Section 1: Introduction to Maternal Critical Care

Key Learning Points

- Maternal critical care is required for pregnant and postnatal women with complex medical and obstetric problems
- There should be appropriate critical care support to manage pregnant and postpartum women who become unwell and this should be provided on the labour ward or a maternal critical care unit
- Maternal critical care requires a multi-professional team of midwives, obstetricians, neonatologists (if mother still pregnant), anaesthetists and intensive care specialists
- Specialised maternal critical care charts should be used to document observations, fluid balance, ongoing clinical investigations, results and medical reviews
- Maternal critical care worksheets provide a useful framework for structured medical review
- Women requiring critical care should receive frequent obstetric reviews to ensure the maintenance of their usual antenatal and postnatal maternity care
- All health care professionals should be aware of the potential long-term effects of a 'near-miss' incident on a mother's health, in particular their mental health

Introduction

Maternal Critical Care is the specialised care of pregnant or postpartum women whose conditions are life-threatening and require comprehensive care and close monitoring. In the UK, and in many countries worldwide, pregnancy care is increasingly complex as the pregnant population becomes older, more obese and has more medical co-morbidities (1). Due to these changing demographics, women are more likely to experience pregnancy-related complications that may require critical care. Women aged 35 and over have a significantly higher maternal mortality rate than women aged 20–24, with 84% of maternal deaths in the UK between 2009 and 2012 having multiple medical co-morbidities and/or significant social factors (1).

In Europe between one and three women for every 1,000 births are admitted to an intensive care unit (ICU) (2). In the USA it is estimated that up to eight women per 1,000 births are admitted to an ICU (3). Most admissions to an ICU are made in the immediate postnatal period, with the most common reasons for admission including postpartum haemorrhage, complications of pre-

eclampsia and hypertension, sepsis and cardiac disease (2).

The RCOG report *'Providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman'* released in 2011, stated that: "Childbirth is a major life event for women and their families. The few women who become critically ill during this time should receive the same standard of care for both their pregnancy-related and critical care needs, delivered by professionals with the same competency levels irrespective of whether these are provided in a maternity or general critical care setting." (4). Furthermore, the MBRRACE-UK '*Saving Lives, Improving Mothers' Care'* (2014) report also recommended: **"**There should be adequate provision of appropriate critical care support for the management of a pregnant woman who becomes unwell. Plans should be in place for the provision of critical care on labour wards or maternity care on critical care units, depending on the most appropriate setting for a pregnant or postpartum woman to receive care" (1).

In August 2018, the Royal College of Anaesthetists (RCoA) released an updated Report *'Care of the critically ill woman in childbirth; enhanced maternal care.'* (5). The document has been produced by a joint working party comprising of representatives from; Obstetric Anaesthetists Association (OAA), Royal College of Anaesthetists (RCoA), Royal College of Midwives (RCM), Royal College of Obstetricians and Gynaecologists (RCOG), Intensive Care Society and The Faculty of Intensive Care Medicine. The report identifies the urgent need for teamwork and multi-disciplinary training in the early recognition of critical illness and also includes reflections from two women who became critically ill peri-partum, emphasising the importance of the woman's voice too.

The report recognises that many of the recommendations from the 2011 RCOG Report have not yet been implemented in UK maternity units, and therefore requests that there should be a nationwide implementation of the recommendations contained within the 2018 report. The key messages for enhanced maternal care (EMC) in the 2018 report include:

- Working in teams is vital for good outcomes
- Training for enhanced maternal care should be competency-based
- ***Multi-professional education and training is essential***
- There is a need for a national early warning system modified for obstetrics (MOEWS)
- Whilst care should usually take place on the labour ward, transfer to ITU may occasionally be warranted
- Women admitted to general ITU should receive coordinated shared care and daily multi-professional reviews

The recommendations for education and training are in line with the content of this PROMPT CiPP training package, with emphasis upon multi-disciplinary team training and simulation-based learning techniques. The 2018 Report also includes the '*Enhanced Maternal Care competency framework for midwives caring for the ill and acutely ill woman'* which is produced by the RCM in collaboration with the OAA.

