



Government of the Republic of Trinidad and Tobago

Ministry of Health



*Women's Health*

# *The Management of Maternal Collapse Clinical Guideline*

*Directorate of Women's Health  
Ministry of Health  
Trinidad and Tobago*

*July 2020*



# Message from the Directorate

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The Directorate of Women's Health (DOWH) was created at the Ministry of Health (MOH) to improve maternal and perinatal outcomes and address international targets for Trinidad and Tobago in achieving the milestones along the way to the 2030 Agenda for Sustainable Development.<sup>1</sup> This document is one such response in order to create standardized clinical guidelines related to Obstetrics and Gynaecology.

In line with the Sustainable Developmental Goals 2030-Agenda and the Global Strategy for Women's, Children's and Adolescent's Health (2016-2030)<sup>2</sup>, this document supports the objectives of "Survive, Thrive and Transform" by promoting the reduction of maternal and perinatal morbidity and mortality.

Data from the public and private sector revealed that our maternal mortality ratios (MMRs) have decreased in the recent past through sustained efforts including national coordination, health promotion and education, targeted interventions with standardized approaches to management by health care workers, improved communication, accountability, other quality improvement projects and mandatory training in emergency simulation. New family planning opportunities are also a recognized contributor to this reduction. The impact of medical, allied health care professionals as well as non-medical staff in the healthcare system remains the most important factor in the improvements seen.

This document not only highlights the clinical management of patients, but also emphasizes the need for formalized training, documentation, incident reporting, near miss analysis, audit and debriefing.

We used an 'adopt and adapt' method in the production of this guideline based on existing resources and expertise. Consensus was obtained from recognized multidisciplinary stakeholders based on the evidence and publications at the time of producing this document.

**This Guideline updates and replaces the information in Section 11 (pages 44-45) of the Standard Operating Procedure (SOP) Manual for Obstetric and Midwifery Services<sup>3</sup> produced by the Ministry of Health in June 2011.**

## Acknowledgements

The Directorate wishes to recognize the contributions from all stakeholders at the RHAs and the private sector. The work of the team from the Corporate Communications department in finalizing this publication is also acknowledged.

Dr. Adesh Sirjusingh  
Director, Women's Health  
July 2020

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# Accountability of this Document

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This Clinical Guideline was developed by the Directorate of Women’s Health, Ministry of Health, Trinidad and Tobago. This publication is one of several that seeks to standardize the delivery of Obstetrics and Gynaecology-services at both public and private health care facilities. It was developed based on the Ministry’s principles of accessibility, equity, affordability, efficiency, effectiveness and safety.

## Control

The senior management including the Chief Executive Officers of the RHAs, Executive Medical Directors, Medical Directors, County Medical Officers of Health, Medical Chiefs of Staff, General Managers of Nursing, Primary Care Managers, and Heads of Departments have the overall responsibility for the dissemination, staff education, implementation of and compliance with this guideline.

## Distribution

The guideline is to be distributed to all relevant health facilities where obstetric and midwifery services are provided.

## Review Cycle

The Guideline will be reviewed on a three-year cycle and updated where necessary, including at earlier intervals if warranted. Unless recalled by the Ministry of Health, the Guideline will remain in force, however.

## Earlier versions

Any earlier version of this document should be archived for use by the health facility as a reference document.

## Clinical disclaimer

The recommendations in this guideline were arrived at after consideration of the existing evidence available. When exercising their clinical judgement, professionals are expected to take this guideline fully into account, along with the individual needs, preferences and values of their patients or service users. The application of the recommendations in this guideline do not dictate an exclusive course of action as we recognize that individual clinical circumstances will require an individualized approach at times. Major deviations from these recommendations, are to be documented in the patient’s case records including the reason(s) for doing so.

Approval date July, 01, 2020

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Director, Women’s Health

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Chief Medical Officer

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Permanent Secretary

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Hon. Minister of Health

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## List of Abbreviations

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ACLS	Advanced Cardiovascular Life Support
ACOG	The American College of Obstetricians and Gynecologists
BLS	Basic Life Support
DOWH	Directorate of Women's Health
ECG	Electrocardiogram
FIGO	International Federation of Gynecology and Obstetrics
IV	Intravenous
IVF	Intravenous fluid
MCHM	Maternal and Child Health Manual
MCOS	Medical Chief of Staff
MEWS	Modified Early Warning Score
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
PAHO	Pan American Health Organization
PMCS	Perimortem Caesarean Section
RCOG	The Royal College of Obstetricians and Gynaecologists
RHA	Regional Health Authority
SDGs	Sustainable Development Goals
SIP	Perinatal Information System
SOGC	Society of Gynecologists and Obstetricians
SOP	Standard Operating Procedure
WHO	World Health Organization

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## 1.0 Key points

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- In Trinidad and Tobago, obstetric collapse in pregnancy is uncommon (5-6 cases per annum) but contributes to maternal morbidity and mortality particularly in women with non-obstetric conditions such as heart disease, respiratory disorders and other medical conditions (indirect causes) as well as morbid obesity.
- Some cases occur in women with no obvious clinical risk factors. Staff must therefore always be equipped with the clinical skills and supportive infrastructure to manage these rare case scenarios.
- Overall maternal survival is low or is associated with significant morbidity despite appropriate resuscitation.
- Call for help. The early involvement of senior experienced staff, including midwives, obstetricians, anaesthetists and haematologists, is essential to optimise outcome.
- Multiple simultaneous actions are required by various categories of staff.
- Improved outcomes may result from the decision to perform a perimortem delivery (hysterotomy or caesarean section) if the gestation is greater than 20 weeks and return of spontaneous circulation does not occur within 4 minutes of effective cardiopulmonary resuscitation.
  - Delivery should ideally be achieved within 5 minutes of cardiac arrest. The evidence for this recommendation is limited and is noted as a good practice point.
  - In a hospital setting, the procedure should be undertaken at the site of the cardiac arrest without moving to an operating theatre.
  - The primary aim of perimortem caesarean section is to aid maternal survival, and not necessarily fetal survival.
  - Rapid decision making by senior staff is required when recommending perimortem caesarean section
- Clinical areas where pregnant women are seen should have a designated emergency 'pregnancy equipment box' that is regularly monitored by the lead nursing staff including the wards and the emergency departments.

