Efficient evidence reviews
Scottish Government Review of Maternity and Neonatal Services

Models of Maternity Care for critically unwell women

Dr Anna Gavine, Prof Alan Cameron and Prof Mary Renfrew
University of Dundee

on behalf of the Evidence and Data Sub-group

Summary and Recommendations

The aim of this rapid review was to inform effective, equitable, sustainable and acceptable maternal critical care provision through distilling core principles and practice recommendations from good quality current evidence. We aimed to identify any relevant systematic reviews and/or guidelines. However, this rapid review identified a paucity of evidence in maternal critical care configuration and provision, with only eight guidelines (the specifics of care provision not being underpinned by a strong evidence), one meta-ethnography and one qualitative primary study, four case studies and the two MBRRACE-UK reports as having any information pertinent to maternal critical care provision. Nevertheless, from the available information we can still go some way to addressing the aims of this review.

Specifically, in terms of determining the optimal model of care for maternal critical care provision which is acceptable for women, we can stipulate that both critical care and maternity/obstetric needs must be considered, and normal midwifery care should be continued. In addition, women and babies should be kept together whenever possible to enable the establishment of attachment processes and breastfeeding. In terms of determining the optimal workforce and service configuration the Maternity Critical Care Working Group (2011) guideline on the provision of critical care provides recommended models. Due to the diverse nature of Scotland’s geography and uneven distribution of population, different models could be used for different locations. For instance model one (a dedicated level 2 unit staffed by appropriately trained midwives with input from anaesthetists and obstetricians) may be suitable for an area with a high volume of women requiring such services, whereas the other approaches may be more appropriate in areas with a smaller amount of women requiring such services. The case studies do provide some illustration as to how model one could be delivered, however, it must be stressed that there is no well-conducted evidence to support this yet. In addition to configuration of care, the available evidence also suggests that women requiring critical care need a multidisciplinary approach.

Core principles and recommendations based upon the limited evidence are presented below. They have been framed in accordance with the Framework for Quality Neonatal and Newborn Care (Renfrew et al., 2014) to distinguish between, and identify, key components of quality care.
The evidence:

- NICE (15 records found on critical care, none on care provision or configuration),
- SIGN (1 record on critical care, not relevant),
- Cochrane Pregnancy and Childbirth Group (20 reviews on critical care, none relevant),
- Cochrane Effective Practice of Care Group (one review on critical care, not relevant),
- RCOG (15 records found, seven with information on provision but lacking an evidence base),
- RCM (no additional records found),
- RCN (no records found),
- Scottish Government Consultation (13 records found, 3 related to provision; specifically the two MBRRACE reports and the guidelines for Obstetric Anaesthetic Services) and the English Maternity Services Review (no consideration of provision of maternal critical care).
- Database search identified a total of 1663 records. Only one systematic review was identified. This was robustly conducted and examined women’s experiences of severe maternal morbidity.
- An additional four case studies, the ACOG guidelines on critical care and one qualitative study on UK-based women’s experiences of maternal critical care were identified, indicating a paucity of evidence in this area.

From the limited evidence available it is possible to distil some core principles on maternal critical care provision and configuration.

Core Principles:

Practices
- All critical care should be high quality both in terms of the equipment available and training and expertise of staff providing the care.
- Women’s critical care needs should be met during any transfers, both between and within hospitals.
- Different models could be utilised in different geographical settings, dependent upon the volume requiring such services.

Values and Philosophies
- All critical care should be woman-and baby-centred, and the woman herself and her family should be involved in decisions as much as possible.
- Separation from the baby could have important implications for both mother and baby, for example in terms of establishing breastfeeding and developing attachment. It is therefore essential the staff caring for women in this situation are cognizant of this and wherever possible, the mother and baby should be kept together and their relationship should be seen as an important priority by all those caring both for the mother and for the baby.
- Any women requiring critical care has ongoing midwifery care, including emotional support and promotion of mother and baby relations, and this should not be neglected at the expense of the critical care. Similarly, the critical care needs should not be neglected at the expense of ongoing midwifery care.
- All critical care is high quality both in terms of the equipment available and training and expertise of staff providing the care.
These core principles could potentially be adhered to using the following service configuration models, proposed by the Maternal Critical Care Working Group (2011).

### Organisation of Care

- A suitably equipped level 2 area is staffed by a team of midwives who have additional training which equips them with the necessary critical care competences. Medical input from anaesthetists, obstetricians and other medical specialists (e.g. cardiologists, microbiologists, haematologists and liaison with other services (e.g. blood transfusion) is essential. Local arrangements for level 3 care should be available when required.
- Staff with critical care skills should be imported onto the labour ward when needed through outreach or other arrangements with local critical care services.
- Local arrangements should be in place to provide ongoing obstetric and midwifery input for all women transferred to a general level 2 unit and to enable direct contact with the baby in that setting.

In addition, it is also possible to make the following recommendations in terms of workforce configuration and characteristics of care providers:

### Care Providers

- All women requiring critical care need integrated care through a multidisciplinary team including critical care doctors and nurses, midwives and obstetricians with up-to-date training in critical care and obstetricians.
- All women requiring critical care should have a named midwife (or a dedicated link midwifery team for critical care units) who can maintain contact with the baby and integrate maternity and critical care plans.
- All staff caring for pregnant and postnatal women with critical care needs should have appropriate training in both maternity and critical care and work cohesively as an interprofessional team to deliver quality services that place the mother and baby at the centre of care planning and delivery.

The case studies identified do provide an illustration of how the service may be configured to facilitate this through dedicated obstetric high dependency units, however, it must be stressed that there is no well-conducted evidence to support such units yet. Given the importance of maternal critical care, it is an essential area of research and could afford Scotland the opportunity to develop and evaluate a Scottish Model of Maternal Critical Care.
1.0 Aim
The aim of this rapid review was to inform effective, equitable, sustainable and acceptable maternal critical care provision through distilling core principles and practice recommendations from good quality current evidence. More specifically, what is the optimal model of care (i.e. the overarching design and values of the service)? And what is the optimal service and workforce configuration (i.e. number and types of units, skill mix) and characteristics of care providers (i.e. interdisciplinary working, education and training)?

The term critical care is defined in accordance with the Department of Health’s description of critical care (Department of Health, 2000), which includes high dependency (level 2 care; single organ support) and intensive care (level 3 care; advanced respiratory support alone or support of two or more organ system). The critical care may necessitate from either an obstetric complication or a pre-existing or new illness that is unrelated to pregnancy and childbirth. We acknowledge that other groups of women (e.g. those with severe mental health problems, those experiencing domestic abuse, or those with substance misuse problems), will have a need for specialised care, and this will be addressed in a separate rapid review on services for vulnerable groups.

2.0 Methods
A rapid evidence review was undertaken by identifying systematic reviews and guidance considering the evidence on effectiveness of workforce and service configuration in maternal critical care settings and identifying examples of good practice. The protocol for the review is detailed in table 1.

Table 1. Rapid Review Protocol.

