Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Clinical Strategy and Programmes Division

Guidelines for the Critically Ill Woman in Obstetrics

Obstetric & Gynaecology, Anaesthetic and Critical Programmes

Clinical Strategy & Programmes Division

Health Service Executive

Version 1.1

13th August 2014

Table of Contents

Introduction

This guideline has been produced by the Guidelines for the Critically Ill Woman in Obstetrics Working Group - a sub-group of the HSE National Clinical Programmes in Obstetrics and Gynaecology, Anaesthesia and Critical Care. The aim of the inter-programme collaboration was to produce a guideline that leads to successful quality and safety outcomes in the care of the critically ill obstetric patient. The remit of the Group was to outline recommendations and standards of care to assist Maternity and Critical Care teams in the provision of care to the critically ill obstetric patient.

The membership of the Group included: Dr. Paula Connolly (Anaesthetist), Dr Michael Gannon, (Obstetrics), Ms Mary Godfrey (National Programme Manager for the National Clinical Programme in Anaesthesia), Dr. Bairbre Golden (Director, National Clinical Programme in Anaesthesia), Prof Richard Greene (Primary Developer), Dr. Geoff King (Director, Pre-Hospital Emergency Care Council), Mr. Brian Lee (National Programme Manager for the National Clinical Programme in Obstetrics and Gynaecology), Prof Fionnuala McAuliffe (National Maternity Hospital), Dr John Murphy (Clinical Lead for the National Clinical Programme in Neonatology), Dr. Michael Power (Clinical Lead for the National Clinical Programme in Critical Care), Dr Mike Robson (National Maternity Hospital), Ms. Sheila Sugrue (National Lead Midwife), Professor Michael Turner (Clinical Lead for the National Clinical Programme in Obstetrics and Gynaecology).

The multidisciplinary Working Group was formed to examine the available documents relating to matters of critical care for women during and after pregnancy with a view to providing recommendations and standards to services providing maternity care to women.

The Working Group aimed to ensure that critically ill obstetrical patients receive a high standard of care for both their pregnancy related and critical care needs, delivered by professionals with the same level of competences irrespective of whether these are provided in a maternity or critical care setting. This guideline sets out the imperative to devise a multidisciplinary care plan for the critically ill pregnant woman that gives consideration to her pregnancy related need and critical illness needs, mindful of the goal of keeping mother and baby together unless precluded by a clinical indication. Regardless of where the care is provided it should be delivered by a trained multidisciplinary team with the appropriate level of competencies.

Note- It is intended in this document to refer to the critically ill pregnant or recently pregnant women. Critical illness may occur ante-partum, may be present in the parturient or may occur post-partum. As a shorthand, the document throughout when referring to the critically ill pregnant woman refers to all these critical illness presentations.

1. Revision History

Version No.	Date	Modified By	Description
1.1	13th August 2014	Martin McNicholl & Prof Michael Turner	Updated to include Version 1.1 of the IMEWS chart, and a Revision History section

2. Background

Maternal critical care is an area given little formal consideration in the past, perhaps because it was uncommon. However, within the National Clinical Programmes, consideration has to be given to the capacity of hospitals to provide different levels of care. Maternity care is only provided at Model 3 and Model 4 hospitals (HSE Acute Medicine Programme) and some 40% of deliveries are undertaken in four stand-alone maternity hospitals. Recommendations and standards should ensure we provide the best care possible to all women.

Maternal mortality has been analysed by the Confidential Enquiries (Centre for Maternal and Child Enquires, 2011; Confidential Maternal Death Enquiry Ireland, 2012) and it is apparent that there are some deaths associated with suboptimal care. Furthermore, there are recurrent and new themes emerging. For every death there are some eighty women who develop maternal morbidity (Murphy et al., 2009).

The recent Confidential Enquiry into Maternal Death in Ireland (Confidential Maternal Death Enquiry Ireland, 2012) reported there were 19 maternal deaths in the triennium 2009–2011 from causes directly or indirectly related to pregnancy (8.6 per 100,000 CI 4.7 – 12.4 maternities). The Saving Mothers Lives (Centre for Maternal and Child Enquiries, 2011) report showed a MMR of 11.4 per 100,000 maternities for the UK. Not all of these women would have necessarily required critical care as some would have had a sudden or unexpected death.

Admissions of pregnant or postnatal women to critical care units have been reported as between 0.05 – 1.7% in developed countries (Baskett, 2008). With different definitions of morbidity, the prevalence varied from 0.8% to 8.2% for disease specific criteria and 0.1%–3.0% for studies using management-based criteria (Say et al., 2004).

Complementary to this data is the report from the Intensive Care National Audit and Research Centre (ICNARC) Case Mix Programme (CMP) on female admissions to adult general critical care units in England, Wales and Northern Ireland (Intensive Care National and Audit Research Centre, 2009). This includes admissions (pregnant and recently pregnant) to the participating critical care units. In 2007 there were 513 women pregnant or recently pregnant women admitted (260/100,000). Analysis of the Critical Care Minimum Dataset (CCMDS) (Information Standards Board for Health and Social Care, 2010) identified the type and level of care required was high dependency (Level 2) in 32% per cent of the bed days used by women identified as recently pregnant.

The diagnoses precipitating admission to critical care include massive haemorrhage (>2,500ml loss), eclampsia, sepsis, thromboembolism, acute organ dysfunction (renal, hepatic, cardiac, respiratory), anaesthesia-related morbidity (aspiration, anaphylaxis and drug related problems). The 6th Scottish Confidential Audit of Severe Maternal Morbidity which gives incidences of haemorrhage of 4.6 per 1,000 live births; eclampsia 0.3/1,000; sepsis 0.1/1,000; embolism 0.1/1,000; renal and liver dysfunction 0.3/1,000; pulmonary oedema 0.2/1,000 and acute respiratory dysfunction 0.2/1,000 (Lennox, 2008). Irish data from the NPEC Severe Maternal Morbidity (SMM) Audit for 2011 reports an overall incidence of SMM of 3.8/1000, including major obstetric haemorrhage - 2.3/1000, Level 3 critical care (ICU) admissions – 1.64/1000, Eclampsia – 0.2/1000 and Septic Shock – 0.06/1000 (NPEC, 2013).