### Clinical issues

- Consider a risk stratification to identify women at higher risk.
- Use a systematic approach to identify the cause as there are many potential reasons.
- All staff should be aware that there are anatomical and physiological differences in the pregnant patient.
- Maternal collapse resuscitation should follow international guidelines using the standard **ABCDE** approach, with some modifications for pregnancy.
- Aortocaval compression significantly reduces cardiac output from 20 weeks of gestation onwards and the efficacy of chest compressions during resuscitation.
  - Manual displacement of the uterus to the left is effective in relieving aortocaval compression in women above 20 weeks' gestation or where the uterus is palpable at or above the level of the umbilicus.

- A left lateral tilt of the woman from head to toe at an angle of 15–30° on a firm surface will relieve aortocaval compression in the majority of pregnant women.
- Pregnant women are at an increased risk of aspiration.
- Difficult intubation is more likely in pregnancy.
- If the airway is clear and there is no breathing, chest compressions should be commenced immediately.
- Two wide-bore cannulae (e.g. ≥ 16 gauge) should be inserted as soon as possible.
- There should be an aggressive approach to volume replacement, although caution should be exercised in the context of pre-eclampsia or eclampsia.
- If available, abdominal ultrasound by a skilled operator may assist in the diagnosis of concealed haemorrhage.
- There should be no alteration in algorithm drugs or doses, or defibrillation energy levels used in the protocols.
- Continue resuscitation until a decision is taken by the consultant obstetrician and consultant anaesthetist to discontinue resuscitation.
- If transferring or transporting, this should be supervised by an adequately skilled team with appropriate equipment.
- In the case of maternal collapse secondary to antepartum haemorrhage, the fetus and placenta should be delivered promptly to allow control of the haemorrhage.
- In the case of massive placental separation, caesarean section or hysterotomy may be indicated even if the fetus is dead to allow rapid control of the haemorrhage and sequelae.
- Intravenous tranexamic acid significantly reduces mortality due to postpartum haemorrhage.
- Massive pulmonary embolism should be treated according to local or international protocols.
- The management of amniotic fluid embolism (AFE) is supportive rather than specific, as there is no proven effective therapy.
- After successful resuscitation, cardiac cases should be managed by an expert cardiology team.
- Septic shock should be managed in accordance with local and national guidelines.
- The antidote to magnesium toxicity is 10 ml 10% calcium gluconate or 10 ml 10% calcium chloride given by slow intravenous injection.
- For suspected local anaesthetic toxicity, immediately stop injecting.
- Lipid rescue should be used in cases of collapse secondary to local anaesthetic toxicity.
- In cases of anaphylaxis, all potential causative agents should be removed, and the ABCDE approach to assessment and resuscitation followed.
- Involve other specialists depending on the cause e.g. neurologists, radiologists.



## Clinical governance

- Accurate documentation is essential in all cases of maternal collapse.
- All cases of maternal collapse must generate a clinical incident form and conform to the mandatory adverse events reporting framework of the Ministry of Health and be reviewed through the RHA's and MOH's clinical governance processes.
- Mandatory formalized and recorded, resuscitation and other emergency skills training are required for all relevant clinical staff at maternity units. These sessions must be coordinated by the Human Resource Departments with the clinical managers and form part of the employee's record/database.
- Debriefing and counselling (to be offered) are recommended for the woman, the family and the staff involved in the event
- The perinatal information system (SIP) must be utilized as mandated by the MOH (see correspondence to RHA of July 26, 2018- Office of the Chief Medical Officer).
- The near miss maternal mortality surveillance data must be submitted monthly to the DOWH at the MOH, by the 15<sup>th</sup> of each month.

## 2.0 Introduction

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### Definition

For the purposes of this document, **maternal collapse** is the term used to define an acute event involving the cardiorespiratory systems and/or central nervous systems, resulting in a reduced or absent conscious level, at any stage in pregnancy and up to 6 weeks after birth. This has the potential to lead to cardiac arrest and death.<sup>4</sup>

### Background

Internationally, maternal cardiac arrest is a rare event occurring in approximately 1 in 36 000 pregnancies.<sup>5</sup> In Trinidad and Tobago, this contrasts with the information published in the Prime Minister's appointed Maternity Services Committee Report (MOH, 2013) and recent data collected by the DOWH from 2017 to date, which revealed a higher incidence of approximately 1 in 10 000. Co-morbid conditions, obesity, higher incidence of chronic non-communicable diseases, ethnicity, lower education levels and other socioeconomic factors are all possible contributors to this higher number in T&T. This still however represents less than 2 cases on an annual basis which means that most obstetric units and individual obstetricians will have little experience in encountering these situations in their career.

Even in the best setting with trained personnel and resources, with early recognition and immediate management in a hospital, the outcome can be poor for both mother and baby, with a case fatality rate of 42 % reported in United Kingdom in 2019.<sup>5</sup>

## 3.0 Causes of maternal collapse

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There are a wide variety of reasons and only a few obstetric causes are noted in this document. It was not the intention of this guideline to reproduce a clinical textbook or the experience of the clinical teams involved. As noted in the "Clinical disclaimer" earlier, this document does not dictate an exclusive course of management.

Causes may or may not be related to pregnancy (Appendix I). If the cause is considered a reversible one, it is anticipated that the outcomes will be improved.

**Follow all other institutional guidelines and protocols as these are not expanded in this document.**

- **Haemorrhage** (see Major Haemorrhage in Obstetrics<sup>6</sup>, MOH)

This is one of the commonest causes worldwide. It remains the commonest cause for severe adverse morbidity (near miss) in Trinidad and Tobago but maternal deaths are now rare.

Also consider nonobvious causes of intraabdominal blood loss including concealed placental abruption, following caesarean section, ectopic pregnancy, splenic artery rupture and hepatic rupture. In typical healthy pregnant women, one may not easily recognize the clinical severity, as they may be able to tolerate significant blood loss prior to decompensation. If readily available, an ultrasound by an experienced operator may be of use in these cases but should not delay the resuscitative efforts.