<table>
<thead>
<tr>
<th>Details</th>
<th>Additional Comments</th>
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| Review question | • What is the optimal model of care for maternal critical care provision?  
• What is the optimal service and workforce configuration for maternal critical care provision?  
• What are the optimal characteristics of care providers for maternal critical care provision?  
• Model of care is defined as the overarching design and values of the service.  
• In terms of this review, service configuration is defined as number and types of unit, and workforce configuration is defined as skill mix (i.e. roles of those providing care).  
• Characteristics of care providers is defined as interdisciplinary working, education and training. |
| Objectives | To distil core principles and practice recommendations that can lead to high quality, equitable and sustainable maternal critical care provision |
| Language | English |
| Study design | • Systematic reviews of RCTs, cluster-controlled trials, quasi-randomised controlled trials, observational studies.  
• Qualitative studies with childbearing women and their families, and/or healthcare professionals.  
If there is a lack of systematic reviews in this subject area then primary studies and then case studies will be sought by contacting experts and examining reference lists of non-systematic reviews and commentaries. |
<table>
<thead>
<tr>
<th>Status</th>
<th>Papers published in academic journals and published reports</th>
<th>Critical care is taken to mean care in high dependency or intensive care settings. This may be within specialised obstetric units or in general hospital high dependency or intensive care units. It also includes women who should be cared for in these settings (e.g. prior to admission or during transport).</th>
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<tbody>
<tr>
<td>Population</td>
<td>Pregnant women requiring critical care</td>
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<tr>
<td>Intervention</td>
<td>Critical care provision in one of the following settings:</td>
<td>Specialised unit is taken to mean a unit specifically for pregnant women with critical care needs. Non-specialist unit is taken to mean care delivered in general hospital high dependency or intensive care units.</td>
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<td></td>
<td>- Specialised critical care unit staffed by midwives, nursing staff and medical staff (i.e. obstetricians and intensive care consultants)</td>
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<td>- Specialised critical care unit staffed by midwives and medical staff (i.e. obstetricians and intensive care consultants)</td>
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<td>- Non-specialised critical care unit staffed by nursing staff and medical staff (i.e. obstetricians and intensive care consultants)</td>
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<td></td>
<td>- Non-specialised critical care unit staffed by midwives, nursing staff and medical staff (i.e. obstetricians and intensive care consultants)</td>
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<td>Comparator</td>
<td>Any of the above</td>
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<td>Outcomes</td>
<td>Maternal mortality</td>
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<td></td>
<td>Maternal morbidity (including pregnancy related complications)</td>
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<td>Length of stay in critical care setting</td>
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<td>Neonatal mortality</td>
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<td>Neonatal morbidity</td>
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<td>Need for neonatal intensive care</td>
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<td></td>
<td>Breastfeeding rates</td>
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<td>Contact between mother and baby including skin to skin care provision</td>
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<td>Any longer term outcomes (e.g. maternal wellbeing)</td>
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<td>Women’s and families’ views and experiences of care</td>
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Other criteria for inclusion/exclusion of studies

- Exclude evidence from resource poor/low income countries
- No date limit
- Exclude conference abstracts
- Filter applied to limit to systematic reviews

Review Strategies

- Cochrane Pregnancy and Childbirth group will be searched. Following databases will be searched: MEDLINE, MIDIRS, HMIC, CINAHL. The websites of NICE, RCOG, RCM and RCN will all be searched. The reports of the English review will also be examined.
- Data on all included reviews will be extracted into evidence tables.
- If possible, a meta-analytical approach will be used to give an overall summary effect.

Critical Appraisal

- The NICE methodology checklist for systematic reviews and meta-analyses will be used to assess study quality for systematic reviews.
- Quality of clinical guidelines will be assessed using Greenhalgh’s (2014) checklist for set of clinical guidelines.

The following sources of systematic reviews were examined for any potentially relevant titles: NICE guidelines, SIGN guidelines and the Cochrane Pregnancy and Childbirth group. Secondly, the Royal College of Obstetricians and the Royal Colleges of Midwives and Nurses websites were searched for relevant guidelines. Thirdly, a database search of MEDLINE, CINAHL, MIDIRS and HMIC was conducted. Fourthly, the results of the consultation conducted by the Scottish Government were examined for any relevant published studies or examples of good practice. Finally, the reports of the English Review of Maternity Services were examined.

3.0 Findings
3.1 Search results
This section provides a description of the records identified by each database or source and the selection process. The study selection process is illustrated in figure 3.1.

3.1.1 NICE
All NICE guidelines (n=15) related to maternity care were examined for relevance according to the inclusion/exclusion criteria detailed in Appendix 2. Only one guideline (NG4 on safe midwifery staffing for maternity settings) aimed to obtain evidence on staffing for women requiring high dependency care, however, no studies were identified. Therefore, no evidence pertinent to the rapid review was identified from NICE.
Figure 3.1 Study Selection Process

Database search
n = 3303

Cochrane Pregnancy and childbirth group
n = 685

Additional records identified through other sources
n = 13
(RCOG = 7, expert consultation = 3 [3 guideline], reference lists = 3)

Records after duplicates removed
n = 2348

Records screened
n = 2361

Records excluded
n = 2280

Full-text articles assessed for eligibility
n = 81
(database/ Cochrane =71, other sources=13)

Full-text articles excluded, with reasons (n=66):
- Not focused on organisation/ provision of critical care (n=37)
- Non-systematic or non-structured literature review/ descriptive article (n=10)
- No access (n=23)

Total number of records included
n=15
(database = 2, other sources =13)
3.1.2 SIGN
Only one current SIGN guideline related to maternity care was identified: 127, management of perinatal mood disorders. Although this has information on service configuration, it is only in relation to mother and baby units for women with serious mental health problems. This will be considered in the rapid review on services for vulnerable groups.

3.1.3 Cochrane Pregnancy and Childbirth group
Titles and abstracts were all screened for relevance to maternal critical care (i.e. reviews which appeared focused on public health intervention and management of women without complications were not retrieved). On the basis of this, 20 articles (detailed in Appendix 2) were retrieved for further examination. However, no reviews focused on how maternal critical care was delivered and instead the focus was on specific interventions.

3.1.4 Cochrane Effective Practice and Organisation of Care group
Reviews within the Cochrane Effective Practice and Organisation of Care group were also examined. One review and two protocols related to pregnancy and childbirth were identified but these were not relevant to maternal critical care.

3.1.5 RCOG
The titles of all guidelines (including green top and good practice guidelines) published by the RCOG were examined for relevance to maternal critical care. The 15 guidelines detailed in Appendix 2 were identified as being potentially relevant and were obtained and the full texts were examined. One guideline entitled “Providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman” (Maternal Critical Care Working Group, 2011), specifically examined maternal critical care and was developed by members of the RCOG, the RCM, the Obstetric Anaesthetists Association (OAA), the British Maternal and Fetal Medicine Society, the Intensive Care Society and Liverpool Women’s NHS Foundation Trust. Six guidelines on: maternal collapse (RCOG, 2011); bacterial sepsis following pregnancy (RCOG, 2012a); bacterial sepsis in pregnancy (RCOG, 2012b); (RCOG, 2009); Safer Childbirth, which was developed in collaboration with the Royal College of Anaesthetists (RCA), the Royal College of Paediatrics and Child Health (RCPH) and the RCM (RCOG, RCM, RCA, RCPH, 2007); and the Good practice guidance on the reconfiguration of women’s services (RCOG, 2013), do all include some information on who should be involved in care and/or where the woman should be managed.

3.1.6 RCM
No additional guidelines identified.

3.1.7 RCN
The publication archive was examined for the terms: labour, maternity, maternal, pregnancy, antenatal, perinatal, postnatal, intrapartum and postpartum. However, no documents relevant to maternal critical care were identified.

3.1.8 Database search
MEDLINE, CINAHL, MIDIRS and HMIC were searched using a combination of index and free-text terms relevant to maternity care and critical care. In addition systematic review filters were added to the CINAHL and MEDLINE searches. See Appendix 1 for the full search strategy.
A total of 1663 records were identified after de-duplication. Following title and abstract screening 68 potentially relevant articles were retrieved for full text screening. Only one record meeting the inclusion criteria was identified, which was a systematic review and meta-ethnography which explored women’s experiences severe maternal morbidity (Furuta et al., 2014).