An audit of severe maternal morbidity in Dublin, with 13 systems and management-based definitions, showed a rate of 3.2/1000, the commonest being massive obstetric haemorrhage, as defined by the requirement of greater than or equal to five units of blood transfusion (Murphy et al., 2009). Massive obstetric haemorrhage occurred in 125/100,000 deliveries in another large multicentre study and was complicated by hysterectomy in 24% and end organ dysfunction in 16% of cases (O'Brien et al., 2010). There is good evidence internationally and in Ireland that postpartum haemorrhage and problems with placenta

accreta are increasing, with an increasing need for critical care (Lutomski et al., 2012) (Upson et al., 2011).

Estimation of the overall level-2-need (high dependency care) is more complicated, particularly in the Irish setting. The reason for this relates to the fact that all Level 3, 'intensive care', patients will be admitted to a level 3 critical care unit and easily identified; in the UK for example, these will therefore be included in the ICNARC data. Women requiring Level 2 critical care, on the other hand, may currently have all or part of their critical care needs met in a maternity unit and at the present time there is no national data recording this activity. Admission to a dedicated critical care facility will depend on the type of organ support required, clinical diagnosis, potential for further deterioration and experience/competency of the current location. If the patient is pregnant and in need of fetal monitoring and/or delivery, this may also effect where care is provided.

The required level of critical care each patient needs will be dependent on which organ requires support and the level of such support. For example a patient with respiratory failure, irrespective of the diagnosis, may only require oxygen therapy (50%), non-invasive modes of support, e.g. continuous positive airway pressure (CPAP) or BIPAP, but will on some occasions require tracheal intubation and mechanical ventilation.

In addition, maternity units frequently record a significant number of women with a high acuity of illness necessitating a level of cardiovascular and respiratory monitoring that exceeds 'normal' practice in delivery units. Such clinical needs are associated with a range of diagnoses; from minor post-partum haemorrhages (>1,500ml), to pre-eclampsia, uterine rupture and HELLP syndrome. An obstetric High Dependency Unit admission rate of 5% has been cited in a number of recent reports, with 1.4/1000 requiring level 3 care (Saravanakumar K et al., 2008) (Wheatly, 2010). To summarise, we have reliable data regarding maternal death rates (8.6/100,000) and Level 3 critical care utilisation in the literature (140 - 260/100,000). However, prevalence rates for women who require a higher level of monitoring or single organ support is more difficult to quantify and may be as high as 5% or more.

3. Critical Care

2.1 What is care of the critically ill pregnant woman?

Maternal critical care, high dependency care and high risk maternity care are not interchangeable, the term critical care having a more precise definition. In a document entitled 'Comprehensive Critical Care' it has been recommended that the terms 'high dependency' and 'intensive care' be replaced by the term 'critical care' (Critical Care Review, Department of Health, London, 2000) . The document also proposes that the care required by an individual be independent of location, coining the phrase 'critical care without walls'.

The level of critical care required by the pregnant woman will be dependent on the number of organs requiring support and the type of support required as determined by the Intensive Care Society's 'Level of Care' document (Levels of Critical Care for Adult Patients, Intensive Care Society London, 2009). This term was first defined in comprehensive critical care, and subsequently updated in 2009.

2.2. Levels of Care – Definitions

Level 0 - Patients whose needs can be met through normal ward care.

Level 1 - Patients at risk of their condition deteriorating and needing a higher level of observation or those recently relocated from higher levels of care.

Level 2 - Patients requiring invasive monitoring/intervention that include support for a single failing organ system (excluding advanced respiratory support).

Level 3 - Patients requiring advanced respiratory support (mechanical ventilation) alone or basic respiratory support along with support of at least one additional organ.

This approach has been beneficial as it has facilitated selected Level 2 critical care to be delivered in a clinical location in a Delivery Suite in a Maternity Unit e.g. Pre-Eclamptic Toxaemia (PET)- (see Appendix 2, Example 1). The Maternity Unit should possess competent staff with appropriate clinical expertise to manage the clinical situation, either with or independently of critical care medical/nursing/midwifery staff.

The Joint Faculty of Intensive Care Medicine of Ireland Levels of Care definitions are shown at Appendix 1.

The critically ill pregnant woman will have combined requirements for obstetric and critical care. While the woman remains pregnant the needs of the fetus must also be considered. All of these components may alter the setting or the requirements at the patient location. The care must, therefore, be individualised depending on the needs assessment by the multidisciplinary team, medical (obstetric and critical care), midwifery, and neonatology input where necessary. The Level of Care need and the multidisciplinary care plan for the individual critically ill pregnant woman will determine the appropriate location for the care requirement.

While the obstetric critical care requirements do not fit the Joint Faculty of Intensive Care Medicine of Ireland definitions precisely, this care provision should always remain within the governance of the multidisciplinary team. This ensures that there is constant communication and team working between obstetricians, anaesthetists and intensive care clinicians, as well as other medical specialities. This should include regular clinical meetings and audit of cases, jointly managed with the obstetric team.

2.3 Levels of care for critically ill pregnant women

The level of care needs to be agreed on the basis of best evidence and practice. The classifications should take into account the various definitions.

Examples of Maternity Care Required at ICS Levels of Support for Critical Care (Saravanakumar et al., 2008)

Level of Care	Maternity Example
Level 0: Normal ward care	Care of low risk pregnant woman
Level 1: Additional monitoring or intervention, or step down from higher level of care	• Risk of haemorrhage • Oxytocin infusion • Mild pre-eclampsia on oral anti-hypertensive/fluid restriction etc. • A woman with a medical condition such as congenital heart disease, or insulin dependent diabetes.
Level 2: Single organ support	**Basic Respiratory Support (BRS)** • 50% or more oxygen via face-mask to maintain oxygen saturation • Continuous Positive Airway Pressure (CPAP), Bi-Level Positive Airway Pressure (BIPAP) **Basic Cardiovascular Support (BCVS)** • Intravenous anti-hypertensive, to control blood pressure in pre-eclampsia • Arterial line used for pressure monitoring or sampling • CVP line used for fluid management and CVP monitoring to guide therapy **Advanced Cardiovascular Support (ACVS)** • 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) • 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: Advanced respiratory support alone, or support of two or more organ systems above	**Advanced Respiratory Support** • Invasive mechanical ventilation **Support of two or more organ systems** • Renal support and BRS • BRS/BCVS and an additional organ supported • Intracranial pressure monitoring

See Appendix 2 for examples

2.4 Care of the critically ill woman in different settings

The challenge of delivering high quality critical care in maternity units differs depending on the setting. Maternity services should have adequate expertise, facilities and equipment, and back-up for timely and comprehensive emergency care to the critically ill woman including capacity for Level 2 care in larger units and capacity to achieve stabilisation and transfer to intensive care in all units.