- **Eclampsia** (see Hypertension in Pregnancy<sup>7</sup>, MOH)

Eclampsia as the cause of maternal collapse is usually obvious in the inpatient setting as often the diagnosis of pre-eclampsia has been made and the seizure witnessed. In the community setting, seizures after 20 weeks' gestation may be attributable to eclampsia, where there is no known history of epilepsy. However, epilepsy should always be considered in cases of maternal collapse associated with seizure activity.

- **Amniotic fluid embolism (AFE)**

Every 1-2 years, a lethal case of AFE is diagnosed in our country according to data received by the MOH (2020). High maternal and perinatal morbidity and mortality is a feature of this condition. It may present during labour or within 30 minutes of birth, with acute hypotension, maternal confusion, respiratory distress, acute hypoxia followed by massive haemorrhage from a coagulopathy depending on if they survive the initial resuscitation.

Research continues on this topic as to the pathophysiology which has been compared to acute anaphylaxis or sepsis like response involving the complement system.<sup>8</sup>

The management of AFE is supportive rather than specific, as there is no proven effective therapy.<sup>9</sup>

As with all cases of collapse, early involvement of senior experienced staff, including obstetricians, anaesthetists, haematologists and intensivists, is essential to optimise outcome.

Coagulopathy needs early, aggressive treatment, including the use of fresh frozen plasma. Recombinant factor VII should only be used if coagulopathy cannot be corrected by massive blood component replacement as it has been associated with poorer outcomes in women with AFE.

In addition to resuscitation and supportive measures, arrhythmias may develop and will require standard treatment. Inotropic support is likely to be needed and measurement of cardiac output may help direct therapy and avoid fluid overload; fluid overload will exacerbate pulmonary oedema and increase the risk of acute respiratory distress syndrome. High filling pressures are indicative of a failing left ventricle.

If undelivered, delivery of the fetus and placenta should be performed as soon as possible. The incidence of uterine atony is increased in this condition and contributes to the postpartum haemorrhage.

- **Thromboembolism**

Approximately 1-2 cases are reported annually. In the recent past, these cases were related to patients with sickle cell disease (national guideline is online) and also morbid obesity. This is the most common direct cause of maternal deaths in our country. Appropriate clinical risk scoring and use of thromboprophylaxis are advocated. In the absence of local or national guideline, it is recommended to follow the updated (2018) RCOG's Green-top Guideline on this topic.<sup>10</sup>

- **Cardiovascular**

In the past few years in T&T, maternal deaths from indirect causes such as cardiac disease have surpassed direct causes (MOH data). These include women with pre-existing cardiac disease as well as rare cases of aortic dissection. Appropriate care from skilled multidisciplinary teams is required.

- **Drugs**

Drug toxicity and overdose should be considered in all cases of collapse. Consult the local poison centre for advice (800-2PIC = 800-2742). Substance misuse should be remembered as a potential cause of collapse especially outside of hospital.

In terms of therapeutic drug toxicity, the commonly used drugs in obstetric practice are magnesium sulphate and local anaesthetic agents.

The antidote to magnesium toxicity is 10 ml 10% calcium gluconate or 10 ml 10% calcium chloride given by slow intravenous injection.

If local anaesthetic toxicity is suspected, stop injecting immediately.

Lipid rescue should be used in cases of collapse secondary to local anaesthetic toxicity. 20% intravenous lipid e.g. Lipofundin® is available in all hospitals offering maternity services.

Toxic effects associated with local anaesthetics usually result from excessively high plasma concentrations. Effects initially include a feeling of inebriation and lightheadedness followed by sedation, circumoral paraesthesia and twitching; convulsions can occur in severe toxicity. Signs of severe toxicity include sudden loss of consciousness, with or without tonic-clonic convulsions, and cardiovascular collapse; sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias can all occur.

- **Intracranial haemorrhage**

This can be a significant complication of uncontrolled, particularly systolic, hypertension, but can also result from ruptured aneurysms and arteriovenous malformations. The initial presentation may be maternal collapse, but often severe headache precedes this.

- **Anaphylaxis**

A severe life threatening, generalized or systemic reaction can result in respiratory, cutaneous and circulatory changes. The presentation is that of sudden onset and rapid progression of symptoms; life-threatening airway and/or breathing and/or circulation; skin and/or mucosal changes (flushing, urticaria, angioedema).

In cases of anaphylaxis, all potential causative agents should be removed, and the ABCDE approach to assessment and resuscitation followed.

If the anaphylactic reaction occurs in the community, the woman should have basic life support and be transferred to a hospital setting as quickly as possible, unless a suitably trained healthcare professional is present with appropriate equipment and drugs in which case definitive resuscitation and treatment should be commenced.

The treatment for anaphylaxis is 0.5 ml of 1:1000 adrenaline 500 micrograms intramuscularly. This can be repeated after 5 minutes if there is no effect.

Adjuvant therapy consists of chlorpheniramine (Piriton) 10 mg and hydrocortisone 200mg (IM or slow IV).

- **Sepsis**

Worldwide, sepsis is a recognized significant cause of maternal morbidity and mortality, and substandard care continues to feature in the cases that result in death.<sup>11</sup> Maternal collapse is not commonly associated with sepsis in our country.

