Maternal, Newborn and Infant Clinical Outcome Review Programme

MBRRACE-UK
Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK

Saving Lives, Improving Mothers' Care

State of the Nation Themed Report

Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths from infection, neurological, haematological, respiratory, endocrine, gastrointestinal and general surgical causes 2019-21

October 2023

HQIP Healthcare Quality Improvement Partnership
University of Leicester
University of Birmingham
The Newcastle upon Tyne Hospitals NHS Foundation Trust
TIMMS
Sands Stillbirth & neonatal death charity
Chelsea and Westminster Hospital NHS Foundation Trust
University of Oxford
Oxford Population Health
NPEU

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Contents

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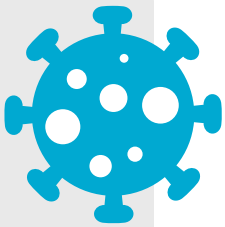
Key messages

from the themed mortality enquiry report 2023

MBRRACE-UK
Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK

Treat pregnant, recently pregnant, and breastfeeding women the same as a non-pregnant person unless there is a very clear reason not to.

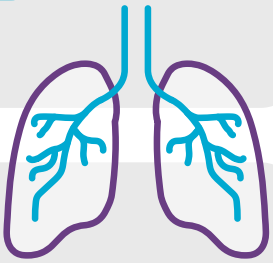
Prepare a route for rapid delivery of advice and data on new vaccines and treatments



Include in medicine and vaccine research

Tailor care after pregnancy to a woman's individual needs

Equity for pregnant and breastfeeding women



Include in guidance for admission to ECMO* services

*ECMO = Extracorporeal membrane oxygenation

Ensure staff in maternal medicine networks have the skills to care for complex physical, mental and social care needs

Develop training resources to promote shared decision making and counselling on medication use

1. Introduction and methods

Important note **NEW FOR 2023.** In accordance with funder requirements, the findings of the MBRRACE-UK Confidential Enquiry into Maternal Deaths and Morbidity (CEMD) are now presented as multiple outputs instead of one report as produced previously. The following outputs are now required to be produced in 2023:

1. An online Data Brief with basic statistics concerning maternal mortality published in advance of the reports. In 2023 this includes information on women who died between 2019 and 2021.
2. A State of the Nation surveillance report with extended details concerning maternal mortality and the characteristics of women who died. In 2023 this includes information on women who died between 2019 and 2021. Online supplementary material with the full data is also available.
3. A State of the Nation themed confidential enquiry report concerning women who died from specific causes and from selected severe morbidities. In 2023 this includes information on women who died from obstetric haemorrhage, amniotic fluid embolism and anaesthetic causes between 2019 and 2021 and women with morbidity following repeat caesarean birth and five national recommendations. Online supplementary material is also available.
4. A State of the Nation themed confidential enquiry report concerning women who died from specific causes. In 2023 this includes information on women who died from infection, neurological, haematological, respiratory, endocrine, gastro-intestinal and general surgical causes between 2019 and 2021 **(THIS REPORT)** and five national recommendations. Online supplementary material is also available.

Together these comprise all the information that was previously included in the single report. Background, aims and scope of work, and details of methods and authors for the sections on different topics are available in online supplementary material at: ***www.npeu.ox.ac.uk/mbrrace-uk/reports***.

Key to colour coding

Vignettes concerning the care of women who died are described in blue boxes

Vignettes concerning the care of women who had severe morbidity but survived are described in purple boxes with the character M in the corner M

New national recommendations are presented in purple boxes with the character N in the corner N

All existing guidance requiring improved implementation is presented in green boxes in the online supplementary material for this report NICE 2345