Maternity and critical care services need to design pathways at a local level which ensure that a critically ill woman accesses high quality care from both services, irrespective of location. These pathways should facilitate mother and baby remaining together, unless precluded by a clinical reason. Such arrangements should detail defined arrangements for staff with appropriate competencies in critical care, midwifery and obstetrics and support care in the maternity or critical care unit as appropriate. These arrangements need to take into account local configuration, size and complexity of maternity and critical care services. Models may include:

- Having a suitable area in the delivery suite with the necessary equipment (Appendix 3), medical input from anaesthetists and obstetricians, staffed by a team of midwives who have additional training in the necessary critical care competencies. Local arrangements for input from other disciplines and health and social care professionals as required with escalation protocols should Level 3 care be required.

- Importing critical care skills onto labour ward through outreach or other arrangements with local anaesthesia or critical care services.

- Transferring the women to a general Level 2 or 3 unit with local arrangements ensuring provision of obstetric, neonatal and midwifery input and maintaining maternal contact with their baby, where possible.

4. Care pathways for the critically ill pregnant woman

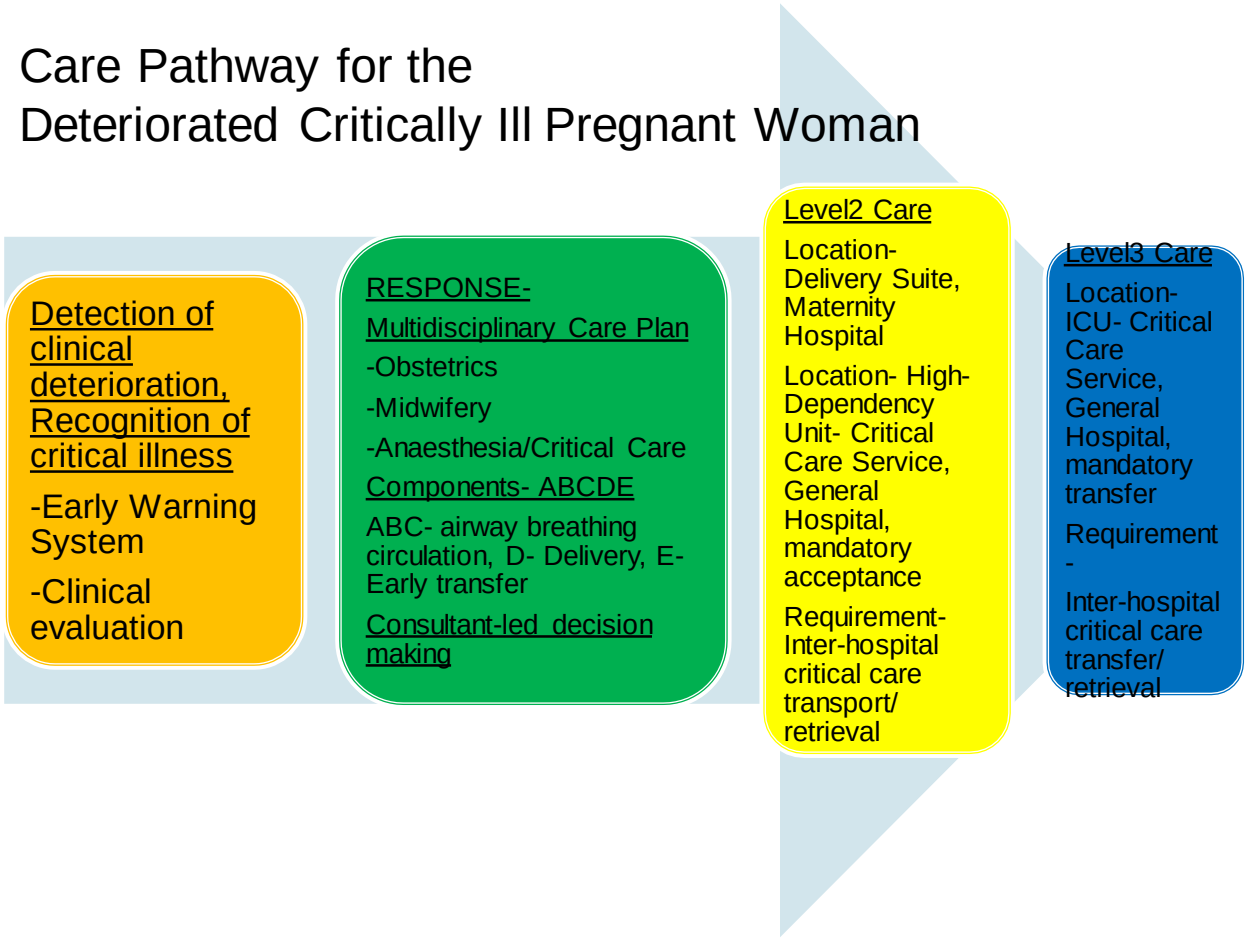
The components of the Care are:

1. **Detection** of clinical deterioration in the pregnant woman

2. **Response** - provision of a multidisciplinary care plan with obstetric interventions as needed

3. **Level 2 Critical Care** - in a delivery suite of a maternity unit or in a HDU

4. **Level 3 Critical Care** - Critical Care Unit



5. Standards for the recognition and immediate care of the acutely ill parturient

Maternity services should implement the agreed Irish Maternity Early Warning System (IMEWS) (Appendix 4).

The IMEWS guideline in use nationally takes into account physiological changes that occur in parameters measured, including temperature, pulse, blood pressure and respiratory rate, oxygen saturation, etc. A woman admitted to maternity services should have her physiological observations recorded at the time of their admission or initial assessment together with a clear written monitoring plan that specifies which physiological observations should be recorded and how often (Appendix 5). The plan should take into account:

- Whether the woman has a high or low risk pregnancy
- Reason for the admission
- Presence of co-morbidities
- Agreed treatment plan

The IMEWS track and trigger systems should be used to monitor all pregnant and postnatal admissions. Critical illness presentation in pregnancy may be subtle - pregnancy related physiologic changes may mask or delay recognition of critical illness in a pregnant woman (Appendix 6). Clinical assessment by experienced clinicians including early consultation with on-site anaesthetic staff should be considered where there is concern or a high risk of rapid deterioration. Clinical experience and judgement must be used at all times and where there are clinical concerns, these should override the IMEWS observations.

The IMEWS includes a detailed policy and training programme for the multidisciplinary team to ensure the physiological observations recorded on an IMEWS chart are acted upon by staff who have been trained to undertake these assessments and who understand their clinical relevance. Education and training is necessary to ensure staff have these competencies and they should be assessed to ensure they can demonstrate them.