Bacteraemia, which can be present in the absence of pyrexia or a raised white cell count, can progress rapidly to severe sepsis and septic shock leading to collapse.<sup>12, 13</sup>

Work with multidisciplinary team including infectious disease, internal medicine and anaesthetic specialists. Management includes:

1. Measure serum lactate.
2. Obtain blood cultures and culture swabs prior to antibiotic administration.
3. Administer broad spectrum antibiotic(s) within the first hour of recognition of severe sepsis and septic shock according to local protocol.
4. In the event of hypotension and/or lactate more than 4 mmol/l:
  - a. begin rapid administration of an initial minimum of 30 ml/kg of crystalloid to be completed within 3 hours of diagnosis.
  - b. once adequate volume replacement has been achieved, a vasopressor (noradrenaline, with vasopressin or adrenaline in addition, if required) and/or an inotrope (for example, dobutamine) may be used to maintain mean arterial pressure more than 65 mmHg.
5. In the event of hypotension despite fluid resuscitation (septic shock) and/or lactate more than 4 mmol/l:
  - a. dynamic variables of fluid status are preferred to static variables
  - b. consider steroids if unresponsive to adequate fluid resuscitation and vasopressor therapy
  - c. maintain oxygen saturation at more than 94% (88%–92% in women at risk of hypercapnic respiratory failure) with facial oxygen
  - d. consider transfusion if haemoglobin less than 70 g/l (7.0 mg/dl)

- **Other**

Airway obstruction especially during anaesthesia as well as other anaesthetic related complication, trauma, metabolic and electrolyte disturbances.

## 4.0 Anatomical and physiological considerations

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Non obstetric staff involved in the resuscitation of pregnant women may not be aware of key anatomical and physiological differences. This includes pre-hospital care clinicians, paramedics and emergency medicine department staff.

These changes can accelerate the development of hypoxia and acidosis, and make ventilation more difficult (Appendix II), and combined with other physical changes, make resuscitation during pregnancy more challenging.

- **Aortocaval compression**

Aortocaval compression significantly reduces cardiac output from 20 weeks of gestation onwards and the efficacy of chest compressions during resuscitation. Cardiopulmonary resuscitation (CPR) is less likely to be effective in these women.

- **Respiratory**

Changes in lung function, diaphragmatic splinting and increased oxygen consumption make pregnant women become hypoxic more readily and make ventilation more difficult.

- **Intubation**

Difficult intubation is more likely in pregnancy.

- **Aspiration**

Pregnant women are at an increased risk of aspiration. Aspiration pneumonitis in pregnant women (Mendelson's syndrome<sup>14</sup>) can be severe. The risks can be minimized by early intubation with effective cricoid pressure, and the use of H<sub>2</sub> antagonists and antacids prophylactically.

- **Circulation**

The increased cardiac output and hyperdynamic circulation of pregnancy mean that large volumes of blood can be lost rapidly, especially from the uterus which receives 10% of the cardiac output at term. Concealed bleeding and underestimation of loss means that intervention can be delayed. Where signs have been subtle, hypovolaemia as the cause of maternal cardiopulmonary arrest may go unrecognised. This can be less well tolerated in the presence of maternal anaemia.

## 5.0 Resuscitation

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Resuscitation should follow the international guidelines<sup>15</sup> using the standard ABCDE approach, with some modifications for maternal physiology especially relief of aortocaval compression (Appendix III).

If maternal cardiac arrest occurs in the community setting, basic life support should be administered, and rapid transfer arranged.

Though there are variances in terminology based on country and site of training, the United Kingdom's terminology is used and explained for standardization. These guidelines are updated based on available evidence and there is a free "app" available for download for mobile devices at their website (see <https://www.resus.org.uk/apps/iresus/>)

### Summon help

The arrest team should comprise senior staff including midwife, obstetricians, anaesthetist. The neonatal staff should also be summoned if the fetus is salvageable. Summon relevant technical and non-technical staff e.g. to assist recording, making telephone calls, helping to move or support patient, transport specimens and obtaining equipment and drugs, and laboratory support.

### Assess for signs of life

Assess for signs of life by checking for breathing and carotid pulse. If not confident or any doubt, begin cardiopulmonary resuscitation (CPR). However, if signs of life are detected, a standard ABCDE approach should be taken.

- Place in left lateral position
- Seek obstetric review
- Assess need for oxygen therapy
- Obtain vascular access
- An alert, verbal stimulus, pain stimulus, unresponsive (AVPU) assessment should be undertaken as an alteration of consciousness can be a sign of critical illness.
- The cause of the maternal collapse should be rapidly identified and treated to prevent potential progression to maternal cardio-respiratory arrest.
- Ongoing regular ABCDE assessment should be performed as the risk of progression to cardiac arrest remains until the cause of the collapse is treated.
- Assessment of fetal wellbeing should be undertaken after ABCDE assessment

If signs of life are not detected in the hospital setting, a cardiac arrest should be declared and the emergency response arrest team activated. An emergency call for the obstetric, obstetric anaesthetic and neonatal (if possibility of viability) resuscitation teams should be made. The consultant obstetrician and consultant anaesthetist should also be summoned. Standard basic life support (BLS) should be initiated.



## 5.1 Relieve Aortocaval compression

Manual displacement of the uterus to the left is effective in relieving aortocaval compression in women above 20 weeks' gestation or where the uterus is palpable at or above the level of the umbilicus. This permits effective chest compressions in the supine position in the event of cardiac arrest. The technique should be performed using an 'up, off and over' method. This is achieved by placing a hand below the uterus on the maternal right and pushing the uterus slightly upwards and to the left.

A left lateral tilt of the woman from head to toe at an angle of 15–30° on a firm surface will relieve aortocaval compression in most cases and allow chest compressions to be performed in the event of cardiac arrest. This can be achieved on a tilting operating table or using a solid wedge (of an appropriate size). In the absence of these, manual displacement of the uterus is preferable. Using soft surfaces, such as a bed, or objects, such as pillows or blankets, are not nearly as effective, compromise effective chest compressions, and should be used as a last resort (a video of the procedure can be found at <https://www.youtube.com/watch?v=2VyqGqDNILc>).

In cases of major trauma, the spine should be protected with a spinal board before any tilt is applied. In the absence of a spinal board, manual displacement of the uterus should be used.