In addition, 10 articles that included a non-systematic literature review which contained information on service and workforce configuration in a maternal critical care setting were identified.

Due to the lack of systematic reviews identified in the search, the reference lists of all these (non-systematic) literature reviews, were examined for any relevant primary studies or case studies. Four case studies (Mabie and Sibai, 1990, Ryan et al., 2000, Saravanakumar, 2008, Zeeman et al., 2003) which included audit of their services, were identified and will be discussed in the narrative summary. One additional qualitative study (published after the included meta-ethnography by Furuta et al., 2014) was identified when screening the titles and abstracts from the database search and will also be discussed in the narrative synthesis (Hinton et al., 2015).

3.1.9 Scottish Government Consultation
The consultation resulted in a document which details a wide range of sources that were recommended by stakeholders. The document was searched for any additional material that had not been previously identified. The 13 additional documents which were retrieved for further consideration against the inclusion/exclusion criteria are detailed in Appendix 2. From this three additional records provided some information on maternal critical care and warranted further consideration: the OAA/AAGBI (Association of Anaesthetists of Great Britain and Ireland) guidelines for Obstetric Anaesthetic Services (OAA and AAGBI, 2013) and the MBRRACE-UK reports on Saving Lives, Improving Mothers’ Care (Knight et al., 2014, Knight et al., 2015a)

3.1.10 English Maternity Services Review reports
The four reports produced for the English Maternity Services Review were examined, namely:

- Report 1: Summary of the evidence on safety of place of birth; and implications for policy and practice from the overall evidence review (Kurinczuk et al., 2015)
- Report 2: Perinatal and maternal outcomes by parity in midwifery-led settings: secondary analysis of the Birthplace in England cohort comparing outcomes in planned freestanding and alongside midwifery unit births (Hollowell et al., 2015a)
- Report 3: Systematic review and case studies to assess models of consultant resident cover and the outcomes of intrapartum care; and two international case studies of the delivery of maternity care (Knight et al., 2015b)
- Report 4: A systematic review and narrative synthesis of the quantitative and qualitative literature on women’s birth place preferences and experiences of choosing their intended place of birth in the UK (Hollowell et al., 2015b)

Maternal critical care provision was not detailed any of the English review reports, which was focused on delivery of care in obstetric units compared to midwife-led units. Whilst one of the reviews (Knight et al., 2015b) did examine models of consultant resident cover, it was not considered in the context of critical care settings and will not be considered further.

3.2 Overview and nature of included evidence
No systematic reviews examining the impact of critical care setting/delivery on maternal outcomes was identified. This is consistent with a (non-systematic) literature review by Patil et al. (2015) who identified a paucity of evidence in this area, illustrated by a MEDLINE search which only identified
two records on maternal critical care delivery. Specifically, the RCOG guidance on providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman (identified in the RCOG search; Maternity Critical Care Working Group, 2011) and the American College of Obstetricians and Gynaecologists (ACOG) clinical management guidelines for critical care in pregnancy (ACOG, 2016). As noted previously, Maternity Critical Care Working Group guidelines also detailed some proposed models of maternal critical care, which will be considered in the narrative summary. The ACOG report is primarily focused specific aspects of clinical management but does contain some recommendations in terms of workforce configuration. The one systematic review that was identified was a well-reported meta-ethnography of women’s perceptions of severe maternal morbidity. Given that the strategic review aims to develop maternity services which are mother, baby and family-centred, it was felt this could provide some insights into how care could be provided that is acceptable to women, and will be detailed in the narrative summary.

Six guidelines published by the RCOG (some in collaboration with the RCN, RCA and RCPH) included recommendations related to maternal critical care provision and will be discussed in the narrative synthesis. These guidelines were all appraised using the checklist reported by Greenhalgh (2014) and were found to have little evidence basis when it came to maternal critical care provision (note there was an evidence basis for some other parts of the guidelines, but these were more focused on clinical interventions) and this should be considered when interpreting their recommendations. Similarly, the OAA and AAGBI (2013) produced Guidelines for Obstetric Anaesthetic Services, which do not appear to be underpinned by a rigorous evidence search.

In addition a number of case studies which detailed and provided some review of their approach to maternal critical care delivery were identified through reference list checking studies (Mabie and Sibai, 1990, Ryan et al., 2000, Saravanakumar, 2008, Zeeman et al., 2003). However, it should be stressed that these are case studies of individual sites, although may provide some insights, no firm conclusions can be drawn from them.

In terms of qualitative work, two relevant records were identified. This included a robust meta-ethnography by Furuta et al. (2014), which explored women’s’ experiences of severe maternal morbidity and critical care. In addition a recently published, well-reported and comprehensive study which explored UK women’s experiences of critical care (Hinton et al., 2015).

The government consultation document also identified the MBRRACE-UK reports on Saving Lives, Improving Mothers’ Care (previously conducted under the Centre for Maternal and Child Enquiries; CMACE). The 2014 report has a focus on sepsis (Knight et al., 2014) and the 2015 report has a focus on mental health, venous thromboembolism, cancer and domestic abuse (Knight et al., 2015).

3.3 Narrative Summary
A summary of each of the identified documents will now be presented.

3.3.1 Guidelines
3.3.1.1 RCOG
The Maternal Critical Care Working Group (2011) guidelines on the providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman states that on the basis of the national Service Framework for Children, Young People and Maternity Services (Department of Health, 2004), commissioners and maternity and critical care services have mechanisms which ensure that a critically ill woman can access equitable maternity and critical care, irrespective of
location. These mechanisms should facilitate mother and baby remaining together unless there is a clinical contraindication. The group recommends that there should be locally defined escalation arrangements for bringing critical care, midwifery and obstetric competences into the maternity or critical care unit, which take into account local configuration, size and complexity of maternity and critical care services. The following models are proposed (Maternal Critical Care Working Group, 2011):

- Having a suitable area and equipment (see Appendix 4 for details) with medical input from anaesthetists and obstetricians, staffed by a team of midwives who have additional training which equips them with the necessary critical care competences. Local arrangements for input from other disciplines and allied 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 critical care services.
- Transferring women to a general level 2 unit with local arrangements for providing obstetric and midwifery input and competences and maintaining direct contact with their baby.

The guideline states that a fundamental principle when caring for a critically unwell pregnant or recently pregnant women, is that “her pregnancy care is continued and integrated into care plans and this continues into the postnatal period. The multiple care givers have to ensure that the needs of the critical care do not over shadow the needs of the woman and her family in regard to midwifery or obstetric care” (Maternity Critical Care Working Group, 2011, p. 13). To this end, the woman needs daily review by a multidisciplinary team including a named obstetric consultant and named senior midwife. The contact telephone numbers for midwifery, obstetric and neonatal staff should be on the women’s chart and the management plan should facilitate delivery of ongoing obstetric and midwifery care during the critical care area admission. This should include significant midwifery input for normal midwifery care during the antepartum, intrapartum and postpartum periods. In addition a neonatologist may be necessary if pre-term delivery occurs or is a possibility. Any specific obstetric conditions should be managed with the critical care team in accordance with the relevant NICE guidelines.

The women’s named midwife should be notified of her admission and units are encouraged to consider having a dedicated link midwifery team for critical care units and NICUs who are contactable and will ensure regular and as-needed midwifery input. These midwives will maintain contact with the baby and mother (who may be in different environments) and can link the two separate care plans.

It should be recognised that the midwife will be able to provide the family with emotional and social support and prepare for a premature delivery or admission to a neonatal unit. The family should be provided with contact details of a midwife (either a named midwife or a member of the unit team). The midwife should also monitor mental health needs and educate the family on their role in the recovery period.