Staff caring for patients in acute hospital settings should have competencies in monitoring, measurement, interpretation and prompt response to the acutely ill patient appropriate to the level of care they are providing. They also need an awareness of the physiological changes in pregnancy and the potential effects of these changes on the care of the critically ill mother (Appendix 6).

The web links to the IMEWS guideline are:

http://www.rcpi.ie/article.php?locID=1.5.71.492

http://www.hse.ie/eng/about/Who/clinical/natclinprog/obsandgynaeprogramme/obsgyneguide.html

6. Minimum Standards for Critical Care in Obstetric Patients

The following table outlines the minimum standards required if a unit is to undertake care of the critically ill obstetric patient.

Minimum requirements for safe care of the critically ill obstetric woman

Laboratories	Providing haematology, biochemistry, coagulation, microbiological investigations and cross match and blood transfusion support services; on-site or close by the unit/hospital.
Blood gas analysers	Close proximity to the patient Should allow measurement of lactate
Local Programme Implementation Board responsible for the care of critically ill women in the unit to ensure the minimum standards are in place	**Core group**: Consultant Obstetrician, Consultant Anaesthetist/Intensivist* Senior Midwife **Others**: Hospital CEO/General Manager
Multidisciplinary staff training	All staff that provide critical care to pregnant women to ensure appropriate care competencies
Senior staff available for each case	Named Consultant Obstetrician responsible for patient Named Consultant Anaesthetist/Intensivist Named experienced Midwife Other medical specialists as needed for consult
Competent NCHDs - Obstetrics and Anaesthetics	Dedicated onsite 'Duty Doctor' 24 hours per day, with appropriate competencies and experience for anaesthesia and obstetrics. There should be immediate access to consultant support by phone and on-site within a reasonable timeframe.
Appropriate critical care nursing skills	Midwives/Nurses with appropriate critical care competencies
Facility	On delivery suite Obstetric emergency theatre in close proximity
Appropriate monitoring equipment **Emergency resuscitation equipment** **Intravenous therapy - suitable infusion devices**	See appendix 3

Delivery Packs	Delivery packs for normal, operative and emergency caesarean section available especially if the patient is in a critical care unit away from a maternity unit.
Alternative Access for infusions	Venous cut-down Tray Ultrasound to assist IV cannulation – *i.e.* CVP line
Facilities to resuscitate the neonate required	Regularly checked, stocked, and maintained emergency resuscitation equipment and medications for critical care of the neonate
Appropriate policies and guidelines available	The National Clinical Programme guidelines for Obstetric & Gynaecology, Neonatology , Anaesthetics and Critical Care should be assessable.
Audit of critically ill patients during and after pregnancy	Local Audit Multidisciplinary Clinical Case Review Meetings National Audit - NPEC Severe Maternal Audit, National Critical Care Audit NOCA

*Local or network intensivist at the receiving hospital

7. Standard for Safe Transfer to critical care area from a maternity unit

All maternity sites must have the facilities and staff to resuscitate, stabilise and transfer critical care patients.

The future development of a critical care retrieval team should greatly assist this high risk area of care.

Women may require transfer to a critical care area for a higher level of care both pre-delivery and postpartum. Such transfers need to satisfy the ICS Standards for 'Guidelines for the transport of the critically ill adult' (Whiteley and Barratt, 2011) and need to be accompanied by an additional plan addressing the maternal, fetal and postnatal needs of the patient. The plan should also indicate the agreed level of shared care by the multidisciplinary team including obstetrics, midwifery, neonatology and critical care; the plan should clearly identify the transfer of care from a named consultant (*i.e.* Dr X Obstetrics) to a named consultant (*i.e.* Dr Y, Critical Care). There must be a named consultant obstetrician who will assume responsibility for the ongoing obstetric care of the patient at the receiving hospital and there must be communication between this obstetrician and the referring obstetrician.

The necessary equipment includes:

- non-invasive and invasive cardiovascular monitoring modalities (invasive arterial and venous pressures)
- ECG

- Oximetry
- Capnography (for ventilated patients)
- Monitor – Maternal Pulse, BP, SO2,ECG/ Cardiotocography
- Ventilator
- Portable suction
- Syringe drivers
- Transport ventilator which is capable of delivering positive end expiratory pressure; pressure and volume control ventilation; pressure support mode of ventilation; equipped with full range of pressure, volume and oxygen alarms.

It is essential that the battery life of this equipment is appropriate for the anticipated journey time required for the transfer and a dedicated site for charging of equipment is identified within the maternity unit.

Transfer equipment should be dedicated solely for transfer.

The transfer should take place with appropriately trained practitioners. This can be an anaesthetist, a specific transfer clinician or an intensivist. Positioning of the pregnant patient poses additional risks in the avoidance of aortocaval compression.

8. Communication

It is important to optimise communication of critical information as an essential component of patient care, safety and risk management.

7.1 ISBAR - A tool for improved communication within the team

The ISBAR (identification - situation – background – assessment – recommendation) tool, developed for health care, may be useful as it can be used to efficiently hand over individual patients (The Institute for Healthcare Improvement and NHS Institute for Innovation, 2006). The steps involved in using ISBAR are:

- **Identification**: identify yourself and your role to the person you are communicating with in the communication.
- **Situation**: describe the specific situation about a particular patient, including name, consultant, patient location, vital signs, resuscitation status and any specific concerns.
- **Background**: communicate the patient's background, including date of admission, diagnosis, current medications, allergies, laboratory results, progress during the admission and other relevant information.
- **Assessment**: this involves critical assessment of the situation, clinical impression and detailed expression of concerns.
- **Recommendation**: this includes the management plan, suggestions for care, detail of investigation requests and expected time frame.

Implementing ISBAR takes considerable training for an individual and the organisation. The request for immediate and direct assistance should be made clear as part of the recommendation so there is no misunderstanding.

9. Implementation strategy

- Distribution of guidelines through the Acute Hospitals Division for operational implementation.
- Implementation through HSE Obstetrics and Gynaecology programme via local implementation boards of units/hospitals.
- Distribution of guideline to all members of the various appropriate Institutes and to all gynaecology, anaesthetic and critical care units
- Distribution to other interested parties and professional bodies.

10. Qualifying statement

This document has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. Clinical material offered in this document does not replace or remove clinical judgment or the professional care and duty necessary for each pregnant woman. Clinical care carried out in accordance with this document should be provided within the context of locally available resources and expertise.