Why is 'maternal' critical care different from 'normal' critical care?

The provision of critical care for women who are pregnant or who have recently given birth provides different challenges to those of the general adult population.

- The pregnant, critically ill, woman requires monitoring and multi-professional management, as does her unborn child. Such care will require the combined knowledge and skills of midwives, obstetricians, anaesthetists and intensive care specialists. When an urgent birth is necessary because of deterioration in the woman's condition, there is a need for immediate access to an operating theatre, neonatal resuscitation facilities and the neonatal unit.
- There is often no ideal location to provide critical care for pregnant women: giving birth in the intensive care unit (ICU) is not ideal as ICU staff may not have the skills to deal with obstetric complications, whereas labour wards often do not have the facilities to provide invasive ventilation or to support women with multi-organ failure. The overriding principle is that a pregnant woman must receive the correct level of care wherever she is. Maternal critical care is most commonly provided in an adequately-equipped and staffed labour ward for antenatal and intrapartum care but transfer to a General ICU may be required if there is further deterioration in the mother's clinical condition.
- The physiological changes of pregnancy provide an increased physiological reserve however they also impose increased physiological demands.
    - The airway can be more difficult to intubate if invasive ventilation is required.
    - There is an increased oxygen demand and reduced oxygen reserve with reduced lung compliance. This means hypoxia is more likely and adequate ventilation can be harder to achieve (6).
    - Aortocaval compression must be considered after 20 weeks' gestation.
    - Cardiac output increases significantly during pregnancy.
    - Not all medications can be safely given in pregnancy, and those that can, may have

altered plasma levels.

- The immunosuppression associated with pregnancy means that infection and sepsis can be more common, more aggressive and may be due to atypical organisms.
- Regurgitation and aspiration of gastric contents and venous thromboembolism (VTE) are more common; prophylaxis should be considered for these potential complications.

- The critically ill woman who has recently given birth should, if possible, have continued contact with her baby to support the establishment of breastfeeding and bonding (7). Such contact can often be achieved in a maternity unit but is more difficult to achieve in an ICU. Separation of mother and baby can lead to maternal emotional distress, which may inhibit the establishment of breastfeeding and increase the risk of postnatal depression.
- Caring for mother and baby in separate locations can also be stressful for the family who are forced to divide their time between the unwell mother and her newborn baby. Care should be as holistic as possible, without compromising clinical practice.

When might maternal critical care be required?

There are multiple conditions where a pregnant woman, or woman who has recently given birth, may require critical care. No list will ever be comprehensive but common conditions may include those listed in **Table 1.1**.

Table 1.1 Possible conditions requiring maternal critical care

Possible conditions requiring maternal critical care	
Respiratory	▪ Severe community acquired pneumonia (including influenza) ▪ Pulmonary oedema ▪ Severe asthma ▪ Pulmonary embolism ▪ Bronchospasm
Cardiovascular	▪ Severe uncontrolled hypertension ▪ Cardiomyopathy ▪ Massive haemorrhage ▪ Pulmonary embolism ▪ Septic shock
Sepsis	▪ Obstetric related: e.g. chorioamnionitis, post-operative, mastitis, UTI ▪ Non-obstetric: influenza, pneumonia, meningitis
Neurological	▪ Status epilepticus ▪ Meningitis ▪ Intracerebral bleed ▪ Malignancy ▪ Guillain-Barré syndrome

Recognition of the critically ill pregnant or postpartum woman

Early detection of mothers who may require critical care can be challenging. Severe illness in pregnancy is relatively rare and the normal physiological changes that occur with pregnancy can mask the early warning signs normally seen in a clinically deteriorating woman. Breathlessness is a common feature of pregnancy, however persistent breathlessness when lying flat needs investigating as it may be due to undiagnosed cardiac disease (8).

As highlighted in a recently published MBRRACE-UK report, reduced or altered conscious level is not an early warning sign; it is a red flag to indicate established illness, and should be acted on immediately and appropriately (8).