2. National recommendations

1. Ensure that pregnant and breastfeeding women are not excluded inappropriately from research, including new vaccine and treatment research, and ensure that messaging about benefits and risks of medication and vaccine use is clear and well informed with involvement of key opinion leaders and representatives of communities at risk from an early stage. Prepare a route to enable rapid dissemination of updated advice and data concerning new vaccines and treatments to both women and their clinicians in the future. **ACTION: Department of Health and Social Care and equivalents in Scotland, Wales and Ireland, UK Health Security Agency and equivalents in Scotland, Wales and Ireland, National Institute for Health Research and other funding agencies, Royal College of Obstetricians and Gynaecologists, Royal College of Midwives, Royal College of Physicians, Royal College of General Practitioners**
2. Update guidance on ECMO for severe acute respiratory failure in adults to include specific information on referral and admission of pregnant and recently pregnant women with respiratory failure to ECMO services. **ACTION: National Institute for Health and Care Excellence (NICE)**
3. Ensure that staff working within maternal medicine networks are equipped with the skills to care for the complex and multiple medical, surgical, mental health and social care needs of the current maternity population. **ACTION: Maternal Medicine Networks**
4. Ensure that guidance on care for pregnant women with complex social factors is updated to include a role for networked maternal medical care and postnatal follow-up to ensure that it is tailored to women's individual needs and that resources in particular target vulnerable women with medical and mental health co-morbidities and social complexity. **ACTION: National Institute for Health and Care Excellence (NICE)**
5. Develop training resources concerning shared decision making and counselling regarding medication use in pregnancy and breastfeeding, including specific information on the benefits and risks of different medications and non-adherence. **ACTION: Royal College of Obstetricians and Gynaecologists, Royal College of Midwives, Royal College of Physicians, Royal College of General Practitioners, Medicines and Healthcare Products Regulatory Agency**

3. Key messages

Note that more in-depth analysis is available at: ***www.npeu.ox.ac.uk/mbrrace-uk/reports***

3.1 Infection

3.1.1 The women who died

In the UK and Ireland 78 women died from sepsis during 2019 to 2021, defined in the broadest sense as death from a primary infective cause. Twenty-two of these women died more than 42 days after the end of pregnancy. This represents a maternal mortality rate from sepsis during or up to 6 weeks after pregnancy in the UK and Ireland of 2.50 per 100,000 maternities (95% CI 1.89 to 3.25 per 100,000).

In total, sixteen women died from direct causes. Ten women died from genital tract sepsis: two women died from postnatal group A Streptococcus (GAS) infection, one after a miscarriage and one after an unassisted vaginal birth; two women died following second trimester preterm prelabour rupture of the membranes, one from *E. coli* and one with no organism identified; three women died following a first trimester septic miscarriage, one caused by *E. coli, one Clostridium perfringens* and one an unknown organism; three further women died following chorioamnionitis at term. Two women died from sepsis after caesarean section. Two women died from intra-abdominal sepsis following feticide. One woman died from urinary sepsis and one from a uterine pyomyoma.

In total, 62 women died due to indirect causes. Two women died from influenza, both from influenza A, and neither had received an influenza vaccine in pregnancy. One died during or up to six weeks after the end of pregnancy while the other died nearly a year after the end of pregnancy.

A total of 45 women died from COVID-19 pneumonitis between March 2020 and December 2021. Thirty-three of these women died during or up to six weeks after the end of pregnancy and a further 12 women died more than six weeks after the end of pregnancy. Five of these twelve women caught their infection during pregnancy or up to six weeks after pregnancy but had life-sustaining care lasting into the later postnatal period. Note that women with a coincidental SARS-CoV-2 infection, but who died from other causes are NOT included in these figures. There were no maternal deaths caused by SARS-CoV-2 vaccination.

Fifteen women died from other infections. Seven women died during or up to six weeks after the end of pregnancy: three women died from pneumonia (due to group A Streptococcus, Pseudomonas and an unidentified viral infection); one woman died from group A Streptococcal meningitis; one woman died from viral myocarditis; one from HIV; and one from disseminated staphylococcal infection. Eight women died from other causes of infection between six weeks and a year after the end of pregnancy: three women died due to pneumonia (one Pneumococcal, two unknown organisms); two from pneumococcal meningitis; one from varicella zoster; one from tuberculosis; and one from sepsis following a skin infection.

Information was sufficient to assess care for all 78 women. Assessors felt that different care might have made a difference for 51 women (65%).

3.1.2 Overview of care and new lessons to be learned

Vaccination

Neither woman who died from influenza had received influenza vaccination during pregnancy. Only one woman who died from COVID-19 pneumonitis had received any vaccine doses; she received a single dose of SARS-CoV-2 vaccine in the month before she died but would have been eligible to receive the vaccine six months prior to her death. She had asked about it several times during pregnancy.