This document does not address all elements of standard practice and assumes that individual clinicians are responsible for:

- Discussing care with women in an environment that is appropriate and which enables respectful confidential discussion.
- Advising women of their choices and ensuring informed consent is obtained.
- Meeting all legislative requirements and maintaining standards of professional conduct.
- Applying standard precautions and additional precautions, as necessary, when delivering care.
- Documenting all care in accordance with local and mandatory requirements.

11. Key recommendations

1. A multidisciplinary care plan should be devised for the critically ill pregnant woman that gives consideration to her pregnancy-related needs and critical illness needs.

2. The level of care need and the multidisciplinary care plan (including the requirements for obstetric and critical care) for the individual critically ill pregnant woman will determine the appropriate location for the care requirement. Care must be customised to the individual patient in the most appropriate site.

3. All staff providing critical care for pregnant women should have appropriate care competencies including the early recognition of critical illness in pregnancy. A multidisciplinary training programme should be rolled out nationally to facilitate this.

4. The Implementation Boards of the National Clinical Programme in Obstetrics and Gynaecology should undertake a gap analysis regarding their unit's preparedness to meet the minimum standards for critical care in the obstetric patient, including the development of a local Steering Group responsible for the care of critically ill. The gap analysis will identify resource and equipment needs.

5. The critical care transport system should be developed to ensure a complete and safe critical care service for obstetric patients.

6. Communication of critical information is an essential component of safe patient care and risk management. Policies on clear communication and training in communication methods should be put in place in all units to ensure optimum care for the critically ill obstetric patient.

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Appendices

Appendix 1 - Joint Faculty of Intensive Care Medicine of Ireland Levels of Care definition

Acute Care	Level 0	Hospital ward clinical management
	Level 1	Higher level of observation eg. PACU
Critical Care	Level 2	Active management by critical care team to treat and support critically ill patients with primarily single organ failure
	Level 3	Active management by critical care team to treat and support critically ill patients with two or more organ failures
	Level 3 s	Level 3 with regional / national service

Levels of Care. Joint Faculty of Intensive Care Medicine of Ireland (JFICMI) *National Standards for Adult Critical Care Services 2011.*

Appendix 2 – Examples of a Critically ill Pregnant Woman

To assist understanding of Level 2 Care for Critically Ill Pregnant Women, it is useful to describe clinical examples or scenarios that describe or illustrate appropriate Level 2 Care for the critically ill pregnant woman depending on the pregnancy related need, critical care need and the clinical setting i.e. the Delivery Suite.

Example 1- Pre Eclamptic Toxemia

A safe Level 2 Care clinical scenario arises where a pregnant woman with PET receiving antihypertensive therapy (e.g. IV labetalol infusion) with invasive intra-arterial BP monitoring is monitored for delivery in a Delivery Suite (in a free-standing Maternity Hospital without a separate Level 2 HDU or separate Level 3 ICU). This Level 2 Care PET clinical scenario occurs normally in a delivery suite in Ireland. The maternity hospital delivery suite develops and maintains the competencies required for such safe Level 2 Care.

Example 2- Chorioamnionitis

A pregnant woman may develop critical illness from chorioamnionitis. The multidisciplinary care plan includes immediate intravenous high dose bactericidal antibiotics within the first hour the diagnosis is suspected. The woman may become critically ill requiring organ support. Following intervention, the critically ill woman may require transfer to a HDU or ICU depending on the severity of critical illness.

Example 3 - Severe Haemorrhage

A critically ill woman with severe haemorrhage may require transfer to a critical care service after treatment of haemorrhage, including multiple blood product transfusions, for further treatment and support.

Example 4 - Severe sepsis e.g. pneumonia

A critically ill pregnant woman may develop respiratory distress and respiratory failure from sepsis not related to pregnancy e.g. pneumonia in a pregnant woman with pre-gestational diabetes. The patient may likely require invasive ventilator support i.e. Level 3 Care and following evaluation and resuscitation as needed should be transferred to a dedicated Critical Care Service facility. The care plan devised in the Level 2 HDU or Level 3 ICU is a joint multidisciplinary care plan based on the joint pregnancy-related needs and critical care needs of the patient.

Appendix 3 - Suggested equipment list for Maternal Critical Care

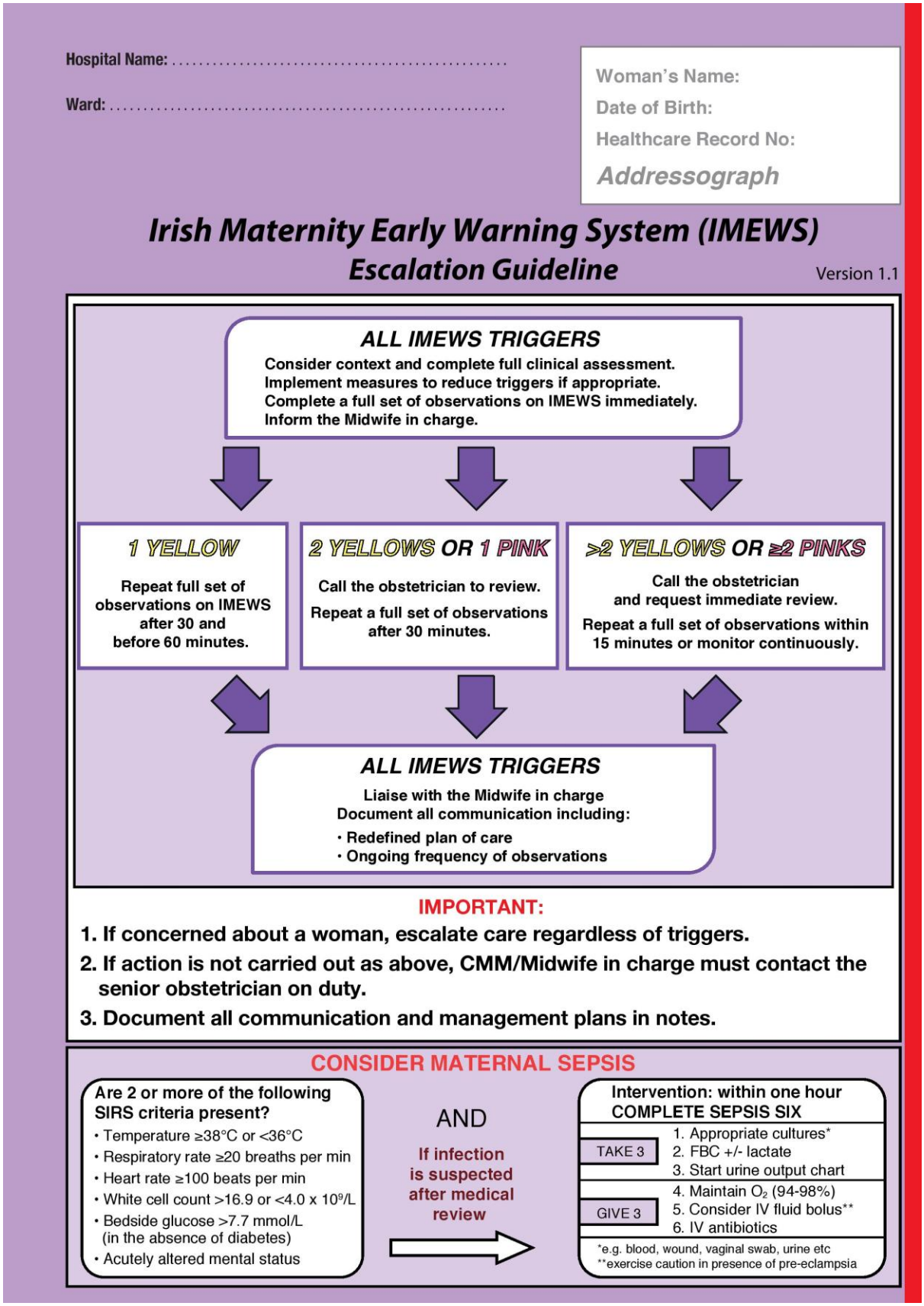
Suggested equipment list for Maternal Critical Care