Mothers who report feeling unwell, who look unwell, and/or report a 'feeling that something awful

is going to happen' should be thoroughly assessed. It is not always necessary to wait until observations deteriorate: early recognition of critical illness, prompt involvement of senior clinical staff and multi-professional involvement save lives and remain the key factors for high-quality care for sick mothers (8). More information on the use of modified obstetric early warning scoring systems (MOEWS) and Maternity Critical Care Charts can be found in **Section 2.**

Investigations for critically ill pregnant and postpartum women

Most investigations can be carried out safely in pregnancy without risk to the mother or the fetus. Investigations to diagnose or exclude life-threatening conditions should therefore not be denied or delayed. Where uncertainty about the safety of an investigation exists, a multi-professional discussion between senior obstetric and radiology clinicians can be helpful in determining the most appropriate and safe way to proceed.

'Women should not be denied relevant investigations or treatments for life-threatening conditions, simply because they are pregnant or breastfeeding.'

MBRRACE-UK 2016 (7).

Where should maternal critical care be provided?

Currently, most maternal critical care is provided within intensive care units (ICU), however critical care should be a *level* of care provision, rather than a *location*. Most aspects of maternal critical care can be provided outside the ICU, including on the labour ward or obstetric theatres.

Women who require advanced respiratory or prolonged cardiovascular support will usually require transfer to an ICU for invasive monitoring and specialised care. Respiratory support may require mechanical ventilation, whilst cardiovascular support may include use of inotropes (medications that increase the force of contraction of the heart to increase cardiac output and blood flow to vital organs) or vasopressors (medications that constrict arteries to increase mean arterial pressure and therefore organ perfusion). However, women requiring Level 2 critical care (see **Table 1.2**) may be able to remain within the maternity unit if trained staff and suitable monitoring equipment are available. If feasible, critical care services should be brought to the woman rather than changing her location (1).

The Intensive Care Society's *Levels of Critical Care Support for Adult Patients* classification of critical care focuses on the level of dependency that individual patients need and the appropriate location for the provision of this level of care, and is now implemented in most NHS institutions (9). Examples of different levels of care that may be required in maternity are listed in **Table 1.2**.

Table 1.2 Levels of critical care, with examples from maternal critical care (4)

Level of care	Definition	Maternity Example
Level 0	Women whose needs can be met through normal ward care in an acute hospital	Care of a low risk mother
Level 1	Women at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the Critical Care team	▪ Risk of haemorrhage ▪ Oxytocin infusion ▪ Mild pre-eclampsia on oral anti-hypertensives/fluid restriction ▪ Woman with medical condition, e.g. congenital heart disease, diabetes requiring sliding scale insulin
Level 2	Women requiring more detailed observation or intervention including support for a single failing organ system or post-operative care and those 'stepping down' from higher levels of care	Basic Respiratory Support ▪ 50% or more oxygen via facemask to maintain oxygen saturation ▪ Continuous positive airway pressure (CPAP) ▪ Bi-level positive airway pressure (BIPAP) Basic Cardiovascular Support ▪ Intravenous anti-hypertensives to control blood pressure ▪ Arterial line for pressure monitoring or sampling ▪ CVP line for fluid management and CVP monitoring to guide therapy Advanced Cardiovascular Support ▪ Simultaneous use of at least two intravenous, anti-arrhythmic/anti-hypertensive/vasoactive drugs, one of which must be a vasoactive drug ▪ Need to measure and treat cardiac output Neurological Support ▪ Magnesium infusion to control seizures (not prophylaxis) ▪ Intracranial pressure monitoring Hepatic support ▪ Management of acute fulminant hepatic failure, e.g. from HELLP syndrome or acute fatty liver, such that transplantation is being considered
Level 3	Women requiring advanced respiratory support alone, or basic respiratory support together with support of at least two organ systems. This level includes all women requiring support for multi-organ failure.	Advanced Respiratory Support ▪ Invasive mechanical ventilation (i.e. intubation and ventilation) Support of two or more organ systems ▪ Renal support plus Basic Respiratory Support ▪ Basic Respiratory/Cardiovascular Support plus an additional organ supported

Regular structured review: ongoing assessment and management

All women receiving critical care require a comprehensive, structured and regular medical review for early detection of problems and timely interventions. A systematic approach should be employed using a standard ABCDE approach, together with review of medications, venous thromboembolism prophylaxis, kidney and bowel function, pain management, fluid balance and

nutritional assessment. More information on the structured review of the critically ill pregnant or postpartum woman and use of a Maternal Critical Care Chart is provided in **Sections 2 and 3**.