## 5.2 Airway (A)

- Intubation in an unconscious woman with a cuffed endotracheal tube should be performed immediately by an experienced anaesthetist.
- The airway in pregnancy is more vulnerable because of the increased risk of regurgitation and aspiration.<sup>16</sup> For this reason, it is important to clear and protect the airway as early as possible. Intubation with a cuffed endotracheal tube should then be performed. This will protect the airway, ensure good oxygen delivery and facilitate more efficient ventilation. Intubation can be more difficult in pregnancy, so this should be undertaken by someone with appropriate skills. Failed intubation is more common in the pregnant than nonpregnant patient and a plan for failed intubation should always be considered. A full description of the failed intubation drill is available from the Difficult Airway Society<sup>17</sup> In brief: Maintain oxygenation; Call for help; Supraglottic airway device; Front of Neck access. During cardiac arrest in a nonpregnant woman it is acceptable to use a supraglottic device, such as a laryngeal mask airway as an alternative to the endotracheal tube. In pregnant women, physiological changes in the airway, such as hyperaemia, hypersecretion and oedema lead to increased friability of the airway mucosa causing bleeding and difficulties in visualisation for intubation.
- Waveform capnography can be used to confirm and continually monitor tracheal tube placement, and may be used to monitor the quality of CPR and to provide an early indication of return of spontaneous circulation.<sup>15</sup>
- Appendix IV of this guideline presents suggested equipment that should be available for cases where airway management may be difficult.

### 5.3 Breathing (B)

- Supplemental high flow oxygen should be administered as soon as possible to counteract rapid deoxygenation.
- Bag and mask ventilation or insertion of a simple supraglottic airway should be undertaken until intubation can be achieved.
- Supplemental oxygen should be added with a gas flow of 10–15 litres per minute to whatever method of ventilation is being employed. Maternal physiological changes lead to increased oxygen requirements. Furthermore, in maternal collapse, reduced oxygen reserve and a reduced functional residual capacity leads to deoxygenation occurring more rapidly than in nonpregnant women.
- Ventilation, using a face mask, or a supraglottic airway device and self-inflating bag, or via a cuffed endotracheal tube, may be more difficult because of the physiological changes of pregnancy as previously described. It can also be difficult to see the chest rise.

### 5.4 Circulation (C)

- If the airway is clear and there is no breathing, chest compressions should be commenced immediately.
- Two wide-bore cannulae (minimum 16 gauge) should be inserted as soon as possible. If peripheral venous access is not possible, early consideration of central venous access, intraosseous access or venous cutdown should be considered.
- There should be an aggressive approach to volume replacement, although caution should be exercised in the context of pre-eclampsia or eclampsia.
- Abdominal ultrasound by a skilled operator can assist in the diagnosis of concealed haemorrhage.
- The same defibrillation energy levels should be used as in a nonpregnant woman.
  - Chest compressions should be commenced immediately in the absence of a cardiac output.<sup>18</sup>
  - Compressions may be made difficult because of obesity and if the woman is in the tilted position.
  - Hand position should be over the centre of the chest and it is important to ensure that the direction of compression is perpendicular to the chest wall. If a left lateral tilt is employed then the angle of tilt must be taken into account when performing chest compressions. Immediate and competent chest compressions have been found to have a direct impact on maternal outcome.<sup>18</sup>
  - In total, 30 chest compressions (at a rate of 100–120 per minute) should be performed for every two ventilation breaths initially. If there are two rescuers, one should be responsible for chest compressions and ventilation breaths, whilst the other should ensure aortic caval decompression with manual uterine displacement.

- Once intubation is performed, the ratio of chest compressions to ventilation breaths should be desynchronised. Ventilation should be at a rate of 10 breaths per minute with continuous chest compressions at 100–120 per minute. Because chest compressions are not as effective after 20 weeks of gestation, there should be early recourse to delivery of the fetus and placenta if CPR is not effective.<sup>15</sup> In woman with a very high BMI chest compressions can be performed over the head of the woman if there is sub-optimal rescuer positioning.<sup>19</sup> Early vascular access will be obtained with wide-bore intravenous cannulae inserted above the level of the diaphragm. This allows the administration of fluids to not be affected by aortocaval compression. If peripheral venous access is difficult, there should be early consideration of central venous access, intraosseous access<sup>20</sup> or venous cutdown to aid volume replacement.
- Haemorrhage is the most common cause of maternal collapse, and is a consequence of other causes of collapse. There must be a high index of suspicion for bleeding and awareness of the limitations of maternal clinical signs. Caution must be exercised in the clinical context of severe pre-eclampsia and eclampsia, where fluid overload can contribute to poor outcome. In the case where significant haemorrhage, and pre-eclampsia or eclampsia exist, careful fluid management is essential.
- Very occasionally, ultrasound by a skilled operator can assist in the diagnosis of free fluid associated with intra-abdominal bleeding, although laparotomy should not be delayed if the findings are negative and/or the index of suspicion is high.<sup>21</sup> This, however, should not interfere with the resuscitation process.
- If defibrillation is required, the same settings should be used as in the nonpregnant adult, as there is no change in thoracic impedance. Adhesive defibrillator pads are preferable to defibrillator paddles, and the left defibrillation pad should be applied lateral to the left breast. If the woman's breasts are large or engorged, defibrillator pads may need to be placed on the anterior and posterior precordium to optimise defibrillation energy transfer. The energy from the defibrillation shock is directed across the heart and there is no evidence that shocks from a direct current defibrillator have an adverse effect on the fetus. Uterine monitors should be removed before shock delivery.

## 5.4 Drugs (D)

- Common, reversible causes of maternal cardiopulmonary arrest should be considered throughout the resuscitation process.
- Resuscitation efforts should be continued until a decision is taken by the consultant obstetrician and consultant anaesthetist to discontinue resuscitation efforts. This decision should be made in consensus with the cardiac arrest team.

## 5.5 Other

- Common, reversible causes of maternal cardiopulmonary arrest should be considered throughout the resuscitation process.
- Resuscitation efforts should be continued until a decision is taken by the consultant obstetrician and consultant anaesthetist to discontinue resuscitation efforts. This decision should be made in consensus with the arrest team.