- Monitor for P, BP, ECG, SaO2 with transducer facility for invasive monitoring
- Monitoring equipment for insertion and management of invasive monitoring
- Monitoring (arterial/CVP)
- Piped oxygen and suction
- Intravenous fluid warmer
- Forced air warming device
- Blood gas analyser*
- Infusion pumps
- Emergency massive haemorrhage box / trolley*
- Emergency eclampsia box*
- Transfer equipment – monitors, gas cylinders and ventilator
- Computer terminal to facilitate access to blood results, PACS system
- Copy of hospital obstetric guidelines (if not available on hospital IT)
- Resuscitation trolley with defibrillator and airway management equipment
- Ventilator
- Cardiff Wedge for patient tilt

***** These items may already be available in the theatre delivery suite

Appendix 4 – Observation Charts

Chart 1 - IMEWS Chart



Hospital Name: .....

Ward: .....

Woman's Name:
Date of Birth:
Healthcare Record No:
Addressograph

Irish Maternity Early Warning System (IMEWS)
Escalation Guideline
Version 1.1

ALL IMEWS TRIGGERS
Consider context and complete full clinical assessment.
Implement measures to reduce triggers if appropriate.
Complete a full set of observations on IMEWS immediately.
Inform the Midwife in charge.

1 YELLOW
Repeat full set of observations on IMEWS after 30 and before 60 minutes.

2 YELLOWS OR 1 PINK
Call the obstetrician to review.
Repeat a full set of observations after 30 minutes.

>2 YELLOWS OR ≥2 PINKS
Call the obstetrician and request immediate review.
Repeat a full set of observations within 15 minutes or monitor continuously.

ALL IMEWS TRIGGERS
Liaise with the Midwife in charge
Document all communication including:
- Redefined plan of care
- Ongoing frequency of observations

IMPORTANT:
1. If concerned about a woman, escalate care regardless of triggers.
2. If action is not carried out as above, CMM/Midwife in charge must contact the senior obstetrician on duty.
3. Document all communication and management plans in notes.

CONSIDER MATERNAL SEPSIS

Are 2 or more of the following SIRS criteria present?
- Temperature ≥38°C or <36°C
- Respiratory rate ≥20 breaths per min
- Heart rate ≥100 beats per min
- White cell count >16.9 or <4.0 x 10^9/L
- Bedside glucose >7.7 mmol/L (in the absence of diabetes)
- Acutely altered mental status

AND

If infection is suspected after medical review

Intervention: within one hour
COMPLETE SEPSIS SIX

TAKE 3
1. Appropriate cultures*
2. FBC +/- lactate
3. Start urine output chart

GIVE 3
4. Maintain O_2 (94-98%)
5. Consider IV fluid bolus**
6. IV antibiotics

*e.g. blood, wound, vaginal swab, urine etc
**exercise caution in presence of pre-eclampsia

Document Number (eg. 1, 2):

Booking BP: /

Gestation at Booking (weeks):

IMEWS Triggers Key

IMEWS Trigger	Normal Values	Yellow Zone	Pink Zone
Respiratory rate (bpm)	11-19	20-24	≤10 or ≥25
SpO_2 (%)	96-100	-	≤95
Temperature (°C)	36.0-37.4	35.1-35.9 or 37.5-37.9	≤35 or ≥38
Maternal HR (BPM)	60-99	50-59 or 100-119	<50 or ≥120
Systolic BP (mmHg)	100-139	90-99 or 140-159	<90 or ≥160
Diastolic BP (mmHg)	50-89	40-49 or 90-99	<40 or ≥100
AVPU	Alert	-	Voice, Pain or Unresponsive

Contact appropriate doctor for early intervention if the woman triggers one PINK or two YELLOW zones at any one time

Year:	Date :																		
	Time :																		
Resp. Rate per min	≥25																		≥25
	20-24																		20-24
	11-19																		11-19
	≤10																		≤10
SpO_2 only if Resp. Rate Triggers	96-100%																		96-100%
	≤95%																		≤95%
Temp °C	≥38.0																		≥38.0
	37.5-37.9																		37.5-37.9
	36.0-37.4																		36.0-37.4
	35.1-35.9																		35.1-35.9
	≤35.0																		≤35.0
Maternal Heart Rate	120																		120
	110																		110
	100																		100
	90																		90
	80																		80
	70																		70
	60																		60
	50																		50
Systolic Blood Pressure	170																		170
	160																		160
	150																		150
	140																		140
	130																		130
	120																		120
	110																		110
	100																		100
	90																		90
	80																		80
	70																		70
Diastolic Blood Pressure	110																		110
	100																		100
	90																		90
	80																		80
	70																		70
	60																		60
	50																		50
	40																		40
Urine	Protein																		Protein
	Glucose																		Glucose
	Other																		Other
Pain Score 0-10																			Pain Score
AVPU Neuro Response	Alert (A)																		A
	Voice (V)																		V
	Pain (P)																		P
	Unresponsive (U)																		U
Total Yellow Zones																			Total yellow zones
Total Pink Zones																			Total pink zones
Initials																			Initials