Other standards for managing critically unwell pregnant or recently pregnant women detailed in the guideline are:

- Implementation of the NICE guideline on the care of the critically ill patient in hospital (NICE, 2007).
Physiological observations should be recorded using track and trigger systems and acted upon by staff who have been trained to undertake these procedures and who understand their clinical relevance.

Staff caring for women in acute hospital settings should have competences in monitoring, measurement, interpretation and prompt response to the acutely ill woman appropriate to the level of care they are providing. Education and training should be provided to ensure staff have these competencies and they should be assessed to ensure they can demonstrate them as per the competencies for recognising and responding to acutely ill patients in hospital (Department of Health, 2009).

A graded response strategy for women identified as being at risk of clinical deterioration should be agreed and delivered locally as per the competencies for recognising and responding to acutely ill patients in hospital (Department of Health, 2009).

Lead professionals in maternity services should ensure staff are deemed competent in the early recognition of acutely ill and deteriorating women and are able to perform the initial resuscitation of such woman. There are a number of national, certified courses available to support workforce development in this area such as the AIM (Acute Illness Management), ALERT (Acute Life-threatening Events Recognition and Treatment), REACTS (Recognition, Evaluation, Assessment, Critical Treatment and Stabilisation), PROMPT (PRactical Obstetric Multi-Professional Training) courses.

If a decision to transfer a woman from critical care to maternity is made, then the transfer should happen as early as possible during the day and avoid transferring between 22.00 and 07.00. There should be continuity of care formulated through a formal structured handover.

Transfers from a maternity unit need to be in accordance with the Intensive Care Society (ICS) guidelines for the transport of the critically ill adult (ICS, 2002) and there must be a plan as to whether or not shared care between Obstetrics and Critical Care.

There is a small amount of information on maternal critical care in the other reports published by (or in collaboration with) the RCOG. First, the Safer Childbirth (RCOG, RCM, RCA, RCPH, 2007) report states that within larger units (especially those which manage high-risk cases), details the following recommendations which would be applicable to critical care:

- Midwives with additional skills and training in the management of complex obstetric problems should be part of the high-risk team, in order to provide care which maintains the philosophy of midwifery care. The principle of one to one midwifery care also applies in the high-dependency environment and therefore the rota must ensure that there is at least one appropriately trained midwife to each woman requiring high-dependency care.
- Management should be by a multidisciplinary team involving obstetricians, midwives and anaesthetists. Whenever possible all members of the team should review the woman together. In the absence of a team member, members of the team should make each other aware of the issues decided.
- Intensive care should start as soon as needed and include early involvement of the intensive care consultant/critical care outreach teams.
- Clear local arrangements for emergency care provision are necessary. The high dependency unit can take the form of a recovery room or separate, dedicated area and should be staffed by appropriately skilled midwifery, nursing and obstetric staff.
- The routes of access to intensive care units (either within or outwith the hospital) should be outlined in multidisciplinary guidelines as well as guidance on when to involve clinicians outwith the maternity service.
• Networks should be in place to provide referral routes for women from low to high-risk units for high dependency care. The use of regional protocols with lists of trigger factors is recommended to promote consistency of care.
• The Scottish Confidential Audit of Severe Maternal Morbidity.

The Green-top clinical guidelines by their nature are focused on the clinical management strategies of maternal collapse (RCOG, 2011), blood transfusion services in obstetrics (2009) and bacterial sepsis during or following pregnancy (RCOG, 2012a, RCOG, 2012b), however, they do state that the critical care team should be involved in the management of such cases. In addition, the guideline on blood transfusion provides the following recommendations in relation to organisation of care and care providers:

• Staff working in obstetric units should be aware of the location of the satellite blood fridge (where available) and should ensure that access is possible for blood collection.
• Women at high risk of emergency transfusion should have a group and screen blood sample taken once a week to exclude or identify any new antibody formation and to keep blood available if necessary. Close liaison with the blood transfusion laboratory is essential.
• If clinically significant red cell antibodies are present, then blood negative for the relevant antigen should be cross-matched before transfusion; close liaison with the transfusion laboratory is essential to avoid delay in transfusion in life-threatening haemorrhage.
• There should be a clear local protocol on how to manage major obstetric haemorrhage.
• The protocol should be updated annually and practised in ‘skills drills’ to inform and train relevant personnel.

It should be noted that the last recommendation is not based on any available evidence and instead based on clinical expertise of the guideline group. The other recommendations are generally based on low quality evidence. Finally, the RCOG (2013) Good Practice Guideline on Reconfiguration of women’s services in the UK, re-iterates the points made in the Maternal Critical Care Working Group (2011) guidelines on the providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman.

3.3.1.2 OAA and AAGBI guidelines
The OAA and AAGBI (2013) guidelines acknowledges a lack of published evidence on which to base their guidance. It is advocated that the NICE (2007) Guideline on recognition of and response to acute illness in adults in hospital should be used. The OAA and AAGBI guideline summarises the relevant recommendations from the Maternity Critical Care Working Group (2011) guidelines on the providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman. The following recommendations are made:

• When level 2 care is provided in a maternity unit that staff who are trained in HDU care are available 24 hours per day (including a named consultant anaesthetist and obstetrician) and midwife/nurse-to-woman ratio must be at least one midwife/nurse to two woman or one-to-one if care is provided in individual rooms.
• Midwives working in this setting should have additional training and ongoing continued professional development that equips them with the necessary critical care competences as well as updated midwifery competencies.
• Every unit must have a clear mechanism to facilitate transfer to ICU and there should be close co-operation between maternity HDU and ICU teams.
It should be noted that guidance on the classification level of units is also detailed in the Expert Group on Acute Maternity Services’ (EGAMS, 2003) Reference Report and the summary table is provided in Appendix 5.

3.3.2.3 ACOG Guidelines
The ACOG guidelines are of course developed in the context of the American healthcare system, which is considerably different in terms maternity care. Nevertheless, these guidelines also emphasise the need for collaborative working and shared decision making with the intensive care consultant, obstetrician, speciality nurses and neonataologist.

3.3.2 Case studies on maternal critical care delivery
Four case studies detailing specialised obstetric critical facilities were identified. No experimental studies have been carried out so the data are limited to audit of women’s records and the authors’ opinions. Nevertheless, as they are all that is available, the models of care provision may be worth considering. Further details on the location, the facility and key findings are presented in table 2. Please note for the Mabie and Sibai (1990) paper on the abstract was available so the data here are limited.
Table 2. Case studies of maternal critical care settings