# 6.0 Perimortem caesarean section or hysterotomy

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- In women over 20 weeks of gestation, if there is no response to correctly performed CPR within 4 minutes of maternal collapse or if resuscitation is continued beyond this, then PMCS should be undertaken to assist maternal resuscitation. It is recommended that this decision and delivery occur within 5 minutes of the collapse. The evidence to support this practice is however limited.<sup>22,23</sup> (see paragraph below).
- PMCS should not be delayed by moving the woman. It should be performed where maternal collapse has occurred and resuscitation is taking place.
- The most experienced clinician should conduct the surgery. However it is recognized that few units or obstetricians would ever experience this scenario in their careers.
- The operator should use the incision, which will facilitate the most rapid access based on experience.
- A scalpel and umbilical cord clamps (or alternative ligatures) should be available on the resuscitation trolley in all areas where maternal collapse may occur, including the accident and emergency department.
  - The gravid uterus impairs venous return and thus reduces cardiac output by approximately 60% secondary to aortocaval compression.<sup>24</sup> Delivery of the fetus and placenta reduces oxygen consumption, improves venous return and cardiac output, facilitates chest compressions and makes ventilation easier. It also allows for internal chest compressions by inserting the hand through the open abdomen up to the diaphragm and compressing the posterior aspect of the heart against the chest wall. This improves cardiac output beyond that achieved in closed chest compressions.
  - At less than 20 weeks of gestation there is no proven benefit from delivery of the fetus and placenta. PMCS should be considered a resuscitative procedure, to be performed primarily in the interests of maternal survival.

- Delivery within 5 minutes of maternal collapse improves the chances of survival for a viable baby. If maternal resuscitation is continuing beyond 4 minutes of the collapse, delivery of the fetus and placenta should be performed as soon as possible to aid resuscitation, even if the fetus is already dead. There is, of course, the possibility that the outcome could be that the surviving child has sustained neurological and their sequelae in an attempt to preserve the life of the mother.
- Time should not be wasted by moving the woman to an operating theatre; a PMCS can be performed anywhere, with a scalpel being the only essential equipment required. With no circulation, blood loss is minimal, and no anaesthetic is required. If resuscitation is successful following birth, there should be prompt transfer to an appropriate environment at that point, as well as anaesthesia and sedation, to control ensuing haemorrhage and complete the operation.
- The doctrine of ‘best interests of the patient’ would apply to conduct of this procedure being carried out without consent.
- Manual uterine displacement can be stopped immediately prior to incision. If resuscitation is successful, the uterus and abdomen should be closed in the usual way to control blood loss and minimise the risk of infection.

## 7.0 Following resuscitation

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- Senior experienced staff should be involved at an early stage. This include staff from other units and departments who are available.
- If indicated, transfer in accordance with the MOH’s Referral and Transfer Protocol (2009)
- For antepartum haemorrhage, prompt delivery is recommended
  - Even with a dead fetus, a caesarean section or hysterotomy may be indicated in a massive placental separation
- Postpartum haemorrhage: intravenous tranexamic acid significantly reduces mortality<sup>6</sup>
- Masive pulmonary embolism: follow local and international guidelines<sup>10</sup>
- Amniotic Fluid Embolism: management is supportive rather than specific, as there is no proven effective therapy.
- Cardiac cases: after successful resuscitation should be managed by an expert cardiology team.
- Sepsis: follow local guidelines and see earlier section above.

## 8.0 Clinical governance (see Appendix V)

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### 8.1 Accurate documentation is essential in all cases of maternal collapse

Poor documentation remains a concern in all aspects of medicine and can have potential clinical and medicolegal consequences. Contemporaneous note keeping is difficult in a resuscitation situation, unless someone is scribing. Those involved should then write full notes immediately after the event, including midwifery staff. This is not to be performed at a later date.

**8.2** As per the Adverse Events Policy and Guidelines<sup>25</sup> (2011), all cases of maternal collapse or maternal death must be reported as guided by the Policy.

**8.3** The monthly near miss maternal mortality surveillance form must be returned by 15<sup>th</sup> of subsequent month to the DOWH of the MOH

### 8.4 Training

All relevant staff working in a maternity unit should have annual formalized multidisciplinary training in generic life support and the management of maternal collapse. This must be coordinated by the Human Resource Department with the assistance of the clinical managers.

### 8.5 Debriefing

The woman and all relevant family and staff members are recommended to have debriefing. Professional support may also be required as post-traumatic stress disorder is well-recognized.

## 9.0 Research and Audit

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- The use of the perinatal information system (100% cases recorded) as made mandatory from August 2018 by the Ministry of Health, will facilitate research and audit
- Compliance of facilities with staff undergoing recorded CPR, maternal collapse and other training skills in their human resources files (100 %)
- Presence of scalpel and clamps on resuscitation trolleys (100 %)
- Compliance with Adverse Events and Near Miss Maternal Mortality Reporting obligations (100 %)
- Review at the institution's mandatory monthly Maternal Mortality and Morbidity Meetings (100%)

## 10.0 References and useful resources

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### Other useful resources

- UK Obstetric Surveillance System (UKOSS) [<https://www.npeu.ox.ac.uk/ukoss>].
- MBRRACE-UK: Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK <https://www.npeu.ox.ac.uk/mbrance-uk>
- Advance Life Support in Obstetrics (ALSO) <http://www.also-uk.com/>
- Practical Obstetric Multi-Professional Training (PROMPT) <http://www.promptmaternity.org/>
- Managing Medical and Obstetric Emergencies and Trauma (mMOET), Advanced Life Support Group (ALSG) <http://www.alsg.org/home/>
- The Birth Trauma Association <http://www.birthtraumaassociation.org.uk/>
- Resuscitation App for Android and Apple (iOS) devices <https://www.resus.org.uk/apps/iresus/>
- Video resource- Perimortem Resuscitation <https://www.youtube.com/watch?v=2VyqGqDNILc>.
- Video resource- Amniotic Fluid embolism- Resuscitation <https://www.youtube.com/watch?v=omsqwd9Ckbc>



## Appendix I

### Possible causes of maternal collapse

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<b>CNS</b>	Eclampsia Intracranial haemorrhage
<b>Embolism</b>	Pulmonary Amniotic fluid
<b>Haemorrhage</b>	PPH Antepartum e.g. ectopic, abruption, praevia Hepatic rupture Splenic artery rupture
<b>Cardiovascular</b>	Aortic dissection, Arrhythmia Myocardial infarction Cardiomyopathy
<b>Sepsis</b>	
<b>Drugs</b>	Magnesium sulphate Local anaesthetic Other anaesthetic drug reactions e.g spinal, epidural Illicit drugs Anaphylaxis
<b>Metabolic</b>	Hyponatremia e.g. oxytocin Hypoglycemia e.g. Acute fatty liver