> An older ethnic minority woman, a long-term UK resident and English speaker, was admitted with COVID-19 pneumonitis in the third trimester of pregnancy four months after she became eligible for SARS-CoV-2 vaccination. She had received an influenza vaccination during pregnancy, but there was no record of SARS-CoV-2 vaccination ever having been discussed. She had an emergency caesarean birth but died a few weeks later.

A pregnant woman with known respiratory disease was eligible for SARS-CoV-2 vaccination early in the vaccination programme. Her respiratory physician advised her to contact her GP. SARS-CoV-2 vaccination was not discussed with her again until five months later, when she accepted it. She contracted COVID-19 and died shortly afterwards.

An extremely high-risk pregnant woman became eligible for SARS-CoV-2 vaccination very early in the vaccination programme. SARS-CoV-2 vaccination was discussed but she was undecided at this time. She died from COVID-19 pneumonitis three months later.

Twenty-seven women who died from COVID-19 pneumonitis were eligible and could have received two doses of vaccine before they died. Some were documented to have received pertussis and/or influenza vaccines but either declined SARS-CoV-2 vaccination, or there was no documentation that SARS-CoV-2 vaccination had been discussed. Even late in the pandemic, discussion of SARS-CoV-2 vaccination was not documented, despite clear evidence of vaccination against other conditions being discussed and administered. The confused messaging due to lack of research evidence and consequent widespread vaccine hesitancy amongst clinicians and pregnant and post-partum women, notably amongst those from disadvantaged backgrounds and ethnic minority groups, has been well documented (Freeman, Loe et al. 2022, Mhereeg, Jones et al. 2022, Skirrow, Barnett et al. 2022, Stock, Carruthers et al. 2022). These women's deaths are evidence of the consequences. It is not clear, however, that plans are in place to prevent similar issues occurring in the future.

Ensure that pregnant and breastfeeding women are not excluded inappropriately from research, including new vaccine and treatment research, and ensure that messaging about benefits and risks of medication and vaccine use is clear and well informed with involvement of key opinion leaders and representatives of communities at risk from an early stage. Prepare a route to enable rapid dissemination of updated advice and data concerning new vaccines and treatments to both women and their clinicians in the future N

Management of COVID-19

An unvaccinated woman was admitted with worsening COVID-19 in the late second trimester of pregnancy. She had been eligible for vaccination for several months but there was no documented discussion about SARS-CoV-2 vaccination in her records. She underwent a category 3 caesarean birth in the late evening. She appeared to be improving initially, self-ventilating on high flow nasal oxygen but had a respiratory rate of 40-50 with worsening oxygen saturations, so non-invasive ventilation was commenced. She developed pneumomediastinum and a pneumothorax. On day 5 post-natal, an ECMO referral was declined because the ECMO team felt that maximal ventilation had not been achieved, so she was intubated and ventilated. When she deteriorated further and re-referral for ECMO was made, she was declined again because she had been ventilated for 8 days by that point. Her condition continued to deteriorate, and she died of COVID-19 pneumonitis three weeks after giving birth.

The care and advice women received with regards to ECMO was highly variable, both amongst women who died from COVID-19 pneumonitis and from other causes of respiratory failure considered in different sections of this report, such as pancreatitis. Some women were never referred for consideration of ECMO, some were referred and advised that it was too early in the course of their illness for ECMO to be considered, and then were re-referred, as for this woman, to be told that they were now too unwell or had received mechanical ventilation with high levels of inspired oxygen for 7 days or more and so were no longer eligible according to referral criteria at the time. Others were referred very late in the course of their disease, at which stage the ECMO centre teams felt that they would be unlikely to benefit. This was coupled with ongoing highly variable medical management of COVID-19, with pregnant and recently pregnant women denied basic evidence-based medical treatments such as steroids and tocilizumab for COVID-19 (Horby, Lim et al. 2021, RECOVERY Collaborative Group 2021) simply because of pregnancy. There was significant uncertainty amongst medical teams not familiar with care of unwell pregnant and lactating women, with respect to both imaging and treatments. The role and value of ECMO, as well as medical management of COVID-19, once again illustrates the challenges in communication across specialties and geographical sites, which

impacts negatively on care for pregnant women. Clear guidance concerning the management of COVID-19 in pregnancy existed (Royal College of Obstetricians and Gynaecologists and The Royal College of Midwives 2022), and a consensus statement and NICE guidance concerning the referral and admission of the general population to the NHS ECMO service has been published (Camporota, Meadows et al. 2021)(National Institute for Health and Care Excellence 2011). However, the highly variable practice observed after publication of these guidelines indicates that they are not applied equitably to pregnant and recently pregnant women.

Update guidance on ECMO for severe acute respiratory failure in adults to include specific information on referral and admission of pregnant and recently pregnant women with respiratory failure to ECMO services **N**

3.1.3 Recurring lessons to be learned

The importance of coherent care with women's needs placed at the centre was a recurrent theme in the reviews; this entails the right specialities available at her point of care, timely senior involvement and senior "helicopter view". Another element was the importance of communication, within and between teams and between services, such as specialist and community care.

The following messages echo previous reports: act on red flag signs of sepsis at presentation or during the course of the disease (UK Sepsis Trust 2016) and consider early initiation of antibiotic treatment, and then discontinue if bacterial infection not confirmed. The reviewers emphasised the importance of recognising symptoms of infection after invasive procedures and also pending planned induction (National Institute for Health and Care Excellence 2016). Pregnant and recently pregnant women also need access to GP care and triage in the community, and reviewers stressed that clinical examination is important in all settings (National Institute for Health and Care Excellence 2016).

Supporting evidence available as supplementary material at: ***www.npeu.ox.ac.uk/mbrrace-uk/reports***

3.2 General medical and surgical conditions

3.2.1 The women who died

Twenty-one women died in the UK and Ireland between 2019-21 during pregnancy or up to 42 days after pregnancy from general medical and surgical conditions not considered elsewhere ("other indirect causes"). This represents an overall mortality rate of 0.94 (95% CI 0.58-1.43) per 100,000 maternities in the UK and Ireland. A further 22 women died between 42 days and a year after the end of pregnancy.

Fourteen women died from endocrine causes: eight had diabetes, five of whom died from diabetic ketoacidosis, one from hypoglycaemia and two from long-term complications of diabetes; two died from Addison's disease; other women died from a phaeochromocytoma, hyponatraemia, metabolic myopathy and severe hypertension. Six women died while pregnant or within six weeks after the end of pregnancy.

Seven women died due to haematological causes: three women died due to thrombotic thrombocytopenic purpura (TTP); two due to haemophagocytic lymphohistiocytosis (HLH); other women died from a thrombotic microangiopathy, and occlusive vasculopathy. Five women died while pregnant or within six weeks after the end of pregnancy.

Two women died from connective tissue disorders, both between six weeks and a year after the end of pregnancy. Five women died from respiratory disorders: four from asthma and one from interstitial lung disease; two women died while pregnant or within six weeks after the end of pregnancy. Six women died from gastrointestinal disorders: four from pancreatitis; other women died from bowel perforation and autoimmune hepatitis; all these women died between six weeks and a year after the end of pregnancy. Six women died from spontaneous intra-abdominal bleeding: four due to splenic artery aneurysmal rupture and two from other bleeding sources; all these women died while pregnant or within six weeks after the end of pregnancy. The causes of death of three women were unascertained, largely due to absent or low-quality postmortem examination, but felt most likely to be due to indirect causes by assessors. Two of these women died while pregnant or within six weeks after the end of pregnancy.

Information was sufficient to assess care for all 43 women. Assessors felt that different care might have made a difference for 20 women (47%).

3.2.2 Overview of care and new lessons to be learned

Complex care needs

A primiparous woman was known to have adrenal insufficiency prior to pregnancy. She had admissions with adrenal crises before pregnancy and several documented episodes in pregnancy. She saw her endocrinologist regularly who increased her medication and ensured a supply of emergency hydrocortisone. The endocrinologist documented repeatedly that she had severe nausea and vomiting from early in the first trimester. No plan was made for comprehensive antiemetic therapy despite the fact she was unable to keep her oral medication down on multiple occasions. There was minimal communication between the obstetric and endocrine teams. She had an uneventful labour and birth and was discharged the following day despite low sodium levels, a marker of poorly-controlled Addison's disease. She had various concerning symptoms postnatally, including further episodes of nausea and vomiting. She died from an adrenal crisis shortly after being discharged to community midwifery care.

The local hospital review identified that the lack of a local joint endocrinology-obstetric clinic adversely impacted this woman's care. Her endocrine care was provided remotely and communication between teams did not occur in a timely manner. A woman having repeated Addisonian crises in pregnancy should have had urgent endocrine review and potentially admission. Her death pre-dates development of maternal medicine networks; women with similar problems should now receive joint endocrine and obstetric care at a maternal medicine centre. Vomiting is a red flag in Addison's disease and needs to be urgently managed. Despite being very unstable, this woman was discharged postnatally with a plan for endocrinology review at 6-8 weeks, by which time she had died. The significance of her symptoms was not recognised either during pregnancy, or postnatally when she was discharged to community midwifery care.

Assessors noted that on many occasions midwives were expected to care for vulnerable women with complex and multiple conditions, including in recovery from theatre, when they had not been trained to do so. The severity of women's illnesses was therefore unrecognised. Midwifery training needs to match the complexity of the current maternity population.

Ensure that staff working within maternal medicine networks are equipped with the skills to care for the complex and multiple medical, surgical, mental health and social care needs of the current maternity population **N**

Vulnerable women and postnatal care

A vulnerable young woman with type 1 diabetes had an unplanned pregnancy. She had no financial and little emotional support. Prior to this pregnancy she had been on a paediatric insulin regime as she had not attended diabetes clinic regularly. She booked early and was converted to the adult regimen in the late first trimester, however this led to multiple hypoglycaemic episodes. She was admitted with diabetic ketoacidosis on several occasions during the pregnancy. She had a caesarean birth in the early third trimester due to poor glycaemic control. After discharge she had some midwifery visits but declined specialist health visiting for vulnerable mothers. She found social services involvement more threatening than helpful. She was admitted to hospital two months postnatally with another ketoacidotic episode but she did not have her baby with her, and self-discharged. She subsequently changed GP and never saw her new GP. She died from diabetic ketoacidosis at home a few months later.

The care of vulnerable women especially those who also have complex medical problems requires careful multidisciplinary care from all agencies. During pregnancy this woman had intensive midwifery, obstetric and diabetes care. After discharge, however, her care was more fragmented and she was unable to develop a trusting relationship with any of the multiple professionals with whom she had brief interactions. Compassionate care on occasions, for example facilitating keeping her baby with her when she was admitted to hospital, may have helped her to manage her condition better.

Many of the women who died from medical co-morbidities, particularly diabetes, were extremely vulnerable. While, as with the first woman described in this section, there was evidence that the severity of their illness was not recognised during pregnancy, women predominantly deteriorated postnatally when they received less support and/or support was not tailored to their needs.

Ensure that guidance on care for pregnant women with complex social factors is updated to include a role for networked maternal medical care and postnatal follow-up to ensure that it is tailored to women's individual needs and that resources in particular target vulnerable women with medical and mental health co-morbidities and social complexity **N**

3.2.3 Recurring lessons to be learned

General medical and surgical conditions are not infrequent among pregnant and recently pregnant women. Many messages concerning utilising expert advice, including through maternal medicine networks where these have been established, were reiterated. Pregnant and lactating women with co-morbidities should receive the same level of care as non-pregnant women unless there is a clear reason not to (Knight, Bunch et al. 2022).

There is a need to address postnatal care planning for women with comorbidities, and to ensure postnatal follow-up with evaluation of treatment for chronic conditions. Women with complex medical diseases should be offered a medical review before discharge after birth. Furthermore, clear guidance for follow-up should be communicated to the primary health care team (GP, midwife, health visitor and others). Women with co-morbidities who experience a stillbirth should have similar access to postnatal care as women who have a live baby, including GP follow-up.

3.3 Neurological causes

Supporting evidence available as supplementary material at: ***www.npeu.ox.ac.uk/mbrrace-uk/reports***

3.3.1 The women who died

In total 42 women died during or up to a year after pregnancy from neurological causes. Seventeen women died during or up to a year after the end of pregnancy in the UK and Ireland in 2019-21 from causes related to epilepsy, a mortality rate of 0.76 per 100,000 maternities (95% CI 0.44-1.22), of whom 14 died from Sudden Unexpected Death in Epilepsy (SUDEP) (mortality rate 0.63 per 100,000 maternities, 95% CI 0.34- 1.05). This is not statistically significantly lower than the rate for 2016-18 (0.74 per 100,000 maternities, 95% CI 0.44-1.18) and represents a near doubling of the rate of SUDEP between 2013-15 and 2019-21 (RR 1.96, 95% 0.77-5.39, p=0.131). None of the women who died were taking sodium valproate.

Thirteen women died from stroke during or up to six weeks after pregnancy: six from subarachnoid haemorrhage, five from intracerebral haemorrhage and two from ischaemic strokes. Three women died from other neurological causes while pregnant or within six weeks of the end of pregnancy. A further nine women died from neurological causes between six weeks and one year after the end of pregnancy (four from subarachnoid haemorrhage, three from intracerebral haemorrhage and two from other causes).

Information was sufficient to assess care for all 42 women. Assessors felt that different care might have made a difference for 11 women (26%).

3.3.2 Overview of care and new lessons to be learned

Medication concordance

A multiparous women known to have epilepsy with tonic-clonic seizures and intermittent focal seizures presented with increasing seizures at four weeks of gestation. Following discussion with the neurologist, levetiracetam was added to her lamotrigine. The woman was unable to tolerate this and reduced the dose. She was not referred to the obstetric medicine clinic after booking. The woman's medication was increased again late in the first trimester at a nurse-led clinic where the associate specialist also joined the consultation. When seen in antenatal clinic she reported ongoing seizures and was advised to contact her epilepsy specialist nurse. No direct contact was made between obstetric and neurology services. Her medication was gradually escalated by the epilepsy team throughout pregnancy, but serum levels were not measured. She continued to experience seizures and died from SUDEP in the third trimester. Serum levels of lamotrigine were low at post mortem. Levetiracetam was not detected.

It is unclear whether this woman was taking her anti-seizure medication. Concordance does not appear to have been discussed antenatally despite her seizures being difficult to control, and lamotrigine levels were not measured despite high dosages of medication and ongoing seizures. Whilst it is impossible to ensure adherence to medication, the pattern of adherence behaviour should be explored, particularly when seizures appear to be resistant to treatment.

De-prescribing or lack of concordance with medication is not a new message to be raised in these confidential enquiry reports. It was very clear in many instances of women whose care was reviewed in every section of this report, including conversations concerning vaccination, steroid use in women with asthma, and epilepsy medication, that clinicians did not feel able to hold conversations, which may need to be repeated, about non-adherence medication safety.

Develop training resources concerning shared decision making and counselling regarding medication use in pregnancy and breastfeeding, including specific information on the benefits and risks of different medications and non-adherence **N**

3.3.3 Recurring lessons to be learned

Recurring messages concerning medication use were observed in the care of women with epilepsy. While adherence with prescribed treatment was a particular theme, it was noted that baseline serum levels may also be useful for pregnant women who are prescribed anti-seizure medicines to check adherence and guide therapeutic management throughout pregnancy and the postnatal period. The need for counselling regarding SUDEP risk was frequently identified; this also included information about potential additional risk with recreational use of drugs or alcohol.

Women at particular risk of accidents, injuries or epilepsy related death should receive urgent epilepsy specialist/neurology team involvement. This includes women with history of: tonic-clonic seizures in the last 12 months, previous nocturnal or prolonged seizures, drug resistant epilepsy (Royal College of Obstetricians and Gynaecologists 2016c, National Institute for Health and Care Excellence 2022), treated with polytherapy anti-seizure medicines or co-prescribed other medicines that can lower seizure threshold (such as SSRI) (Maguire, Marson et al. 2021), lack of pre-conception counselling or previous non-attendance at neurology appointments, unplanned pregnancy, medication adherence concerns, learning disability or complex social economic factors.

A lack of pre-conception counselling, contraceptive advice and appropriate transition from paediatric to adult specialist services were recurrent themes for women with a variety of medical comorbidities across chapters.

Early specialist review, imaging and multidisciplinary involvement are also necessary for women with signs and symptoms of intracerebral disease, such as headache and vomiting, or with persistent or new neurological symptoms or signs. Persisting, acute or severe headaches and focal symptoms are red flags. For several women there was a lack of post-partum follow-up with blood pressure measurement. This echoes a recurrent message across topics in this year's report about the importance of postpartum care for the mother.

Assessors noted a need for better evidence regarding survival in out of hospital collapse and emergency/resuscitative hysterotomy.

References available as supplementary material at: ***www.npeu.ox.ac.uk/mbrrace-uk/reports***.

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