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Country</th>
<th>Brief Description of HDU facility</th>
<th>Key findings</th>
</tr>
</thead>
</table>
| Saravanakumar et al. 2008 | UK (Birmingham)   | 3-bedded HDU within delivery suite. Staffed by midwives and covered by anaesthetic and obstetric teams. MDT working emphasised. A critical care Professional Development Nurse and Lead Critical Care Midwife provide ongoing training to midwives including the care of intravascular lines and associated basic science. Close proximity to a separate hospital with an ICU. | • Pool of staff with higher competence means midwives have been able to provide holistic care for even very unwell mothers.  
  • Authors argue that although the cost of this service is not negligible, it needs to be offset against ensuring safe services, particularly in the context of obstetric negligence claims.  
  • 66.3% of babies stayed with their mother which facilitated early bonding; 25.4% of babies were admitted to the neonatal unit; and 8.3% of babies were located away from the mother (e.g. in another ward, at home or in another hospital).  
  • Over the 23 years the unit has been open the admission rate was 2.67%, in the last decade this has increased to 5.01%  
  • Within last 4 years the transfer rate to ITU was 1.4 per 1000 deliveries  
  • 66.3% stayed <24hrs and 16.9% stayed >48 hrs. The duration of stay has decreased over time. |
| Ryan et al. 2000 | Ireland (Dublin) | 2-bedded HDU of standard recommended size (35m²) and equipment. Located close to theatres and the recovery area. Staffed by anaesthetic and obstetric consultants, and house officer. All nurses are registered midwives who have undertaken | • Admission rate to the HDU was 1.02% of all deliveries  
  • ICU utilisation decreased from 0.08% to 0.04% and median duration of stay in ICU decreased from 3 days to 2 days following the establishment of the unit (note \( p = 0.25 \) and numbers small, 123 women admitted).  
  • No maternal deaths occurred during the study period  
  • Advantages of the HDU in the obstetric unit: removes need to transfer woman; personnel familiar with invasive monitoring and techniques; enables the mother and baby to be kept together |
| Zeeman et al. 2003 | US (Dallas County) | 5-bedded obstetric intermediate care unit, contiguous to labour and delivery. Obstetric nurses rotate through the unit but majority are not trained in critical care. Ideally they provide 1:1 or 1:2 care depending on acuity. Women are evaluated hourly by nursing staff, 2-hourly by 3rd year residents and are supervised by senior residents and faculty. Anaesthesia residents are onsite. A maternal-foetal medicine faculty member is the director of the unit. | • 1.7% of all deliveries were admitted to the unit  
  • Mean length of stay was 18 hours  
  • 15% required transfer to a ICU  
  • Enabled continuity of obstetric care |
| Mabie 1990 | US (city-country) | 3-bed ICU in the labour and delivery area.                                                        | • 0.9% of all deliveries were admitted  
  • Service had the following benefits: prevention or early recognition of complications; personnel were familiar invasive monitoring which enabled prompt treatment of women; continuity of care was improved pre- and post-delivery; medical staff learned about intensive care and management of rare complications |
3.3.3 Qualitative studies
The meta-ethnography (Furuta et al., 2014) aimed to explore women’s perceptions and experiences of severe maternal morbidity and identified 12 studies. Specific themes related to critical care provision include:

- Finding critical care emotionally difficult to accept, despite having a knowledge that it was necessary for survival.
- Positive feelings about care were more likely to occur if women were involved in the decision making process.
- Even in emergency situations women were able to remember what healthcare professionals said and felt more positive when given an explanation by health professionals about the situation and the rationale for treatment.
- Even when explanations were not given, women felt safe if they trusted their health professional with good non-verbal communication.
- Some women reported feeling distressed, isolated, ignored, treated inadequately, impersonally or unequally, or not listened to.
- Some women had negative feelings and emotion towards their healthcare professionals and blamed delays in diagnosis on them.
- Some women felt that their emotional needs were not met.
- Cultural and language barriers contributed to negative feelings and poor literacy and communication could contribute to sub-standard care.
- Some women felt anger at being robbed of a normal pregnancy and birthing process.
- Separation from the baby could trigger a sense of sadness, guilt or regret.
- Sometimes care of the baby had to be handed over which could have implications for establishing breastfeeding or developing attachment. This in turn could lead to distress, or even a sense of failure as a mother.

Hinton et al. (2015) reported that women tended to feel negatively towards their experience in a general ICU, with some reporting loss of dignity. However, several women described the ICU staff positively and felt they made their time there bearable. Many women found being separated from their baby very difficult, particularly in terms of not being able to see or hold the baby, and missing out on key firsts. Some hospitals made arrangements for the baby to visit the mother, however, often this was not possible as ICU staff felt it was inappropriate to bring a newborn baby into adult critical care and there is a risk of infection. In some cases arrangements were made for the mother to visit her baby instead. For some women, establishing breastfeeding was a way of establishing normality after a traumatic experience, particularly if a natural birth had not occurred. Some women reported being well-supported by staff to help establish breastfeeding and also appreciated understanding if they were unable to breastfeed. At times there were difficulties in identifying the most appropriate setting for step-down care. Some women were sent to delivery suites and others were sent to maternity wards. Women reported mixed experiences with their transfers, with some staff outside critical care not understanding what they had been through and their current physical state. In addition, being around women who had not experienced any complications could be upsetting. Having good relationships with staff, follow-up with critical care staff and/or a private room helped women feel more positive after the transfer.
3.3.4 Additional Evidence from the Scottish Government Consultation

As noted, the government consultation also identified the two the MBRRACE-UK reports on Saving Lives, Improving Mothers’ Care (Knight et al., 2014, Knight et al., 2015a). In addition to detailing the incidence and characteristics of maternal morbidity and mortality, these reports make recommendations for future care. Specifically to critical care provision in women with sepsis, Knight et al. (2014) reported that some women with sepsis were cared for on medical wards and therefore did not receive appropriate obstetric and midwifery care. It is therefore recommend that all consultant led delivery suites have access to level 2 HDU care that are staffed by teams of senior obstetricians, anaesthetists and midwives, skilled in looking after seriously ill women with sepsis (Knight et al., 2014). In addition, plans should be in place to provide critical care in a delivery setting or maternity care in a critical care setting, whichever is most appropriate. No additional information was provided in the 2015 report. In addition the MBRRACEE-UK reports identified issues in interprofessional working across maternity care generally. Good interprofessional team working is key in maternal critical care provision and is addressed further in the rapid review focused on improving interprofessional working.

4.0 Conclusions

This rapid review identified a paucity of evidence in maternal critical care configuration and provision, with only eight guidelines (the specifics of care provision not being underpinned by a strong evidence), one meta-ethnography and one qualitative primary study, four case studies and the two MBRRACE-UK reports as having any information pertinent to maternal critical care provision. Nevertheless, from the available information we can still go some way to addressing the aims of this review.

Specifically, in terms of determining the optimal model of care for maternal critical care provision which is acceptable for women, both critical care and maternity/obstetric needs must be considered, and normal midwifery care should be continued. This could in part be facilitated by training midwives in critical care skills and training critical care nurses in midwifery skills. In addition, women and babies should be kept together whenever possible to enable the establishment of attachment process and breastfeeding. In terms of determining the optimal workforce and service configuration the Maternity Critical Care Working Group (2011) guideline on the provision of critical care provides recommended models (outlined in the summary sheet). Due to the diverse nature of Scotland’s geography and uneven distribution of population, different models could be used for different locations. For instance model one (a dedicated level 2 unit staffed by appropriately trained midwives with input from anaesthetists and obstetricians) may be suitable for an area with a high volume of women requiring such services, whereas the other approaches may be more appropriate in areas with a smaller amount of women requiring such services. The case studies do provide some illustration as to how model one could be delivered, however, it must be stressed that there is no well-conducted evidence to support this yet. In addition, to configuration of care, the available evidence also suggests that women requiring critical care need a multidisciplinary approach and it is also suggested how this can be configured in the summary sheet.
Appendix 1. Search strategies.