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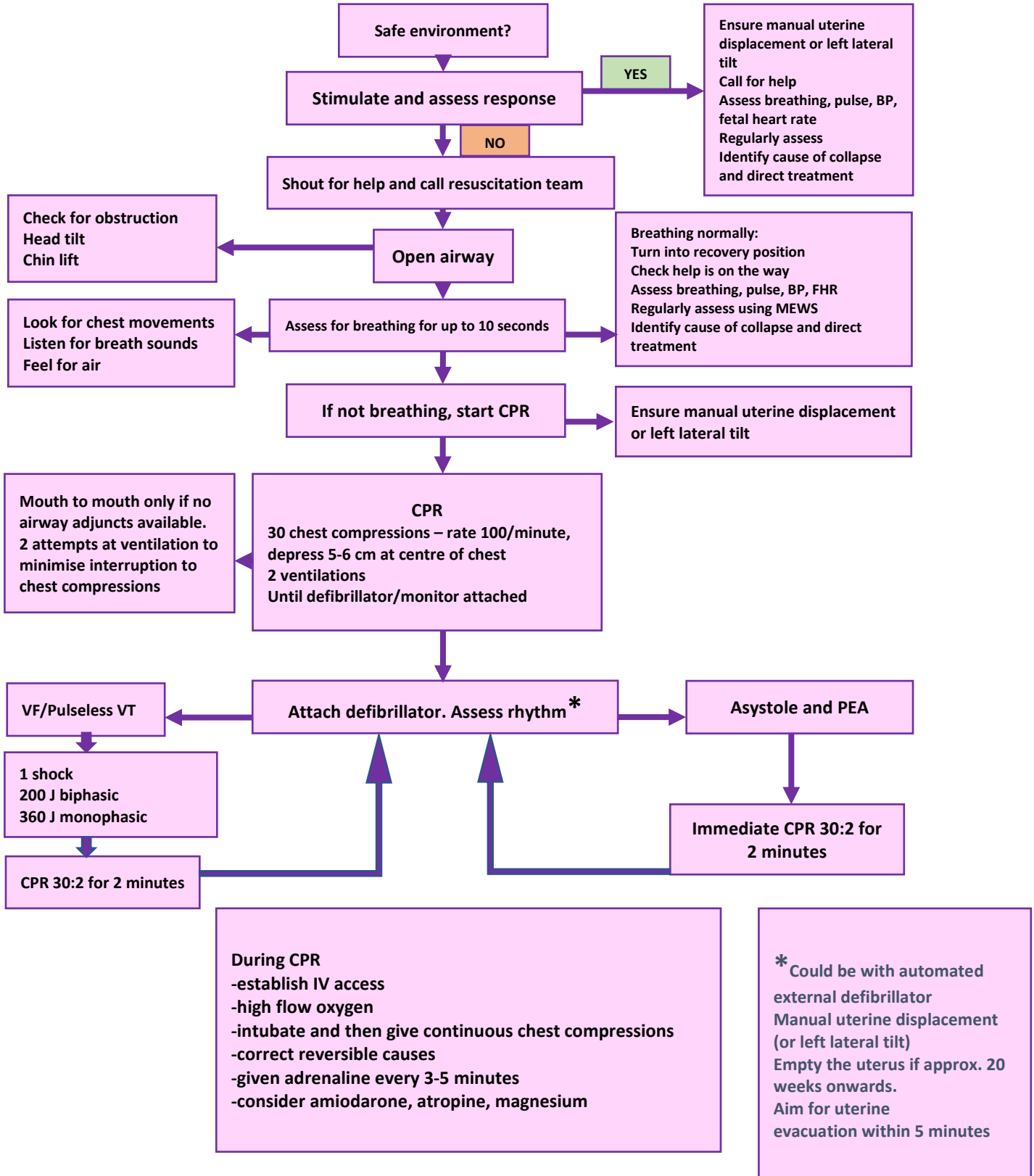
## Appendix II

### Physiological and anatomical changes in pregnancy

SYSTEM	CHANGES IN PREGNANCY	IMPACT ON RESUSCITATION
<b>Cardiovascular</b>		
Plasma Volume	Increase up to 50%	Dilutional anemia Reduced oxygen carrying capacity
Heart rate	Increased by 15-20 bpm	Increased CPR circulation demands
Cardiac output	Increased by 40% Pressure of gravid uterus/supine hypotension	Increased CPR circulation demands
Uterine blood flow	Receives 10% of cardiac output at term	Risk of rapid massive haemorrhage
Systemic vascular resistance	Decreased	Sequesters blood during CPR
Arterial blood pressure	Reduced by 10-15 mmHg	Decreased reserve
Venous return	Reduced by gravid uterus compression on IVC	Increased CPR circulation demands Decreased reserve
<b>Respiratory</b>		
Respiratory rate	Increased	Decreased buffering capacity, acidosis more likely
Oxygen consumption	Increased by 20%	Hypoxia develops more quickly
Residual capacity	Decreased by 25%	Hypoxia develops more quickly when apnoeic
Arterial pCO <sub>2</sub>	Decreased	Decreased buffering capacity, acidosis more likely
Laryngeal oedema	Increased	Difficult intubation
<b>Other changes</b>		
Gastric motility	Decreased	Increased risk of aspiration
Lower oesophageal sphincter	Relaxed	Increased risk of aspiration
Uterus	Enlarged	Diaphragmatic splinting reduces residual capacity and makes ventilation more difficult
Weight/BMI	Increases	Large breasts may interfere with resuscitation

# Appendix III

## Maternal collapse algorithm





**Manual uterine displacement**

## APPENDIX IV

### Recommended airway equipment

(Brands are named only as an example and not as the only option to be considered)