Chart 2 - ANTENATAL OBSERVATION RECORD (Sample)

Date		**Agreed E.D.D.**			**Anti D Administered** No ☐ Yes ☐			
Time (24 HrClock)								
Gestation								
Legible ID Band								
Vital Signs to be recorded on IMEWS Chart								
Abdominal Examination:								
Inspection								
Palpation	**Fundal Height**							
	Lie							
	Presentation							
	Position							
	Fifths palpable Engaged /Not							
Auscultation of Fetal Heart Rate								
Fetal Wellbeing:								
If SROM Please Record Date _____ Time_____ hrs								
Fetal Movement								
Membranes / Liquor/P.V.Loss								
CTG Recorded (√) (if applicable)								
Maternal Wellbeing:								
Emotional State								
Sleep / Rest								
Eating & Drinking								
Intake Output chart required (Yes / No)								
Bowels								

Oedema							
Signature, **PRINTED NAME, & Role**							
Investigations Performed (Please date and initial when investigations are performed)							
Ultrasound Scan/Dopplers							
FBC/Kleihauer							
U&E							
LFTs							
Coag							
Group&Antibodies							
Blood Cultures							
MSU							
24 Hour Urine							
Total Protein							
HVS/LVS							
Other:							

Chart 3 - Suggested Antenatal Observations (Reverse Side)

(This list is not exhaustive and is only intended for useful reference)

Any concerns / deviations from the norm should be reported to the appropriate Midwife / Obstetrician.		
Agreed EDD		Refer to agreed EDD (confirmed with early dating ultrasound scan)
Weight / BMI		All women should have their weight, height and BMI calculated and documented at booking. Women with a BMI>29.9kg/m² should commence a pregnancy/obesity care pathway / action plan.
Vital Signs on IMEWS		
All physiological observations must be recorded on the Irish Maternity Early Warning System		
Abdominal Examination		
Inspection		NAD, size, shape, scars, striae
Palpation	**Fundal Height**	Equal to dates, height measured in cms, small for dates /gestational age, large for dates/gestational age
	Lie	Longitudinal, transverse, oblique, unstable
	Presentation	Cephalic, breech, shoulder
	Position	OA, LOA, ROA, LOT, ROT, OP, LOP, ROP
	Fifths palpable Engaged /Not	Engaged, 1/5, 2/5, 3/5, 4/5, 5/5, ballotable, free
Auscultate: **Fetal Heart Rate**		Average rate measured in beats per minute with Pinard Stethoscope/ Doppler/CTG.
Fetal Wellbeing:		
Fetal Movement		Normal pattern, increased activity, reduced fetal movements, absence of fetal movements
Membranes / Liquor/P.V.Loss		Membranes intact, ruptured, suspected ruptured membranes. Liquor/ PV Loss: *Colour*: clear, pink, blood stained, meconium, *Volume*: small / large amount, *Odour: no odour, foul smelling*
CTG Recorded **(Yes / No)** **(if applicable)**		If applicable record CTG and comment on the features / findings in the woman's notes.
Maternal Wellbeing:		

Emotional State	Coping well, anxiety, tearful, low mood.
Eating & Drinking	Normal intake, fasting, restricted fluid intake, reduced appetite, special diet, nausea, vomiting.
Intake/Output Chart required **(Yes/No)**	(Yes / No) if Intake/Output chart or Fluid Balance chart required.
Bowels	B.O (bowels opened), BNO (bowels not opened), constipation, diarrhoea, leakage, urgency, haemorrhoids
Sleep / Rest	Sleeping/resting well, insomnia, fatigue.
Oedema	NAD, Facial generalised leg, ankle. (*Comment x 2 or indicate (L) Left & (R) Right*) Mild, moderate, severe.
Investigations Performed:	
Document if any investigations are performed by inserting date and initials in the appropriate box	

Chart 4 - Postnatal Observation Record: Mother (Sample)

Orientation to Ward ***(carried out by the Midwife accepting the transfer to the postnatal ward)***

Introduction to Midwife	☐ Yes	☐ No	Visiting arrangements explained	☐ Yes	☐ No
Introduction to Ward Layout	☐ Yes	☐ No	Meal times explained	☐ Yes	☐ No
Information on Baby Security	☐ Yes	☐ No			

Special Requirements: **Anti D Required** ☐ Yes ☐ No If yes: _____/_____/_____date administered Signature_____	**MMR Required** ☐ Yes ☐ No If yes: _____/_____/_____ date administered Signature_____

Postnatal Day	**Admission**	**Day**	**Day**	**Day**	**Day**	**Day**
Date						
Time (24hr clock)						
Legible I.D Band **(Yes / No)**						
Vital Signs to be recorded on IMEWS Chart						
Wellbeing/mood						
Sleep						
Breasts						
Nipples						
Breastfeeding						
Uterus						
Wound						
Perineum						
P.V Loss/Lochia						

Micturition						
Bowels						
Legs						
Postnatal Exercise						
Bonding						
Signature, Printed Name & Job Title						

Postnatal Education: ☐ Yes ☐ No ***(See reverse for list of same to be completed)***

(If all complete) Signature_____ Date_____

Chart 5 - Suggested Postnatal Observations *(Reverse Side)*

(This list is not exhaustive and is only intended for useful reference)

Any concerns / deviations from the norm should be reported to the appropriate Midwife / Obstetrician.	
Vital Signs:	All physiological observations must be recorded on the IMEWS
Wellbeing / Mood:	Coping well, baby blues, excessive anxiety, postnatal depression.
Sleep:	Good, intermittent, little, none, excessive sleep, inability to get sleep, premature waking
Breasts:	***Indicate (L) Left & (R) Right or Comment x 2:*** Soft, filling, full, engorged, sore
Nipples:	***Indicate (L) Left & (R) Right* or *Comment x 2*:** NAD, cracked, bleeding, bruised, healing, sore,
Breastfeeding:	Confidence with positioning, attachment, support required, expressing, any problems?
Uterus:	W/C (well contracted), abdominal tenderness, involuting, sub- involution, boggy, high
Wound:	Clean and dry, healing, moist, inflamed, infected, suture / clip removal.
Perineum:	Soreness, bruising, swelling, sutures, infection
P.V.Loss/Lochia:	Type (rubra, serosa, alba), amount(minimal, average, heavy), colour (red, brown, pink) , offensive odour, presence of clots
Micturition:	Pain on passing urine, leakage, stress incontinence, urgency. ***Time and volume (mls) of first 2 voids to be documented*.** **If either of first 2 voids is less than 200mls, consult Bladder Care Guideline**
Bowels:	B.O (bowels opened), BNO (bowels not opened), constipation, diarrhoea, leakage, urgency, haemorrhoids
Legs:	***Comment x 2 or indicate (L) Left & (R) Right***, NAD, oedema, redness, swelling, pain, varicose veins, thrombophlebitis, cramps, deep vein thrombosis
Postnatal Exercises:	Explained and encouraged (Ex/ENC), doing them, not doing them
Bonding:	Good, reassured, mother expressing difficulty