**MEDLINE**

Medline searched using the Ovid platform on 03/2/2016. Search terms detailed below. Systematic review filter is the MEDLINE systematic review search strategy developed by the NHS Centre for Reviews and Dissemination at the University of York. No. of records = 1294

1. meta-analysis/
2. exp review literature/
3. (meta-analyses or meta analy$ or metaanaly$).tw.
4. meta analysis.pt.
5. review academic.pt.
6. review literature.pt.
7. letter.pt.
8. review of reported cases.pt.
9. historical article.pt.
10. review multicase.pt.
11. 1 or 2 or 3 or 4 or 5 or 6
12. 7 or 8 or 9 or 10
13. 11 not 12
14. animal/
15. human/
16. 14 and 15
17. 14 not 16
18. 13 not 17
19. Midwifery/og, ma, ut [Organization & Administration, Manpower, Utilization]
20. Hospitals, Maternity/ma, og, sd [Manpower, Organization & Administration, Supply & Distribution]
21. Maternal Health Services/ma, og, sd [Manpower, Organization & Administration, Supply & Distribution]
22. midw*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
24. maternity.mp.
25. (intrapartum or postnatal or antenatal or prenatal or perinatal).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword
heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

(pregnancy or pregnant).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

Pregnancy Complications/
Prenatal Care/
Perinatal Care/
exp Postnatal Care/
(obstetric adj3 emergenc*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

Obstetric Labor Complications/
((pregnant or pregnancy) adj3 emergenc*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
exp Critical Care/
critical care.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

Intensive Care Units/
high dependency care.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

high dependency unit.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

intensive care.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

intensive therapy unit.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

35 or 36 or 37 or 38 or 39 or 40 or 41

34 and 42

18 and 43
CINAHL searched using the EBSCO platform on 04/02/2016.
Search terms detailed below. Systematic review filter applied was reported by Wong et al. (2006).
No. of records = 321.

S31  S24 AND S30
S30  S25 OR S26 OR S27 OR S28 OR S29
S29  meta-analysis
S28  systematic review
S27  (MH "Systematic Review")
S26  PT systematic review
S25  PT review
S24  S22 AND S23
S23  S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21
S22  S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14
S21  intensive therapy unit
S20  intensive care
S19  "high dependency unit"
S18  "high dependency care"
S17  (MH "Intensive Care Units")
S16  critical care
S15  (MH "Critical Care+")
S14  (pregnant or pregnancy) N3 (emergenc*)
S13  (MH "Labor Complications") OR (MH "Obstetric Emergencies")
S12  (obstetric) N3 (emergenc*)
S11  (MH "Postnatal Period") OR (MH "Postnatal Care")
S10  (MH "Perinatal Care")
S9   (MH "Prenatal Care")
S8   (MH "Pregnancy Complications")
S7   (pregnancy or pregnant)
S6   (intrapartum or postnatal or antenatal or prenatal or perinatal)
S5   maternity
S4 (MH "Nurse Midwives/AM/MA/ST/UT")
S3 midwi*
S2 (MH "Maternal Health Services/AM/MA/OG/ST/UT")
S1 (MH "Midwifery/MA/OG/UT/ST")

MIDIRS
MIDIRS searched using the Ovid platform on 03/2/2016.
Search terms detailed below.
No. of records = 184
1 midwi*.mp. [mp=title, other title, abstract, heading words]
2 (intrapartum or postnatal or antenatal or prenatal or perinatal).mp. [mp=title, other title, abstract, heading words]
3 (pregnancy or pregnant).mp. [mp=title, other title, abstract, heading words]
4 (obstetric adj3 emergenc*).mp. [mp=title, other title, abstract, heading words]
5 ((pregnant or pregnancy) adj3 emergenc*).mp. [mp=title, other title, abstract, heading words]
6 critical care.mp. [mp=title, other title, abstract, heading words]
7 high dependency care.mp. [mp=title, other title, abstract, heading words]
8 high dependency unit.mp. [mp=title, other title, abstract, heading words]
9 intensive care.mp. [mp=title, other title, abstract, heading words]
10 intensive therapy unit.mp. [mp=title, other title, abstract, heading words]
11 exp Maternity hospitals/
12 exp Midwives/ or exp Staff midwives/ or exp Named midwives/
13 exp Emergency treatment/
14 exp Pregnancy complications/
15 exp Antenatal care/
16 exp Perinatal care/
17 exp Postnatal care/
18 exp Critical care/
19 exp Intensive care/
20 1 or 2 or 3 or 4 or 5 or 11 or 12 or 14 or 15 or 16 or 17
21 6 or 7 or 8 or 9 or 10 or 13 or 18 or 19
22 20 and 21

HMIC
Medline searched using the Ovid platform on 03/2/2016.
Search terms detailed below.
No. of records = 202
1  [Midwifery/og, ma, ut [Organization & Administration, Manpower, Utilization]]
2  midwi*.mp. [mp=abstract, heading word, title]
3  maternity.mp.
4  (intrapartum or postnatal or antenatal or prenatal or perinatal).mp. [mp=abstract, heading word, title]
5  (pregnancy or pregnant).mp. [mp=abstract, heading word, title]
6  (obstetric adj3 emergenc*).mp. [mp=abstract, heading word, title]
7  ((pregnant or pregnancy) adj3 emergenc*).mp. [mp=abstract, heading word, title]
8  1 or 2 or 3 or 4 or 5 or 6 or 7
9  critical care.mp. [mp=abstract, heading word, title]
10 high dependency care.mp. [mp=abstract, heading word, title]
11 high dependency unit.mp. [mp=abstract, heading word, title]
12 intensive care.mp. [mp=abstract, heading word, title]
13 intensive therapy unit.mp. [mp=abstract, heading word, title]
14 9 or 10 or 11 or 12 or 13
15 8 and 14
Appendix 2. Detailed study selection tables.

### Table A2.1 NICE Guideline Search.

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Details</th>
<th>Relevant to rapid review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guideline CG62 on antenatal care.</td>
<td>Specifically focused on uncomplicated pregnancies. No evidence reviewed on critical care.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline NG3 on diabetes in pregnancy.</td>
<td>No information on workforce or service configuration in terms of critical care (only in terms of diabetes management).</td>
<td>No</td>
</tr>
<tr>
<td>Guideline CG107 on hypertension in pregnancy.</td>
<td>Has a chapter on medical management of severe hypertension or severe pre-eclampsia in a critical care setting. Focused on specific treatment options: use of antihypertensives, corticosteroids, fluid balance and volume expansion, caesarean section versus induction of labour. Also provides recommendations on when level 1, level 2 and level 3 care should be implemented. But no information on workforce or service configurations.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline PH11 on maternal and child nutrition</td>
<td>Critical care settings not considered in guidance.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline CG129 on antenatal care for twin and triplet pregnancies</td>
<td>Does not appear to have any information on critical care management for women with multiple pregnancies. However, full guideline not available – re-check.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline CG110 on pregnancy and complex social factors</td>
<td>No evidence reviewed on critical care for mother (only NICU).</td>
<td>No</td>
</tr>
<tr>
<td>Guideline NG25 on preterm labour and birth</td>
<td>No evidence reviewed on critical care management for mother (focused on treatments to prevent/manage preterm labour).</td>
<td>No</td>
</tr>
<tr>
<td>Guideline PH26 on smoking in pregnancy.</td>
<td>No evidence reviewed on maternal critical care.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline PH27 on weight management before, during and after pregnancy</td>
<td>No evidence reviewed on maternal critical care.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline on ectopic pregnancy and miscarriage</td>
<td>Does have information on service configuration but only in relation to EPAU.</td>
<td>No</td>
</tr>
<tr>
<td>Guideline CG192 on antenatal and postnatal mental health.</td>
<td>Does have information on service configuration but only in relation to mother and baby units. No evidence reviewed on critical care.</td>
<td>No</td>
</tr>
</tbody>
</table>
Guideline NG4 on safe midwifery staffing for maternity settings

Contains 3 evidence reviews:
- Approaches (including tool kits) for identifying midwifery staffing requirements. No evidence reviewed on critical care.
- Factors affecting staffing levels. Did aim to identify evidence on requirements for midwives to provide high dependency care but none identified
- Economic review on staffing requirements. Did aim to identify evidence related to high dependency care but none identified

Guideline CG37 on postnatal care

No evidence reviewed on maternal critical care

Guideline CG132 on C-Section

Does provide evidence on admissions to critical care settings post CS but no evidence on service or workforce configuration

Guideline CG70 on inducing labour

No evidence reviewed on maternal critical care

---

Table A2.2 Cochrane Pregnancy and Childbirth Group Search.