#### A. Routine airway equipment

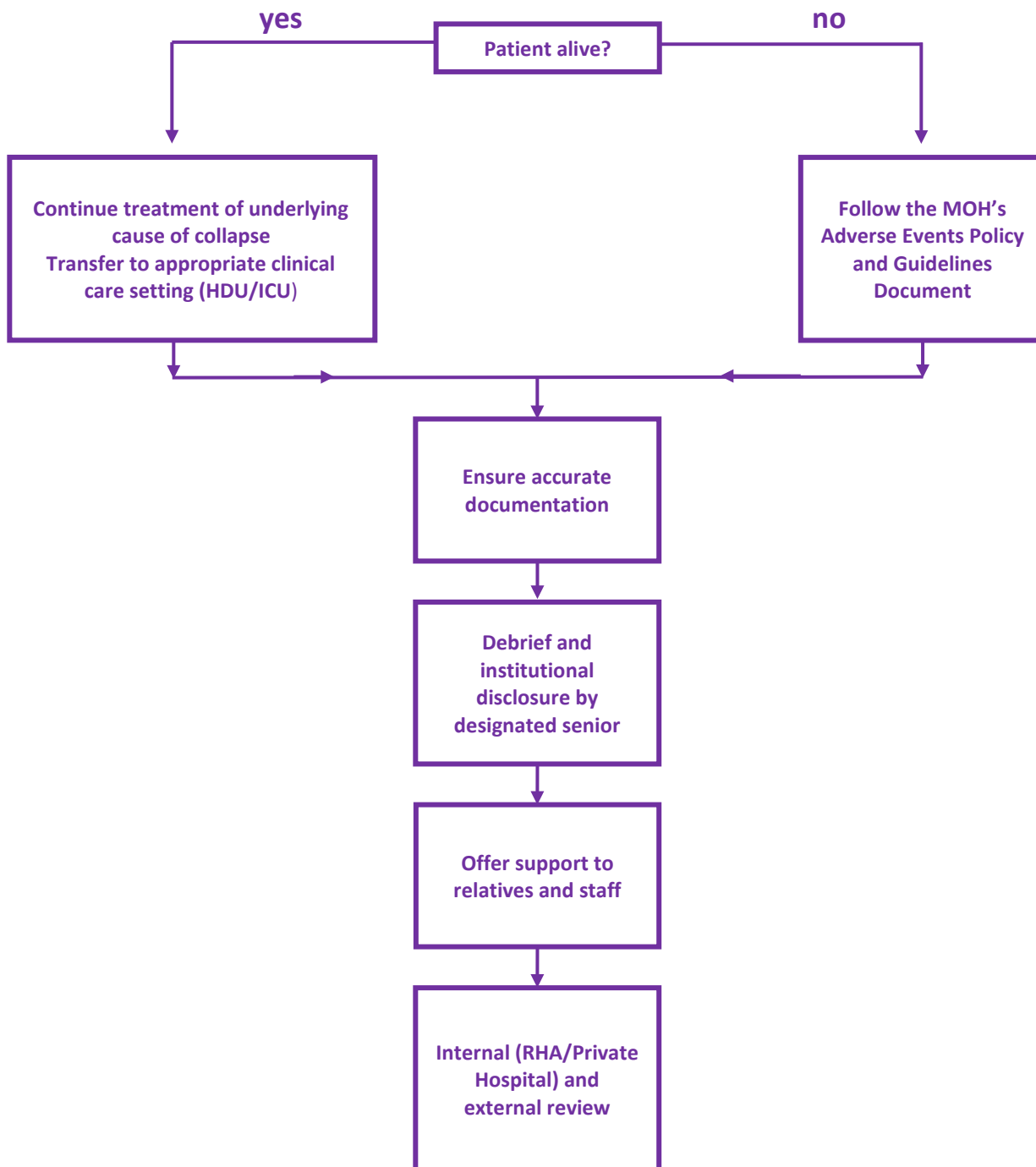
- Face masks (various sizes)
- Oropharyngeal airways size 2, 3 and 4
- Endotracheal tubes in a range of sizes laryngoscopes – Macintosh blades (sizes 3 and 4)
  - two working short handles
  - McCoy laryngoscopes (sizes 3 and 4 blades)
  - videolaryngoscopes (at least one type)
- Tracheal tube introducer – such as a bougie malleable stylet
- Magill forceps
- Nasal cannula and oxygen tubing equipment for ramping/pillows
- Monitoring equipment including capnography (see AAGBI guidelines- Recommendations for standards of monitoring during anaesthesia and recovery. 4th edition, 2007)

#### B. Recommended equipment for the management of unanticipated difficult intubation

- Endotracheal tubes – range of reinforced tubes, microlaryngeal tubes sizes 5.0 and 6.0 mm, LMA-Fastrach™ tracheal tubes
- Supraglottic airway devices (SAD) to include cLMA, and a second generation SAD (e.g. LMA Proseal™, LMA Supreme™ or I-gel®) - sizes 3, 4 and 5
- LMA cuff pressure manometer Fiberoptic scope, camera and monitor Aintree® intubating catheter
- Surgical cricothyroidotomy equipment for the ‘can’t intubate can’t oxygenate’ situation:
  - Scalpel with No. 10 blade
  - Bougie
  - Size 6.0 endotracheal tube
  - Tracheal hook
  - Forceps or tracheal dilator
- Equipment for awake fiberoptic intubation:
  - Equipment to deliver topical atomised local anaesthetic to the upper airway such as the Mucosal Atomization Device (MAD®) or Mackenzie technique set
  - Berman airway
  - Epidural catheter
  - Local anesthetic for topical anaesthesia (4% lidocaine, Instillagel®)
  - Vasoconstrictors for the nose – phenylephrine/lidocaine (Co-phenylcaine®) or Xylometazoline

See the Obstetric Anaesthetists’ Association and Difficult Airway Society [[http://www.oaa-anaes.ac.uk/assets/\\_managed/cms/files/03102015\\_Equipment\\_List%20final.docx](http://www.oaa-anaes.ac.uk/assets/_managed/cms/files/03102015_Equipment_List%20final.docx)].

### Post collapse algorithm



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