[11]

Prevalence

- The reported incidence of AFE is reported to be between 0.8 to 7.7 per 100,000 deliveries.
- A recent cohort study of 14.6 million deliveries in the USA reported an incidence of 6.0 per 100,000 deliveries.[12]
- McDonnell et al report an incidence of 5.4 per 100,000 per women birthing in Australia with a case fatality rate 15%.[13]
- More recently, case fatality rates of 11-43% have been reported in Australia, UK, Netherlands, Canada and the USA.[8]
- Factors that may have contributed to lower case fatality rates include an improved awareness of the condition with less severe cases included in registries, and improvements in the resuscitation of pregnant women and advances in intensive care.

Risk factors

- Recent reports indicate that placenta accreta syndrome is associated with a tenfold increase in the risk of amniotic fluid embolism.[8]

Presentation

- The woman is often conscious at the onset of symptoms. More than 80% of women with AFE experience cardio-respiratory arrest within the first few minutes.
- Not all AFE is rapidly progressive and early diagnosis and supportive treatment may result in better outcomes.
- Symptoms include acute shivering, sweating, anxiety and coughing, followed by respiratory distress, altered mental status, seizure or seizure-like activity and cardiovascular collapse (profound hypotension, tachycardia, and possible arrhythmias) with fetal distress on the CTG.
- Acute coagulopathy can occur quickly, causing massive maternal haemorrhage.

Diagnosis

- Presumptive, based on clinical presentation after considering other causes of haemodynamic instability.
- Premonitory symptoms, such as restlessness, numbness, agitation, tingling, may have been present.
- There is no definitive diagnostic test.
- Early echocardiography to assist in diagnosis and management of acute cardiopulmonary failure.

Differential Diagnoses

- Anaphylaxis
- Aortic dissection
- Myocardial infarction
- Pulmonary embolism (see Table 4)
- Septic shock

Table 4: Clinical features of amniotic fluid embolism (AFE) compared to pulmonary embolism (PE)

	AFE	PE
Timing of onset	Most likely to occur during birth	Any time
Early symptoms	Dyspnoea, restlessness, panic, feeling cold, paraesthesia	Dyspnoea, cough, haemoptysis
Collapse	Highly likely	May occur
DIC	Highly likely	Absent
ECG	Non-specific	Non-specific
Chest X-ray	Pulmonary oedema, ARDS, right atrial enlargement, prominent pulmonary arc	Segmental collapse, raised hemidiaphragm, unilateral pleural effusion
Arterial blood gas (ABG)	Non-specific	Non-specific
Computed tomography pulmonary angiography (CTPA)	Negative	Positive

Management of AFE

- Manage as per Management of Maternal Collapse.
  - Seek **additional support** (e.g., anaesthetics, obstetric, nursing/midwifery staff) if not already present.
- Anticipate uterine atony, coagulopathy, and haemorrhage.

- Prioritise replacement of fibrinogen with fibrinogen concentrate and/or cryoprecipitate, and clot stabilisation with IV tranexamic acid 1 gm over 10 minutes, repeating after 30 minutes if still bleeding.
- Uterine or aortic compression may acutely be necessary to decrease uterine blood loss and acute increase peripheral resistance to stabilise the patient's condition.
- Treat major obstetric haemorrhage as per *Postpartum Haemorrhage PPG* and *Blood Transfusion and Massive Blood Transfusion PPG* (available in the A-to-Z index at www.sahealth.sa.gov.au/perinatal), including the use of cell salvage where available and appropriate.
- Ensure ROTEM (if available), extended coagulation studies (including fibrinogen and D-dimers), CBP and arterial blood gas analysis are performed and repeated to optimise management of the coagulopathy and use of blood products

- Vasopressors as needed, e.g., noradrenaline.
- Manage pulmonary hypertension and right heart failure.
  - Consider echocardiography (thoracic or oesophageal).
  - Pulmonary vasodilator if needed to off load the right ventricle:
    - Inhaled nitric oxide
    - Milrinone
    - Sildenafil
- Avoid fluid overload.
- Consider Extracorporeal membrane oxygenation (ECMO) if prolonged CPR or refractory right heart failure.[14]

Post AFE Resuscitation Considerations

- Manage as per Post Resuscitation and Perimortem Caesarean Section Care
- Consider transfer to intensive care unit
- Pulmonary oedema is a common occurrence in survivors. Pay close attention to fluid input and output.
- Continue to monitor for coagulopathy.

Prognosis

- Many survivors will have ongoing neurological deficits.

Resources

Australian and New Zealand Resuscitation Council: (www.anzcor.org)

Australian Government Pregnancy, Birth and Baby: (www.pregnancybirthbaby.org.au)
Pregnancy, Birth and Baby | Pregnancy Birth and Baby (pregnancybirthbaby.org.au)

Medicines Information: (www.sahealthlibrary.sa.gov.au)
https://sahealthlibrary.sa.gov.au/friendly.php?s=SAPharmacy

Pathology Tests Explained: (www.pathologytestsexplained.org.au/)
Pathology Tests Explained

SA Health Pregnancy:
Pregnancy | SA Health

SAPPGs Web-based App:
Practice Guidelines (sahealth.sa.gov.au)

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