<table>
<thead>
<tr>
<th>Title</th>
<th>Exclude/Include</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doswell et al. 2009. Antenatal day care units versus hospital admission for women with pregnancy complications.</td>
<td>Exclude</td>
<td>Not maternity critical care. Women were stable attending day care or were cared for in a non-critical care setting.</td>
</tr>
<tr>
<td>Moore et al., 2012. Skin-to-skin contact between a mother and her baby at birth reduces crying, and helps the mother to breastfeed successfully.</td>
<td>Exclude</td>
<td>No consideration of women in critical care settings</td>
</tr>
<tr>
<td>Hodnet et al., 2012. Alternative versus conventional institutional settings for birth</td>
<td>Exclude</td>
<td>Only women at low risk of obstetric complications included. Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td>Bond et al., 2015. Immediate delivery or expectant management of the term baby with suspected fetal compromise for improving pregnancy outcomes.</td>
<td>Exclude</td>
<td>Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td>Stock et al., 2012. Immediate or deferred delivery of the preterm</td>
<td>Exclude</td>
<td>Management in maternal critical care settings not detailed.</td>
</tr>
<tr>
<td>Baby with suspected fetal compromise for improving outcomes</td>
<td>Exclude</td>
<td>No studies with women in critical care settings</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>---------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Becker et al., 2015. Methods of milk expression for lactating women.</td>
<td>Exclude</td>
<td>No studies with women in critical care settings</td>
</tr>
<tr>
<td>Jaafar et al., 2012. Separate care for new mother and infant versus rooming in for increasing duration of breastfeeding.</td>
<td>Exclude</td>
<td>No studies with women in critical care settings</td>
</tr>
<tr>
<td>Carlin et al., 2008. Interventions for treating pregnant women or new mothers with heart failure of unknown cause (peripartum cardiomyopathy).</td>
<td>Exclude (unless review updated with more studies).</td>
<td>Review would meet inclusion criteria as does include intensive care as an intervention. However, only 1 study identified and that was specifically focused on pharmacotherapy.</td>
</tr>
<tr>
<td>Churchill et al., 2013. Interventionist versus expectant care for severe pre-eclampsia before term.</td>
<td>Exclude</td>
<td>Did include women in critical care settings but no information on workforce or service configuration</td>
</tr>
<tr>
<td>Magee et al., 2013. Prevention and treatment of postpartum hypertension.</td>
<td>Exclude</td>
<td>Did include women in critical care settings but focused on pharmacotherapy</td>
</tr>
<tr>
<td>Woudstra et al., 2010. Corticosteroids for HELLP syndrome in pregnancy.</td>
<td>Exclude</td>
<td>Did include women in critical care settings but no information on workforce or service configuration</td>
</tr>
<tr>
<td>Duley et al., 1999. Plasma volume expansion for treatment of pre-eclampsia.</td>
<td>Exclude</td>
<td>Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td>Bain et al., 2014. Interventions for managing asthma in pregnancy.</td>
<td>Exclude</td>
<td>Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td>Hofmeyr et al., 2015. Planned caesarean section for a twin pregnancy.</td>
<td>Exclude</td>
<td>Did include women in critical care settings but no information on workforce or service configuration</td>
</tr>
<tr>
<td>Abdel-Aleem et al., 2015. Use of nitroglycerin to deliver a retained placenta.</td>
<td>Exclude</td>
<td>Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td>Mousa at al., 2014. Treatment for excessive bleeding after childbirth.</td>
<td>Exclude</td>
<td>Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td>El Senoun et al., 2014. Planned home versus hospital care for rupture of the membranes before 37 weeks' gestation.</td>
<td>Exclude</td>
<td>Maternal ICU admission only reported in terms of being an outcome.</td>
</tr>
<tr>
<td><strong>Guideline</strong></td>
<td><strong>Details</strong></td>
<td><strong>Relevant to rapid review</strong></td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Antepartum haemorrhage</td>
<td>Describes recommendations for clinical management of APH. No detail provided on service or workforce configurations of critical care</td>
<td>No</td>
</tr>
<tr>
<td>Blood transfusions in obstetrics</td>
<td>Describes which blood products should be used. No detail provided on service or workforce configurations of critical care</td>
<td>YES</td>
</tr>
<tr>
<td>Maternal collapse</td>
<td>Describes management of maternal collapse. States who should be on the team managing the woman</td>
<td>Yes</td>
</tr>
<tr>
<td>Placenta praevia</td>
<td>Describes clinical management. Workforce information limited to grade of obstetrician.</td>
<td>No</td>
</tr>
<tr>
<td>Postpartum haemorrhage</td>
<td>Describes clinical management. Workforce information limited to grade/numbers of obstetricians</td>
<td>No</td>
</tr>
<tr>
<td>Bacterial sepsis following pregnancy</td>
<td>Describes clinical management. Workforce information limited to involvement of other clinical teams (e.g. microbiology) and where they should be managed (i.e. ICU)</td>
<td>Yes</td>
</tr>
<tr>
<td>Bacterial sepsis in pregnancy</td>
<td>Describes clinical management. Workforce information limited to involvement of other clinical teams (e.g. microbiology) and where they should be managed (i.e. ICU)</td>
<td>Yes</td>
</tr>
<tr>
<td>Thromboembolic disease in pregnancy and the puerperium: acute management</td>
<td>Describes clinical management. Workforce information limited to involvement of other clinical teams</td>
<td>No</td>
</tr>
<tr>
<td>Tubal pregnancy</td>
<td>Describes clinical management. Service configuration limited to EPAUs.</td>
<td>No</td>
</tr>
<tr>
<td>Umbilical cord prolapse</td>
<td>Describes clinical management. No detail provided on service or workforce configurations of critical care</td>
<td>No</td>
</tr>
<tr>
<td>Safer Childbirth</td>
<td>Details standards for the organisation and Delivery of Care in Labour. Provides some information on critical care provision, although mainly just statements.</td>
<td>Yes</td>
</tr>
<tr>
<td>Standards for Maternity Care</td>
<td>No information on service or workforce configurations of critical care</td>
<td>No</td>
</tr>
<tr>
<td>Good practice guidance on the reconfiguration of women’s services.</td>
<td>Describes workforce configuration for critically ill pregnant women</td>
<td>Yes</td>
</tr>
<tr>
<td>High quality women’s health care</td>
<td>No information on service or workforce configurations of critical care</td>
<td>No</td>
</tr>
<tr>
<td>Providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman</td>
<td>Describes workforce configuration for critically ill pregnant women Describes models of care for critically ill women from Providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman report</td>
<td>Yes</td>
</tr>
<tr>
<td>Document</td>
<td>Group/ Author/ Organisation</td>
<td>Details</td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>State of Maternity Services Report</td>
<td>RCM</td>
<td>Details number of women requiring maternity care number of midwives needed to provide this. No detail on critical care</td>
</tr>
<tr>
<td>UK National Core Competencies for Post-anaesthesia Care</td>
<td>Royal Colleges of Anaesthetists (RCOA)</td>
<td>Details competencies for providing post-anaesthesia care. No detail on pregnant or recently pregnant women</td>
</tr>
<tr>
<td>AABGI Safety Guideline. Immediate Post-Anaesthesia Recovery 2013. AAGBI London 2013.</td>
<td>RCOA</td>
<td>Details post-anaesthesia recovery. No detail on pregnant or recently pregnant women</td>
</tr>
<tr>
<td>Support Overdue: Women’s experiences of maternity services</td>
<td>The National Federation of Women’s Institutes (NFWI) &amp; NCT</td>
<td>Report which explored women and their families’ experiences of pregnancy and childbirth. No detail provided on women requiring critical care</td>
</tr>
<tr>
<td>UK Obstetric Surveillance System (UKOSS) Annual Report 2013</td>
<td>RCOG &amp; NPEU</td>
<td>Report details incidence of rare conditions in pregnancy. No detail provided on provision of care</td>
</tr>
<tr>
<td>Dignity in Childbirth: The Dignity Survey 2013: Women’s and midwives’ experiences of dignity in UK maternity care</td>
<td>NHS Lothian</td>
<td>Commentary</td>
</tr>
<tr>
<td>Having a Baby in Scotland 2013: Women’s Experiences of Maternity Care - National Report</td>
<td>NHS Scotland</td>
<td>Results of 2013 survey on women’s experiences of maternity services. No detail from women receiving critical care services</td>
</tr>
<tr>
<td>OAA / AAGBI Guidelines for Obstetric Anaesthetic Services</td>
<td>OAA / AAGBI Obstetric Anaesthetists’ Association / Association of Anaesthetists of GB &amp; Ireland</td>
<td>Provides some recommendations on staffing around women requiring critical care</td>
</tr>
<tr>
<td>Study</td>
<td>Author</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The European Perinatal Health Report Health and Care of Pregnant Women and Babies in Europe in 2010</td>
<td>Euro Peristat</td>
<td>Provides information on number of women requiring intensive care but no detail on care organisation</td>
</tr>
<tr>
<td>Safe Births: Everybody’s business: An Independent Inquiry into the Safety of Maternity Services in England</td>
<td>Kings Fund</td>
<td>Does describe training to manage emergency situations but no detail on provision of critical care</td>
</tr>
<tr>
<td>Safe Births: Everybody’s business: An Independent Inquiry into the Safety of Maternity Services in England</td>
<td>MBRRACE</td>
<td>UK confidential enquiry into maternal deaths. Has information on management of critically unwell women.</td>
</tr>
<tr>
<td>Safe Births: Everybody’s business: An Independent Inquiry into the Safety of Maternity Services in England</td>
<td>MBRRACE</td>
<td>UK confidential enquiry into maternal deaths. Has information on management of critically unwell women.</td>
</tr>
<tr>
<td>Scottish Confidential Audit of Severe Maternal Morbidity: reducing avoidable harm 10th annual report</td>
<td>Health Improvement Scotland</td>
<td>Scottish audit of maternal morbidity and mortality. Does have information on numbers requiring critical care but none on maternity critical care provision.</td>
</tr>
</tbody>
</table>
### Appendix 3. Critical Appraisal of Guidelines

#### Table A3 Checklist for a set of clinical guidelines

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did the preparation and publication of these guidelines involve a significant conflict of interest?</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2. Are the guidelines concerned with an appropriate topic, and do they state clearly the goal of ideal treatment in terms of health and/or cost outcome?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>3. Was a specialist in the methodology of secondary research (e.g. meta-analyst) involved?</td>
<td>N</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>4. Have all the relevant data been scrutinised and are guidelines’ conclusions in keeping with the data?</td>
<td>N</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>5. Do they address variations in clinical practice and other controversial areas (e.g. optimum care in response to genuine or perceived underfunding)?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>7. Are they clinically relevant, comprehensive and flexible?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>8. Do they take into account what is acceptable to, affordable by and practically possible for patients?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>9. Do they include recommendations for their own dissemination, implementation and periodic review?</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>
Appendix 4. Suggested equipment list for Maternal High Dependency Unit

Suggested equipment as detailed by the Maternity Critical Care Working Group (2011):

- Monitor for Pulse, Blood Pressure, ECG, SaO2 and with transducer facility for invasive monitoring
- Equipment for insertion and management of invasive monitoring (arterial and CVP)
- 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 (if not available on hospital intranet)
- Resuscitation trolley with defibrillator and airway management equipment

*These items may already be available in theatres on delivery suite.
### Appendix 5. Levels of Intrapartum Care by Location and Childbirth

**Table A5 Levels of intrapartum care by location and childbirth (EGAMS, 2003, p.5)**

<table>
<thead>
<tr>
<th>Level of Care</th>
<th>Location of Delivery</th>
<th>Lead Carer</th>
<th>Clinical Situation</th>
<th>Care need and delivery</th>
<th>Suggested no. of deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia</td>
<td>Home (planned)</td>
<td>Midwife (GP)</td>
<td>Normal pregnancy and labour</td>
<td>Suitable home facility with back-up from the Scottish Ambulance Service (paramedics) and supporting advice from a linked maternity unit</td>
<td></td>
</tr>
<tr>
<td>Ib</td>
<td>Stand-alone community maternity unit</td>
<td>Midwife (GP)</td>
<td>Normal pregnancy and labour</td>
<td>Appropriately equipped midwifery unit for normal care and agreed transfer guidelines to a linked maternity unit</td>
<td></td>
</tr>
<tr>
<td>Ic</td>
<td>Community maternity unit adjacent to nonobstetric hospital</td>
<td>Midwife (GP)</td>
<td>Normal pregnancy and labour</td>
<td>As Ib above. Medical staff (surgeon/GP) appropriately trained to perform emergency caesarean section</td>
<td></td>
</tr>
<tr>
<td>Id</td>
<td>Community maternity unit adjacent to maternity unit</td>
<td>Midwife (GP)</td>
<td>Normal pregnancy and labour</td>
<td>As Ib above</td>
<td></td>
</tr>
<tr>
<td>IIa</td>
<td>Consultant-led maternity unit with no neonatal facil</td>
<td>Consultant Obstetrician (plus midwife)</td>
<td>Low risk pregnancy and labour</td>
<td>Maternity unit care with monitoring facilities and anaesthetic cover with no access to paediatric facilities on site</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>IIb</td>
<td>Consultant-led maternity unit with on-site neonatal facil</td>
<td>Consultant Obstetrician (plus midwife)</td>
<td>Low to medium risk pregnancy and labour</td>
<td>Maternity unit care with monitoring facilities, access to anaesthetic and paediatric cover, but transferring out as required to special care baby unit or neonatal intensive care in a larger maternity unit</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>IIc</td>
<td>Consultant-led maternity unit</td>
<td>Consultant Obstetrician (plus midwife)</td>
<td>Low and most high risk pregnancies and labour</td>
<td>Full maternity unit and support services with easy access to special care baby unit/neonatal intensive care and access to adult high dependency care and adult intensive care</td>
<td>1,000-3,000 or more</td>
</tr>
<tr>
<td>III</td>
<td>Consultant-led specialist maternity unit</td>
<td>Consultant Specialist in Maternal Fetal Medicine (Midwives /others)</td>
<td>Complex and high risk pregnancies and labour</td>
<td>As for level IIc, but with on-site neonatal intensive care and access to neonatal surgery and adult intensive care</td>
<td>&gt;3,000</td>
</tr>
</tbody>
</table>
References


KNIGHT, M., HENDERSON, J. & KURINCZUK, J. J. 2015b. Systematic review and case studies to assess models of consultant resident cover and the outcomes of intrapartum care; and two international case studies of the delivery of maternity care. Oxford.


MATERNAL CRITICAL CARE WORKING GROUP 2011. Providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman. OAA, RCoA, RCOG, 7.


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RCOG 2013. Reconfiguration of women's services in the UK. Good Practice No. 15. London.