Postnatal Education

(Please provide this education from the time of admission and clearly document same below)

Information Given and Discussed with Mother	Date	Signature
Rest/Hygiene/Nutrition		
Postnatal "Blues" / Depression		
Breastfeeding Support/Information		
Cervical Smear		
Family Planning		
Vaccination/ Immunisation/BCG		
***Instruction on the safe use of formula (if required)**		
Changing / Top and tail/ Handling		
Cord Care		
Eye Care		
Bathing		
Prevention of SIDS		
Signs of effective feeding		
Plagiocephaly		
Vitamin D Supplementation		

Appendix 5 - Suggested Frequency of IMEWS observations

Clinical Situation	**Minimum frequency of recording observations on IMEWS**
Antenatal Low risk (inpatient) woman with an uncomplicated pregnancy	Full set of vital signs recorded on the IMEWS on admission. Thereafter as clinically required.
Postnatal low risk inpatient woman with an uncomplicated pregnancy and birth	Full set of observations following the birth of the baby. Thereafter TPR, Pain Score and AVPU score recorded until discharge unless otherwise indicated.
Antenatal or Postnatal	**Minimum frequency of recording observations on IMEWS**
• Hypertensive disorders of pregnancy	Full set of vital signs including urinalysis recorded daily. Thereafter blood pressure recorded 4 hourly
• Suspected and/or confirmed maternal infection	Full set of vital signs recorded daily. Thereafter TPR, Pain Score and AVPU recorded 4 hourly.
Any other clinical concerns	Full set of vital signs recorded daily and thereafter as required.
Emergency situation	As clinically required

Blood Transfusion	See local Blood Transfusion Guidelines
Post Caesarean Section or Post Surgery during Pregnancy/Postnatal period (including recovery)	
Full set of vital signs (urinalysis only if applicable) to be recorded: • Every 5 minutes for 15 minutes • Thereafter, every 15 minutes for 1 hour • Thereafter, every 30 minutes for 1 hour • Thereafter, every hour for 2 hours • Thereafter, every 4 hours for 48 hours • Thereafter, daily until discharge	

Customise according to local resources

Appendix 6 - Physiological and physical changes associated with pregnancy

These factors should be considered in their effect on critical care management in a pregnant woman whatever the cause:

- Aortocaval compression significantly reduces cardiac output from 20 weeks of gestation thus reducing venous return and, as a consequence, cardiac output by up to 30–40%, causing what is known as supine hypotension. It also significantly reduces the efficacy of chest compressions during resuscitation and reduces cardiac output to around 10%.

- Changes in lung function, diaphragmatic splinting by the enlarged uterus and increased oxygen consumption make the pregnant woman become hypoxic more readily and make ventilation more difficult. This means that the pregnant woman becomes hypoxic much more rapidly during periods of hypoventilation.

- Difficult intubation is more likely in pregnancy because of large breasts inhibiting the working space and laryngeal oedema can contribute to make intubation more difficult.

- Pregnant women are at an increased risk of aspiration requiring early intubation with effective cricoid pressure and the use of H2 antagonists and antacids prophylactically.

- Maternal resuscitation should follow the Resuscitation Council (UK) guidelines. From 20 weeks of gestation onwards, the pressure of the gravid uterus must be relieved from the inferior vena cava and aorta. Approach with a left lateral tilt of 150 on a firm surface or manual displacement of the uterus.

- If there is no response to correctly performed CPR after maternal collapse or if resuscitation is continued beyond this in women beyond 20 weeks of gestation, delivery of the fetus / evacuation of the uterus should be considered to assist maternal resuscitation. Additional points include:

    - BP of 90/60 mm is a normal blood pressure in pregnancy and hypertension aim of BP < 150/100 mmHg. If there is organ damage, aim for BP < 140 mmHg.

    - Increased cardiac output means that large volumes can be lost rapidly, especially from the uterus which receives 10% blood volume at term.

    - Increased coagulation – increased risk of VTE – prophylaxis is required.

    - Nutritional requirements – macronutrients – 300 kcal required daily extra. Micronutrients – iron, Vit D, omega-3 etc.

These physiological alterations will require adjustment of delivery of critical care as detailed in table below.

Physiological and physical changes in pregnancy[20]

	Changes in Pregnancy	**Impact on Resuscitation**
Cardiovascular System		
Plasma	Increased by up to 50%	Dilutional anaemia Reduced oxygen-carrying capacity
Heart rate	Increased by 15–20 bpm	Increased CPR circulation demands
Cardiac output	Increased by 40% Significantly reduced by pressure of gravid uterus on IVC	Increased CPR circulation demands
Uterine blood flow	10% of cardiac output at term	Potential for rapid massive haemorrhage
Systemic vascular resistance	Decreased	Sequesters blood during CPR
Arterial blood pressure	Decreased by 10–15 mmHg	Decreased reserve
Venous return	Decreased by pressure of gravid uterus on IVC	Increased CPR circulation demands Decreased reserve
Respiratory System		
Respiratory rate	Increased	Decreased buffering capacity, acidosis more likely
Oxygen consumption	Increased by 20%	Hypoxia develops more quickly
Residual capacity	Decreased by 25%	Decreased buffering capacity, acidosis more Likely
Arterial PCO2	Decreased	Decreased buffering capacity, acidosis more Likely
Laryngeal odema	Increased	Difficult intubation
Other changes		
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 Aortocaval compression causes supine hypotension, reduces

		venous return and significantly impairs CPR
Weight	Increases	Large breasts may interfere with intubation Makes ventilation more difficult

CPR = cardiopulmonary resuscitation; IVC = inferior vena cava; PCO2 = partial pressure of carbon dioxide

From the RCOG Green-top Guideline No.56: Maternal collapse in pregnancy and the puerperium, 2011[18].