Equipment required

The RCOG's Maternal Critical Care Working Group have produced guidance on the minimum equipment required for the provision of Maternity Critical Care (4). This is listed in **Figure 1.1** below.

Figure 1.1 Minimum equipment list for provision of maternal critical care (4)

Minimum equipment list for provision of maternal critical care* (RCOG 2011)

- Monitor for HR, BP, ECG, SpO_2 and transducer for invasive monitoring
- Piped oxygen and suction
- Intravenous fluid warmer
- Forced air warming device
- Blood gas analyser
- Infusion pumps
- Emergency massive haemorrhage trolley
- Emergency eclampsia box
- Transfer equipment – monitor and ventilator
- Computer terminal to facilitate access to blood results, PACS system
- Copy of hospital obstetric guidelines including Maternal Critical Care
- Resuscitation trolley with defibrillator and airway management equipment

* Many of these items may already be available in maternity theatres or on the labour ward

Transfer of the critically ill pregnant or postpartum woman to Intensive Care

Critically ill pregnant or postpartum women may need transferred from the labour ward to other locations including the ICU radiology, operating theatres or another hospital. All transfers risk destabilisation and deterioration and therefore require specialised equipment and personnel. Transfers should be timely, coordinated and well-planned so they can be safely accomplished (1).

Senior doctors should assess the woman and engage in multi-professional discussion to determine the best location for on-going care. Once a decision is made there should be one single transfer to definitive care. Decisions must include the means and timing of intra- or inter-hospital transfer to ensure that the transfer is carried out safely (10).

Transfers should not be undertaken until the woman has been resuscitated and stabilised. In many circumstances an 'ICU outreach team' will attend to assist with both preparation and transfer.

- Before transfer to the ICU it may be necessary to secure the woman's airway with an endotracheal tube (with appropriate end-tidal carbon dioxide monitoring), rather than risk deterioration *en route*.
- Appropriate intravenous access must be in place.
- Continuous invasive blood pressure measurement is the best technique for monitoring blood pressure during the transfer of ill women and therefore an arterial line may need to be sited before transfer.
- Adequate supplies of oxygen, intravenous fluids, resuscitation drugs and blood products (if required) must be available prior to transfer.

If a woman is transferred to an ICU for ongoing management there should be a daily consultant obstetric and midwifery review, even if only in a supportive role, until such time that the woman can be repatriated to the maternity unit. Regular information and neonatal updates, including photos of their baby, can be very helpful.

Longer-term impacts of near-miss maternal morbidity for women, their babies and families

Women should be aware that their experience of a 'near-miss' incident can have long-lasting effects on their health, particularly their mental health, and may also affect their partner (11). Research suggests that one in five ICU survivors have developed a post-traumatic stress disorder (PTSD) at one year following discharge (12). Follow-up consultations can be helpful and may reduce symptoms of post-traumatic stress at 3 to 6 months after ICU discharge (13).

The 2018 RCoA Report includes 2 vignettes of women's reflections after experiencing critical illness, and they both provide excellent accounts of the impact of their illness on both them, and their families (5).

Community midwives and GPs should be informed when a woman is discharged from hospital after an episode of critical care. Follow-up appointments with the obstetrician and/or midwifery staff can be helpful and should be arranged for at least six weeks postnatally or sometimes longer afterwards, depending on the mother's recovery and also the collation of any test results that may be necessary for the follow-up appointment.

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Further reading

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Intercollegiate Maternal Critical Care (MCC) Sub-Committee of the Obstetric Anaesthetist Association: *Maternity Enhanced Care Competencies Required by Midwives Caring for Acutely Ill Women*. 2015

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Notes: