

Maternal, Newborn and Infant Clinical Outcome Review Programme



Saving Lives, Improving Mothers' Care

Core report: Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2018-20



November 2022

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Core report: Lessons learned to inform maternity
care from the UK and Ireland Confidential Enquiries
into Maternal Deaths and Morbidity 2018-20

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November 2022



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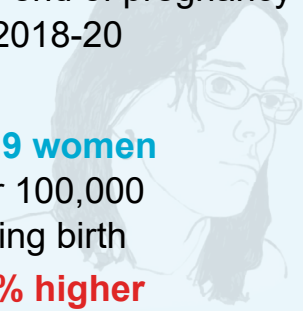
Missing Voices

Key messages from the report 2022



229 women died during or up to six weeks after the end of pregnancy in 2018-20

10.9 women per 100,000 giving birth
24% higher than 2017-19

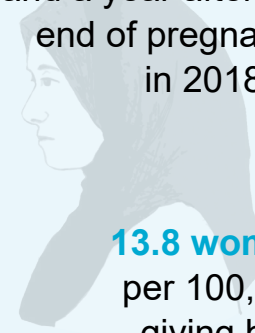


27 of their babies died
366 motherless children remain



A further **289 women** died between six weeks and a year after the end of pregnancy in 2018-20

13.8 women per 100,000 giving birth



9 women died from covid-19



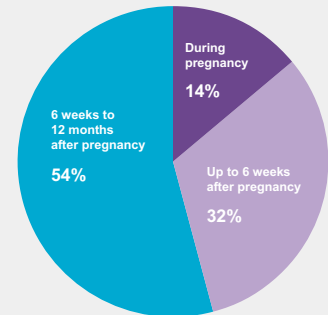
Excluding their deaths, **10.5 women** died per 100,000 giving birth

19% higher than 2017-19

1 in 9 women who died had **severe and multiple disadvantage**



Most women died in the postnatal period **86%**

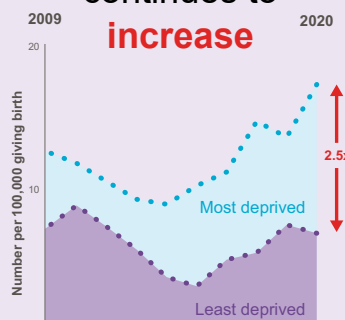


Black women were **3.7x** more likely to die than white women (**34 women** per 100,000 giving birth)

Asian women were **1.8x** more likely to die than white women (**16 women** per 100,000 giving birth)

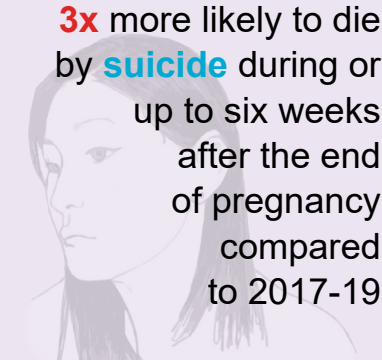


More women from **deprived areas** are dying and this continues to **increase**



In 2020, women were **3x** more likely to die by **suicide** during or up to six weeks after the end of pregnancy compared to 2017-19

1.5 women per 100,000 giving birth



Executive Summary

Introduction

This report, the ninth MBRRACE-UK annual report of the Confidential Enquiry into Maternal Deaths and Morbidity, includes surveillance data on women who died during or up to one year after pregnancy between 2018 and 2020 in the UK. In addition, it also includes Confidential Enquiries into the care of women who died between 2018 and 2020 in the UK and Ireland from cardiovascular causes, hypertensive disorders, early pregnancy disorders and accidents and the care of women who died from mental-health related causes in 2020.

The report also includes a Morbidity Confidential Enquiry into the care of women with diabetic ketoacidosis in pregnancy.

Surveillance information is included for 536 women who died during or up to one year after the end of pregnancy between 2018 and 2020. The care of 61 women with diabetic ketoacidosis in pregnancy was reviewed in depth for the Confidential Enquiry chapter.

This report can be read as a single document; each chapter is also designed to be read as a standalone report as, although the whole report is relevant to maternity staff, service providers and policy-makers, there are specific clinicians and service providers for whom only single chapters are pertinent. There are seven different chapters which may be read independently, the topics covered are: 1. Surveillance of maternal deaths 2. Mental health and multiple adversity 3. Diabetic ketoacidosis (morbidity enquiry) 4. Cardiovascular disease 5. Hypertensive disorders of pregnancy 6. Early pregnancy disorders 7. Critical care.

Methods

Maternal deaths are reported to MBRRACE-UK, NIMACH or to MDE Ireland by the staff caring for the women concerned, or through other sources including coroners, procurators fiscal and media reports. In addition, identification of deaths is cross-checked with records from the Office for National Statistics, Information Services Division Scotland and National Records of Scotland. Each woman's care is examined by between ten and fifteen multidisciplinary expert reviewers and assessed against current guidelines and standards (such as those produced by NICE or relevant Royal Colleges and other professional organisations). Subsequently the expert reviews of each woman's care are examined by a multidisciplinary writing group to enable the main themes for learning to be drawn out for the MBRRACE-UK report. These recommendations for future care are presented here, alongside a surveillance chapter reporting three years of UK statistical surveillance data.

IMPORTANT NOTE: Relevant actions are addressed to all health professionals involved in the care of women who are pregnant, have recently been pregnant or likely to become pregnant in the future as silo working leading to compromised care is a recurring theme identified in these enquiries. *The phrasing 'All Health Professionals' is used for brevity but should be taken to mean the groups noted above.* Some actions may be more pertinent to specific professional groups than others but all should nonetheless be reviewed for relevance to practice by each group.

Causes and trends

There was a statistically non-significant increase in the overall maternal death rate in the UK between 2015-17 and 2018-20. An increase occurred even when deaths due to covid were excluded which suggests that an even greater focus on implementation of the recommendations of these reports is needed to achieve a reduction in maternal deaths. **ACTION: Policy makers, service planners/commissioners, service managers, all health professionals**

There remains a more than three-fold difference in maternal mortality rates amongst women from Black ethnic backgrounds and an almost two-fold difference amongst women from Asian ethnic backgrounds compared to white women, emphasising the need for a continued focus on action to address these disparities. **ACTION: Policy makers, service planners/commissioners, service managers, all health professionals**

Psychiatric disorders and cardiovascular disorders are now responsible for the same number of maternal deaths in the UK; together these two causes represent 30% of maternal deaths. During 2020, maternal mortality directly attributable to covid-19 was at a rate comparable with that due to psychiatric and cardiovascular disorders.

There was a statistically significant increase in maternal death rates from direct causes between 2015-17 and 2018-20. Thrombosis and thromboembolism remains the leading cause of direct maternal death during or up to six weeks after the end of pregnancy.

Deaths from mental health-related causes as a whole (suicide and substance abuse) account for nearly 40% of deaths occurring within a year after the end of pregnancy with maternal suicide remaining the leading cause of direct deaths in this period. Of concern is a further rise in suicides among young women, many of whom were care leavers.

Key messages to improve care

The majority of recommendations which MBRRACE-UK assessors have identified to improve care are drawn directly from existing guidance or reports and denote areas where implementation of existing guidance needs strengthening. Actions needed for which national guidelines are not available are presented here. All recommendations based on existing guidance are presented in online supplementary material available at www.npeu.ox.ac.uk/mbrrace-uk/reports

New recommendations to improve care

For professional organisations:

1. Develop guidance for the use of Brain Natriuretic Peptide measurement in pregnancy **[ACTION: Royal Colleges of Obstetricians and Gynaecologists, Physicians]**.
2. Develop guidance on ketone testing in pregnancy and the subsequent response to an abnormal test **[ACTION: Royal Colleges of Obstetricians and Gynaecologists, Midwives, Physicians, General Practitioners]**.
3. Ensure that guidance on the management of diabetic ketoacidosis in pregnancy is included in all guidelines used outside of the maternity setting **[ACTION: Joint British Diabetes Societies for Inpatient Care]**.

For policy makers, service planners/commissioners and service managers:

4. Commissioning bodies should ensure that providers of specialist Perinatal Mental Health Teams have sufficient resource to advise, and in complex or high-risk cases, be involved, in mental health assessments when in normal working hours. **[ACTION: Service planners/commissioners, Hospitals/Trusts/Health Boards]**.
5. Consider skills and drills training on the management of diabetic ketoacidosis in pregnancy to ensure that obstetricians and midwives are aware of the symptoms and signs of diabetic ketoacidosis. **[ACTION: Hospitals/Trusts/Health Boards]**.
6. Ensure the appropriate national Maternity Early Warning Score is used to monitor a pregnant woman wherever in the hospital she receives care **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.
7. Ensure that the national Patient Group Direction allowing prescription of aspirin for pregnant women at risk of pre-eclampsia by midwives and pharmacists is widely implemented **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.
8. Ensure that women's electronic records can be easily accessed and shared when they receive care in different settings **[ACTION: National Digital Policy Teams, Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.
9. Be aware of how to contact the regional maternal medicine lead for urgent advice to ensure multidisciplinary senior review of women who are unwell. **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards, All Health Professionals]**.
10. Ensure maternal medicine networks and their equivalents in the devolved nations and Republic of Ireland can provide appropriate expertise and supervision for all women including those in rural/remote areas **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards, All Health Professionals]**.
11. Vulnerable and young women remain disproportionately represented amongst those who have died from ectopic pregnancy. Ensure care is personalised to provide appropriate additional safety measures **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.
12. Recognise the importance of a trauma history in the assessment of risk. Involve specialist Perinatal Mental Health Teams where there is a history of significant involvement with secondary mental health services or significant risk, particularly if it is a first pregnancy **[ACTION: Service planners/commissioners, service managers, health professionals]**.
13. Allow sufficient opportunity in electronic records systems for free text comment rather than relying solely on 'tick boxes'. Where a woman has a history of mental health difficulties, make a brief (as a minimum) comment on mental health **[ACTION: Service planners/commissioners, service managers, health professionals]**.

For health professionals and those designing professional education programmes:

14. Assess women with persistent and severe insomnia carefully for signs of underlying mental illness **[ACTION: All health professionals]**.
15. Access services such as Psychiatric Liaison, Crisis and Street Triage Teams should alert specialist Perinatal Mental Health Teams to any referrals of self-harm in pregnant or postpartum women that they have received to allow triage regarding the need for specialist follow-up **[ACTION: All health professionals]**.

16. Be alert to factors, such as cultural stigma or fear of child removal, which may influence the willingness of a woman or her family to disclose symptoms of mental illness, thoughts of self-harm or substance misuse **[ACTION: All health professionals, Professional education programmes]**.
17. Wheeze can be due to pulmonary oedema. Consider wheeze which does not respond to standard asthma management and exertional syncope as red flag symptoms of cardiovascular disease in addition to orthopnoea and chest pain **[ACTION: All health professionals, Professional education programmes]**.
18. Be aware of the common risk factors for heart disease and venous thromboembolism, such as extreme obesity, and consider on an individual basis whether women should be made aware of the symptoms and signs of heart disease as well as those of venous thromboembolism **[ACTION: All health professionals, Professional education programmes]**.
19. Be aware that women using oral anticoagulation with warfarin may be more safely managed without transition to low molecular weight heparin treatment when having an early termination of pregnancy **[ACTION: All health professionals, Professional education programmes]**.
20. Be aware of the added risk of fetal compromise when a woman's pregnancy is complicated by both hypertension and diabetes. It is not only babies predicted to be small for gestational age who may be at risk **[ACTION: All health professionals, Professional education programmes]**.
21. Involve the critical care team in antenatal multidisciplinary team planning for women with serious morbidity who are anticipated to require admission to intensive care after giving birth **[ACTION: All health professionals]**.

Conclusions

This report includes the surveillance information for women who died during and after pregnancy for 2018-20, which includes the first year of the Covid-19 pandemic, when there were many service-related changes. The clearest impact on maternal mortality rates has been an increase in mental health-related deaths, principally women who have died by suicide. The maternal mortality rate has risen even if women who died from Covid-19 are excluded. Across all the chapters in this report, assessors identified important messages concerning the care of women with multiple adversity and multiple morbidities, who are once again over-represented. The reviews of the care of women who died from Covid-19 are not included here, but impacts of pandemic-related service changes have been noted in several chapters reporting on the care of women who died from other conditions. The majority of women who died from Covid-19 in 2020 were from ethnic minority groups, but it is encouraging that despite this the disparity in maternal mortality rates between women from Black, Asian and Mixed ethnic groups and White women has continued to decrease slightly. Nevertheless, the maternal mortality rate amongst women who live in the most deprived areas is increasing and addressing these disparities must remain an important focus.

Acknowledgements

It is with grateful thanks that the MBRRACE-UK collaboration would like to acknowledge the contribution of the many healthcare professionals and staff from the health service and other organisations who were involved in the notification of maternal deaths, the provision of data and the assessment of individual deaths in both the UK and Ireland.

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1. Introduction and methodology

In accordance with funder requirements, this report has been considerably shortened and will no longer include an update on actions which have followed previous reports. Readers are referred to the 2016 report (Knight, Nair et al. 2016) for a full description of the methods of the confidential enquiry into maternal deaths, and to Chapter 4 for a description of the methods for this year's confidential enquiry into maternal morbidity, which focussed on diabetes and multimorbidity.

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

Recommendations based on improvements in care noted by MBRRACE reviewers for which there is no current national guidance and which has not been noted in previous guidance or reports are shown in purple boxes. Example:

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

The recommendations identified by MBRRACE reviewers as the most frequently needed improvements are highlighted in the key messages section at the start of each chapter. The specific individuals or professional groups who need to take action are indicated alongside the key messages, where appropriate.

The majority of recommendations described in MBRRACE-UK reports arise from existing national guidelines or previous reports that assessors have identified require improved implementation. For brevity and to meet funder requirements, the evidence underpinning these recommendations is no longer included within this report and is available as online supplementary material. The recommendations requiring improved implementation and the source of these recommendations are cited within green boxes at the end of each chapter. Example:

Existing guidance requiring improved implementation is presented in green boxes

NICE 2345

2. Maternal Mortality in the UK 2018-20: Surveillance and Epidemiology

Kathryn Bunch and Marian Knight

Note that more in-depth analysis is available in online supplementary material at: www.npeu.ox.ac.uk/mbrance-uk/reports

2.1 Key points

There was a statistically non-significant increase in the overall maternal death rate in the UK between 2015-17 and 2018-20. An increase occurred even when deaths due to covid were excluded which suggests that an even greater focus on implementation of the recommendations of these reports is needed to achieve a reduction in maternal deaths. **ACTION: Policy makers, service planners/commissioners, service managers, all health professionals**

There remains a more than three-fold difference in maternal mortality rates amongst women from Black ethnic backgrounds and an almost two-fold difference amongst women from Asian ethnic backgrounds compared to white women, emphasising the need for a continued focus on action to address these disparities. **ACTION: Policy makers, service planners/commissioners, service managers, all health professionals**

Eleven percent of the women who died during or up to a year after pregnancy in the UK in 2018-20 were at severe and multiple disadvantage. The main elements of multiple disadvantage were a mental health diagnosis, substance use and domestic abuse.

Psychiatric disorders and cardiovascular disorders are now responsible for the same number of maternal deaths in the UK; together these two causes represent 30% of maternal deaths. During 2020, maternal mortality directly attributable to covid-19 was at a rate comparable with that due to psychiatric and cardiovascular disorders.

There was a statistically significant increase in maternal death rates from direct causes between 2015-17 and 2018-20. Thrombosis and thromboembolism remains the leading cause of direct maternal death during or up to six weeks after the end of pregnancy.

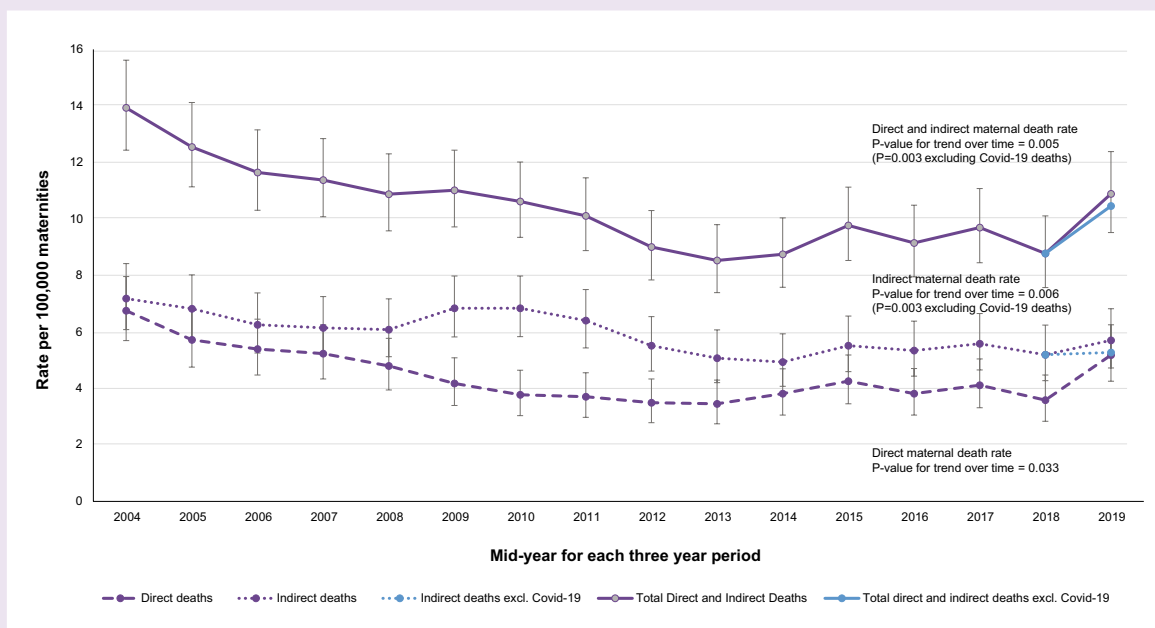
Deaths from mental health-related causes as a whole (suicide and substance abuse) account for nearly 40% of deaths occurring within a year after the end of pregnancy with maternal suicide remaining the leading cause of direct deaths in this period.

2.2 Causes and trends

Overall, 247 women died in 2018-20 during or within 42 days of the end of pregnancy in the UK. The deaths of 18 women were classified as coincidental. Thus in this triennium 229 women died from direct and indirect causes, classified using ICD-MM (World Health Organisation 2012), among 2,101,829 maternities, a maternal death rate of 10.90 per 100,000 maternities (95% CI 9.53 – 12.40). This compares to the rate of 8.79 per 100,000 maternities (95% CI 7.58 – 10.12) in 2017-19 (rate ratio (RR) 1.24, 95% CI 1.02-1.51, p=0.028). Nine of the deaths which occurred between March and December 2020 were directly attributable to Covid-19 infection. If these nine deaths are excluded, the maternal mortality rate for 2018-20 would be 10.47 (95% CI 9.13 – 11.95) still higher than the rate for 2017-19 (RR 1.19 (95%CI 0.98 – 1.45), p=0.077) but no longer significantly so.

Figure 2.1 (Table S2.1) shows rolling three-yearly maternal death rates since 2003 using ICD-MM. There remains an overall decrease in maternal death rates between 2003-05 and 2018-20 (rate ratio (RR) 0.78, 95% CI 0.65-0.93, p=0.005 for trend in rolling rates over time). The direct maternal death rate has decreased by 23% since 2003-05 with a RR of 0.77 (95% CI 0.59-0.99 p=0.036) while there was a 21% decrease in the rate of indirect maternal deaths (RR 0.79, 95% CI 0.62-1.02, p=0.059).

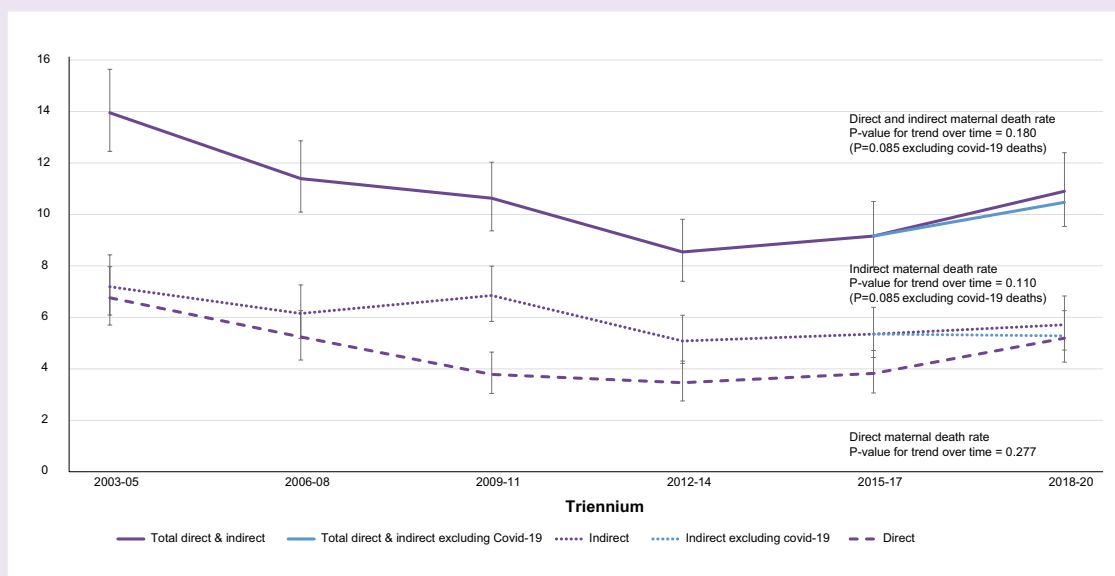
Figure 2.1: Direct and indirect maternal mortality rates per 100,000 maternities using ICD-MM and previous UK classification systems; three-year rolling average rates 2003-2020



Sources: CMACE, MBRRACE-UK

The progress towards the Government ambition in England to reduce maternal mortality by 50% between 2010 and 2025 (Department of Health 2017) can be assessed by comparing maternal death rates between the 2010-12 and 2018-20 triennia. Over this time, maternal mortality has increased by 8%, (RR 1.08, 95% CI 0.90-1.30). Excluding 2020 maternal deaths from Covid-19, maternal mortality over this period has increased by 3% (RR 1.03, 95% CI 0.86-1.27). Triennial rates are shown in Figure 2.2 (Table S2.2).

Figure 2.2: Direct and Indirect maternal mortality rates per 100,000 maternities by discrete triennia; UK 2003-2020 (using ICD-MM)

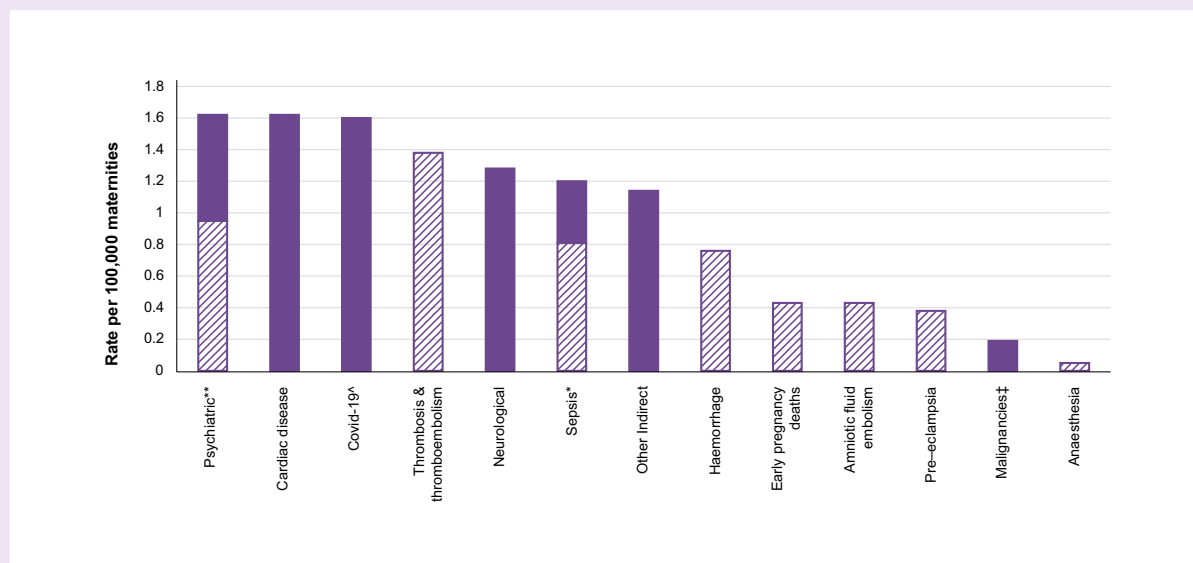


Sources: CMACE, MBRRACE-UK

Deaths due to individual causes

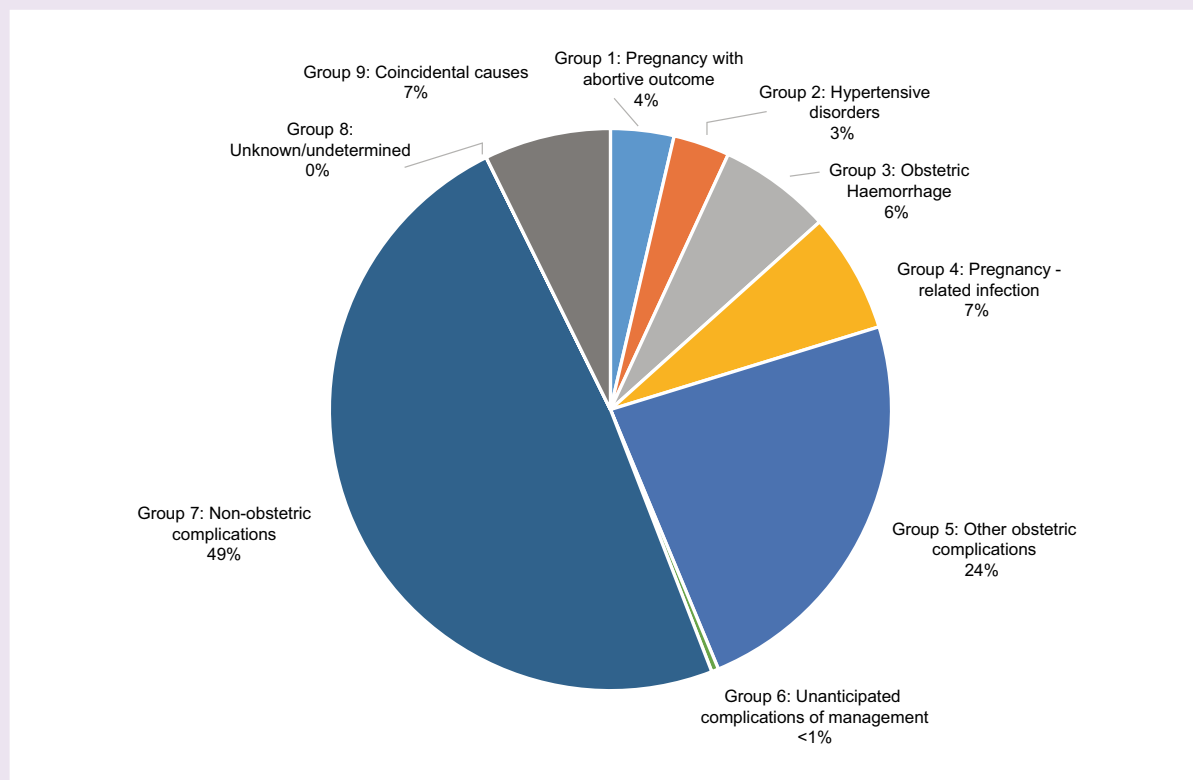
Maternal deaths by cause are shown in Figure 2.3 (Tables S2.3 and S2.4) and according to ICD-MM sub-groups are presented in Figure 2.4 (Table S2.5).

Figure 2.3: Maternal mortality by cause 2018-20



Hatched bars show direct causes of death, solid bars indicate indirect causes of death; *Rate for direct sepsis (genital tract sepsis and other pregnancy related infections) is shown in hatched and rate for indirect sepsis (influenza, pneumonia, others) in solid bar; **Rate for suicides (direct) is shown in hatched and rate for indirect psychiatric causes (drugs/alcohol) in solid bar; ‡Rate for indirect malignancies (breast/ovary/cervix); ^Rate for Covid-19 deaths calculated using maternities March to December 2020 as denominator. Source: MBRRACE-UK

Figure 2.4: Maternal mortality proportions by ICD-MM classification 2018-20



International comparison

For international comparison, the rate estimate from routine sources of data is much lower (6.04 per 100,000 live-births, 95% CI 5.04-7.18, for 2018-20, Table S2.6) than the actual rates as identified through the UK CEMD, which uses multiple sources of death identification.

Women who died between six weeks and one year after the end of pregnancy

In the triennium 2018-20, 289 women died between six weeks and one year after the end of pregnancy, representing a mortality rate of 13.7 per 100,000 maternities (95% CI 12.2 – 15.4). Rolling rates of late deaths are shown in Figure 2.5 and causes of late death in Figure 2.6.

Figure 2.5: Pregnancy-associated maternal mortality rates six weeks to one year after the end of pregnancy, UK, 2009-2020

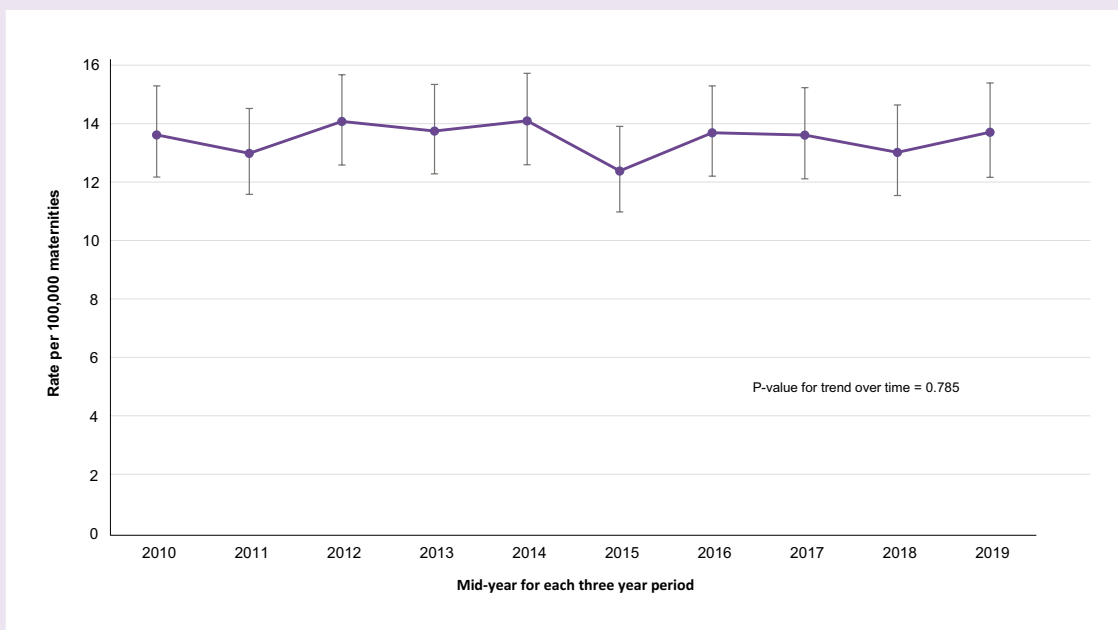
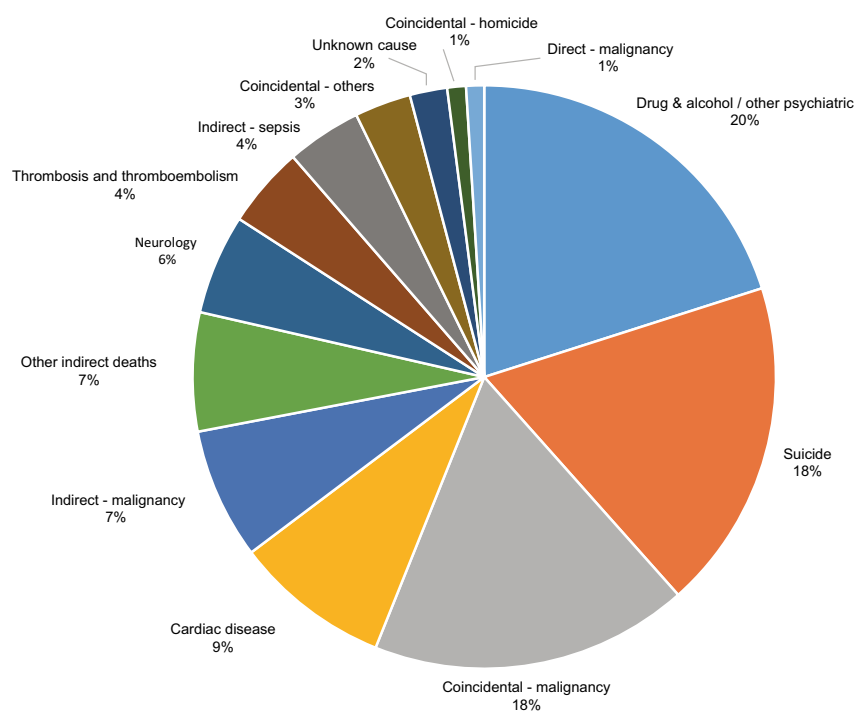


Figure 2.6: Causes of death amongst women who died between six weeks and one year after the end of pregnancy, UK 2018-20



2.3 The characteristics of women who died 2018-20

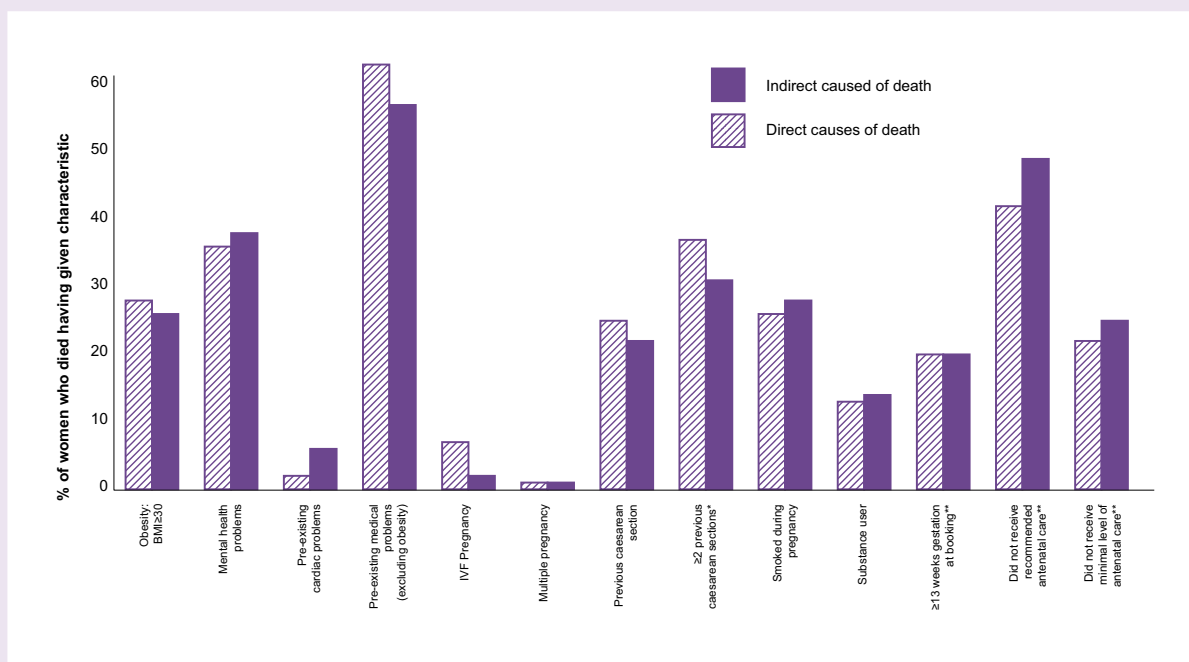
Of the 229 women who died from direct and indirect causes during or up to 42 days after the end of their pregnancy in 2018-20, 28% (64 women) were still pregnant at the time of their death and of these women 64% were ≤ 20 weeks' gestation (Table S2.7). The majority of the 142 women who gave birth did so in hospital (85%); 12% of women gave birth in an emergency department or an ambulance, and 4% at home (Table S2.8).

Socio-demographic characteristics

The socio-demographic characteristics of women who died in 2018-20 are shown in Figure 2.7 (Tables S2.9-S2.16).

Women living in the most deprived areas continue to have the highest maternal mortality rates (Figure 2.8). The risk of maternal death in 2018-20 was statistically significantly over three and a half times higher among women from Black ethnic minority backgrounds compared with white women (RR 3.68; 95% CI 2.32 to 5.65) (Figure 2.9). Women from Asian backgrounds also continued to be at higher risk than white women (RR 1.75, 95% CI 1.13 to 2.62), as were, to a lesser extent, women from mixed ethnic backgrounds (RR 1.32, 95% CI 0.35-3.47) although, because of the smaller numbers of women involved, this increased risk was not statistically significant.

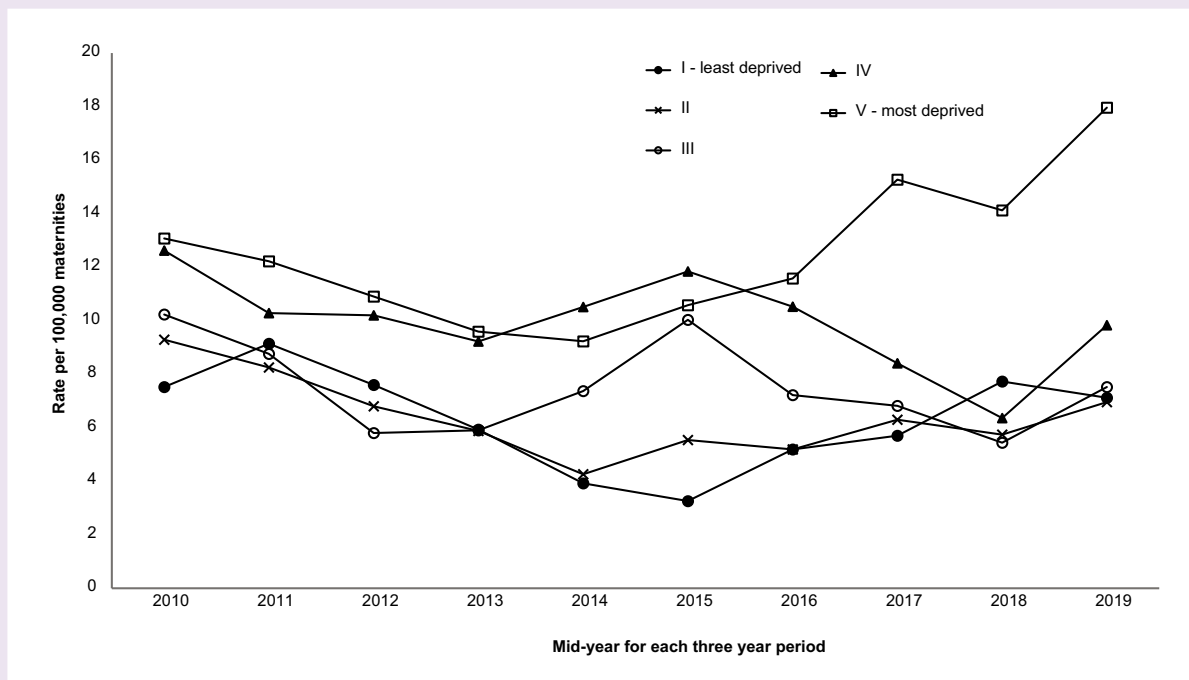
Figure 2.7: Selected characteristics of women who died from direct or indirect causes 2018-20



*Amongst women who had a previous caesarean birth

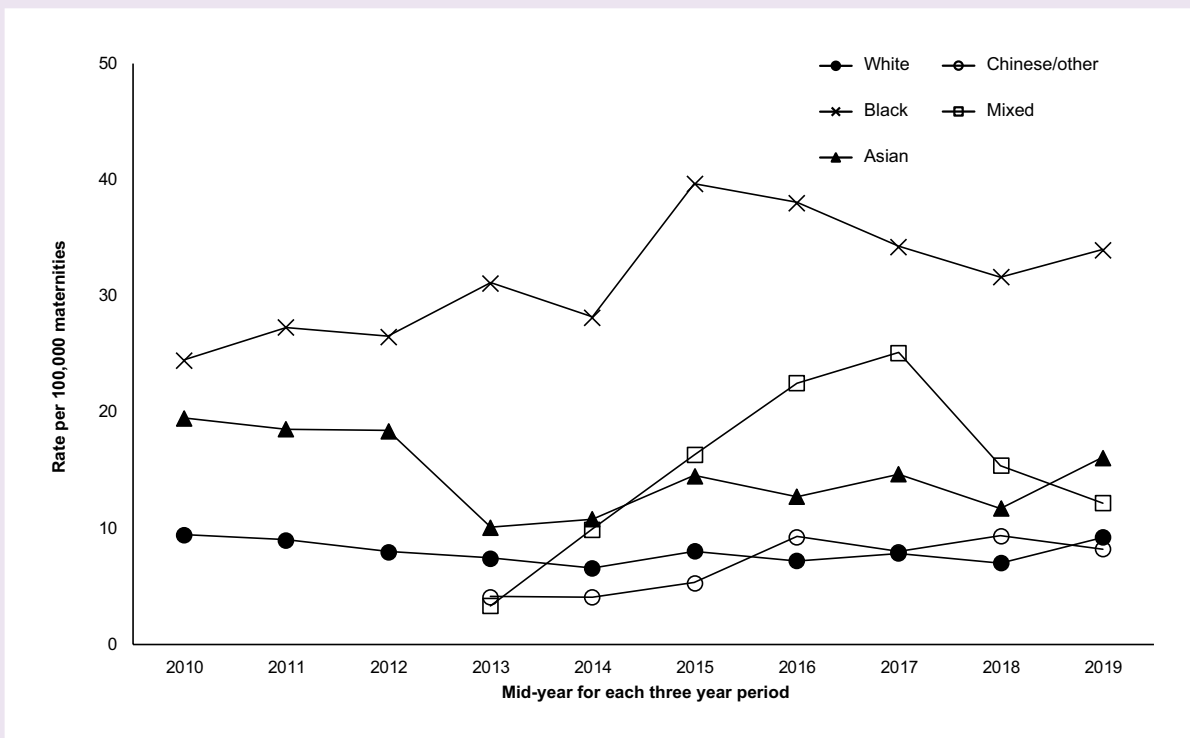
**NICE recommended antenatal care: booked at 10 weeks or less and no antenatal visits missed. Minimum level of care: booked at less than 13 weeks and 3 or fewer antenatal visits missed.

Figure 2.8: Maternal mortality rates 2009-20 among women from different levels of socio economic deprivation in England*



*Data for England only due to availability of denominator data

Figure 2.9: Maternal mortality rates 2009-20 among women from different ethnic groups in England*



*Data for England only due to availability of denominator data

Classification of quality of care

This section includes information on women who died between 2018 and 2020 and are included in the confidential enquiry chapters of this report (including women who died between six weeks and a year after the end of pregnancy and women from the Republic of Ireland), along with the 61 women admitted for diabetic ketoacidosis management during pregnancy who are included in the morbidity enquiry. Figure 2.10 (Table S2.17) shows the classification of care as agreed by the assessors for the 144 women who died and whose case notes were available with sufficient information for an in-depth review. Opportunities to improve care were identified amongst the great majority (90%) of women admitted to hospital for diabetic ketoacidosis management; in 38% it was thought that improvements may have made a difference to outcome, but of note, improvements to care which would have made no difference to outcome were identified in 52% (Figure 2.11, Table S2.17).

Figure 2.10: Classification of care received by women who died and are included in the confidential enquiry chapters and for whom case notes were available for an in-depth review, UK and Ireland (2018-20)

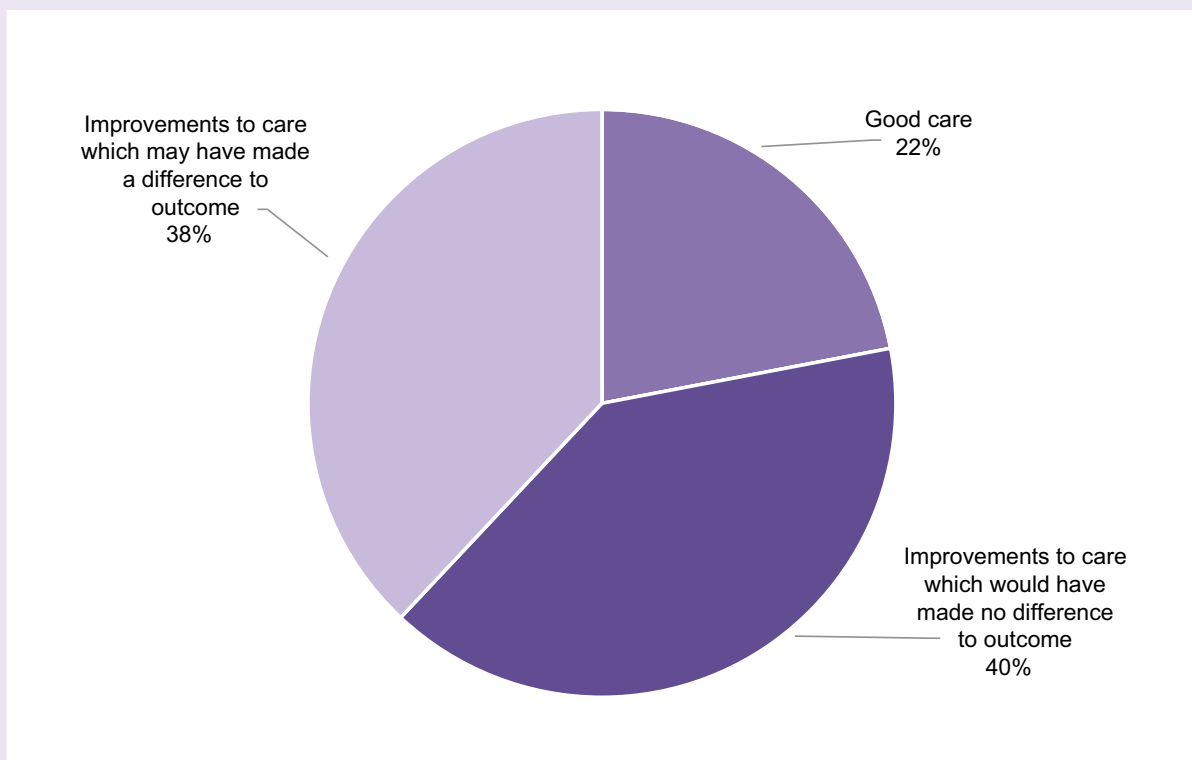
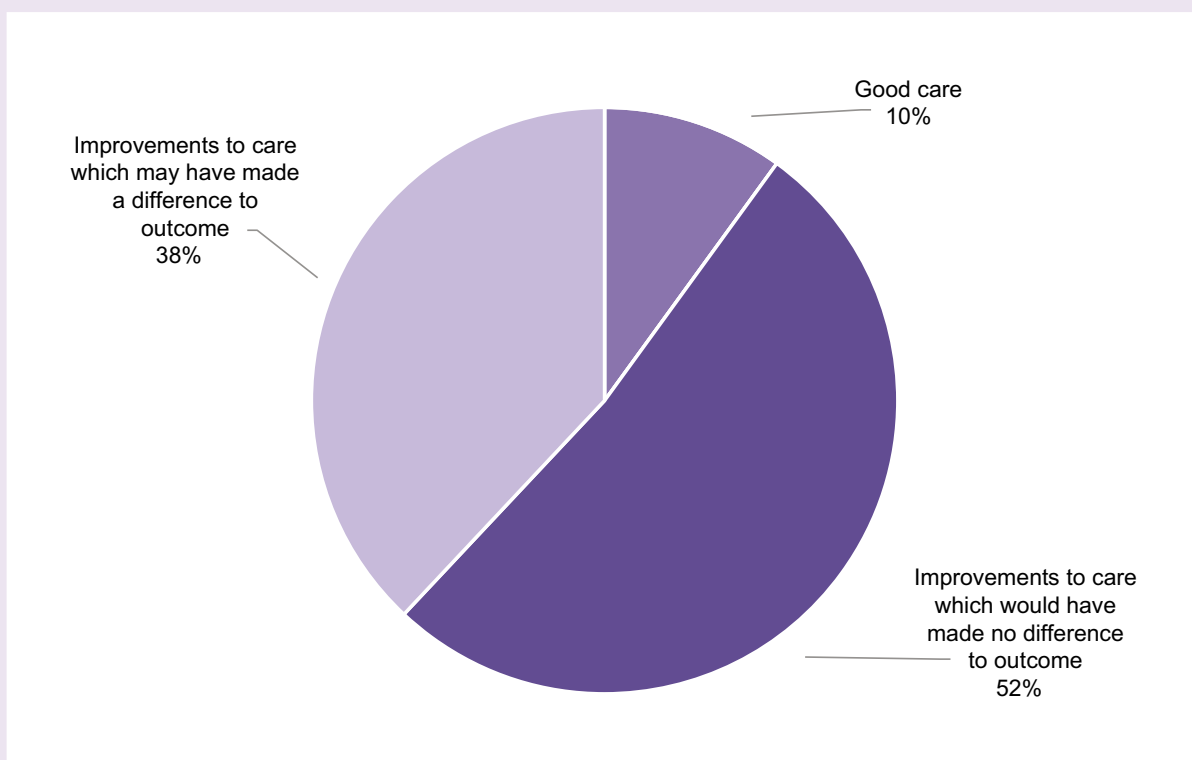


Figure 2.11: Classification of care received by women who had a diabetic ketoacidosis episode and are included in the morbidity enquiry, UK (2019-20)



3. Improving mental health care and care for women with multiple adversity

Andrew Cairns, Sara Kenyon, Roshni Patel, Kathryn Bunch and Marian Knight on behalf of the MBRRACE-UK mental health chapter-writing group

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

3.1 New recommendations for care

Assess women with persistent and severe insomnia carefully for signs of underlying mental illness. **ACTION: Health professionals.**

Recognise the importance of a trauma history in the assessment of risk. Involve specialist Perinatal Mental Health Teams where there is a history of significant involvement with secondary mental health services or significant risk, particularly if it is a first pregnancy. **ACTION: Service planners/commissioners, service managers, health professionals.**

Be alert to factors, such as cultural stigma or fear of child removal, which may influence the willingness of a woman or her family to disclose symptoms of mental illness, thoughts of self-harm or substance misuse. **ACTION: All health professionals, Professional education programmes.**

Access services such as Psychiatric Liaison, Crisis and Street Triage Teams should alert specialist Perinatal Mental Health Teams to any referrals of self-harm in pregnant or postpartum women that they have received to allow triage regarding the need for specialist follow-up. **ACTION: Service planners/commissioners, service managers, health professionals.**

Commissioning bodies should ensure that providers of specialist Perinatal Mental Health Teams have sufficient resource to advise, and in complex or high risk cases, be involved, in assessments when in normal working hours. **ACTION: Service planners/commissioners, service managers.**

Allow sufficient opportunity in electronic records systems for free text written comment rather than relying solely on 'tick boxes'. Where a woman has a history of mental health difficulties, make a brief (as a minimum) comment on mental health. **ACTION: Service planners/commissioners, service managers, health professionals.**

3.2 Background

Mental ill health remains one of the leading causes of maternal death in pregnancy and the first postnatal year. Building on the rapid report published in 2020 looking at deaths in the early months of the COVID-19 pandemic, this chapter looks at those women who died during 2020 through suicide. These reviews have been expedited due to the significantly increased maternal mortality rate due to mental health-related causes. As has been noted in other MBRRACE reports, multiple adversity remains a common theme amongst women dying through suicide, substance misuse, homicide and accidental death.

During the first year of the COVID-19 pandemic, very rapid changes were made to health services across the UK and Ireland. Mental health services were not immune from this and there was a broad spectrum of changes from teams where some staff were redeployed to other roles, through to teams that were able to operate relatively normally. Changes were seen across the pathway including both Perinatal Community Mental Health Teams, specialist inpatient Mother & Baby Units, referring universal services and emergency mental health teams such as Crisis Teams. Perhaps the most ubiquitous change was a reduction in face to face contact with patients and their families, and a sudden adoption of new (online) and not so new (telephone) means of assessment.

All of this occurred on a background of a recent huge expansion in specialist Perinatal Mental Health Services. Some of the specialist community teams had not existed two years prior to the outbreak of COVID-19. There was the potential for some newer members of staff being required to utilise novel means of contacting patients alongside changes in day-to-day contact with colleagues and senior team members due to other measures such as home working.

When reviewing the deaths, if specialist services were involved, we were not able to know whether that service was new or well-established, due to the methodology behind this enquiry. Nor were we able to know how staffing had been affected by the pandemic or what processes had been introduced, such as use of telephone or online contact.

3.3 The women who died

This report includes 28 women who died by suicide during 2020 in the UK and Ireland during pregnancy or up to one year after the end of pregnancy, a rate of 3.84/100,000 maternities (95% CI 2.55-5.55). This compares with a rate of 2.64/100,000 maternities in 2017-19 (RR 1.46, 95% CI 0.90-2.23, p=0.106). The women who died by suicide had a median age of 30 (IQR 24-33), the majority (86%, compared to 79% in the general maternity population) were from white ethnic groups and were UK or Irish citizens (82%).

Noting that pregnancy is usually considered a protective factor for death by suicide, there has been a statistically significant increase in the rate of suicide during pregnancy and up to six weeks after pregnancy in the UK, comparing 2017-19 with 2020. 10 women died out of 2,173,810 women giving birth in 2017-19 (0.46 per 100,000) compared with 10 out of 674,377 in 2020 (1.48 per 100,000) (RR 3.22, 95% CI 1.20-8.63, p=0.012). Of particular concern is the further increase in teenage suicides, with 5 deaths amongst 18,514 women giving birth in the UK and Ireland, giving a rate of 27/100,000. This is consistent with the increase in teenage suicides first reported in the 2017-19 report (11/100,000). Both findings are significantly higher than the previous 2014-16 report (2.5/100,000) which itself was in line with the rate in the general female population of that age group, thus the increase in rate pre-dates the COVID-19 pandemic.

This report also includes the deaths of 27 women who died by as a result of substance misuse and other psychiatric causes during 2020. This gives a rate of 3.70/100,000 maternities (95% CI 2.44-5.38). This compares with a rate of 2.47/100,000 maternities in 2017-19. Sixteen women died from accidental causes in the UK and Ireland between 2018 and 2020, and messages from their care are also included in this chapter. Messages for care identified from the deaths of women who were murdered were including in the 2020 MBRRACE-UK Rapid Report on covid-related deaths (Knight, Bunch et al. 2020).

Pregnancy or postnatal loss

Previous reports have found high rates of loss events (termination, miscarriage, stillbirth, neonatal loss, child removal) in both those women dying by suicide and those dying in relation to substance misuse. In 2020 there were fewer associated loss events with 79% of women dying by suicide having had no loss vs 63% in 2017-19 (Table S3.2). The figures for deaths due to substance misuse showed an increase from 57% having a loss event in 2017-19 to 74% in 2020. This increase was primarily due to a relative increase in child removals.

This review found no real change to the mode of suicide, with hanging remaining the most common mode of death (13/25, 52%), and overdose (4/25, 16%) and falls from height (4/25, 16%) the second most frequent methods (mode unknown for 3 women). Other than an increase in the proportion of overdoses, these proportions have remained static for more than 20 years, with hanging the most common and over 80% of suicides being violent.

During 2020, the suicide deaths occurred both antenatally and postnatally, with the majority postnatally (Figure 3.1). Deaths from substance misuse and other psychiatric causes were predominantly post-pregnancy (Figure 3.2).

Figure 3.1: Timing of death by suicide during pregnancy or the post-pregnancy year, 2020

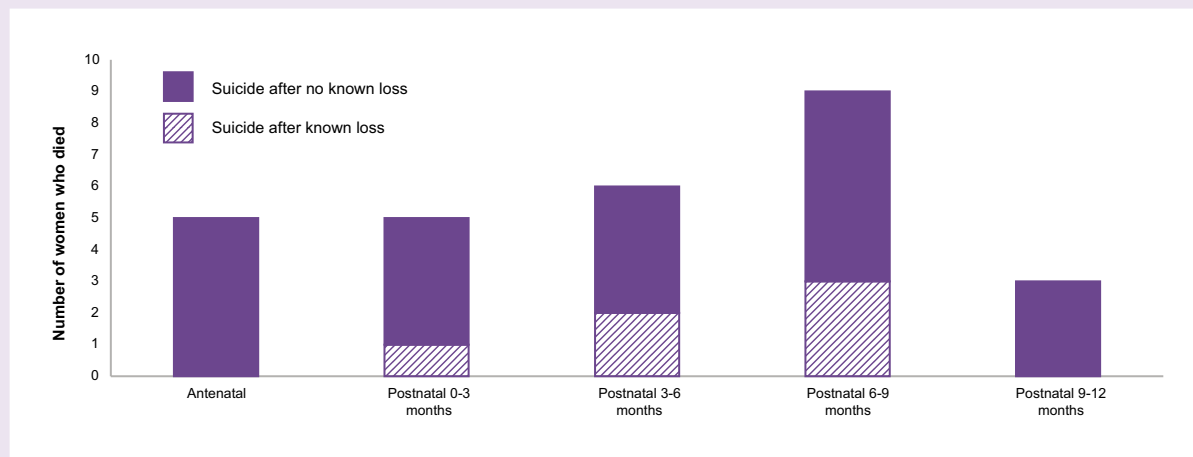
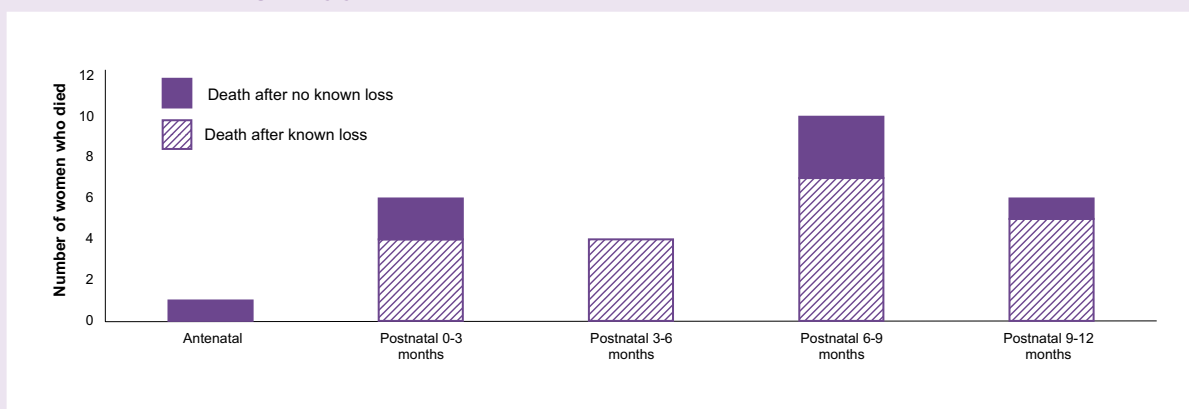


Figure 3.2: Timing of death from substance misuse or other psychiatric causes during pregnancy or the post-pregnancy year, 2020



Mental health diagnoses

In contrast to previous years, very few women who died by suicide had formal, clearly diagnosed mental health diagnoses. Four women had been given a diagnosis of emotionally unstable personality disorder. One had a diagnosis of anxiety and depression made during the index pregnancy by her GP. On review of the other women's records, it seems likely that two had undiagnosed severe depressive illnesses, one of whom had a red flag symptom of thoughts of maternal incompetence.

3.4 Overview of care and new lessons to be learned

Multiple adversity

At least half of the women who died by suicide and the majority of women who died from substance misuse had multiple adversity. A history of childhood and/or adult trauma were very frequent. Many of the younger women who died were care leavers. Presentations could be complex with mental illness, substance misuse and physical health symptoms, such as chronic pain. There were several instances where services did not become involved soon enough during pregnancy. Earlier involvement may have given more time to develop a therapeutic professional relationship. There seemed to be a general lack of consideration of the potential interaction between mental and physical symptoms, such as the influence of mental state on chronic pain and seizure-like activity. In one instance, a woman had apparent poor control of epilepsy during pregnancy in association with low mood, and a question as to whether these represented non-epileptic attacks.

As has been noted in some previous reports, on occasion specialist Perinatal Mental Health Teams declined to become involved with women who had a complex history with previous secondary mental health involvement, despite evidence suggesting that the woman might struggle with the adjustment to parenthood, with potential for an associated deterioration in mental state and increase in risk of self-harm or other risky behaviour.

A multiparous teenager had a miscarriage before her death. She had a history of child abuse and previous involvement with Child and Adolescent Mental Health Services. She had a history of substance misuse and domestic violence. A diagnosis of Bipolar Affective Disorder had been raised although assessors considered this unlikely. The Perinatal Mental Health Team declined a referral prior to her death by suicide.

Women may struggle to engage for a variety of reasons including their attachment style and fear of child removal. Mental Health services are not a replacement for Social Care support and intervention but the women whose deaths were reviewed were typically of a complexity and risk that required secondary care intervention, be it mental health teams, addictions services or both. Even when women are unable to engage for whatever reason, Perinatal Mental Health Teams can have a role in providing advice and scaffolding to both universal services and social care in understanding potential patterns of deterioration, risk (such as risk of deterioration related to child removal) and how to access services in a crisis.

Recognise the importance of a trauma history in the assessment of risk. Involve specialist Perinatal Mental Health Teams where there is a history of significant involvement with secondary mental health services or significant risk, particularly if it is a first pregnancy. N

Violent Suicide

As has been well established across many years, the commonest means of suicide remain violent methods. Thoughts of violent suicide have been recognised as a 'red flag' by the Enquiry since 2015. During this one year 13 women died by hanging, three by jumping in front of a train and four by jumping from heights. This makes up over two thirds of all deaths. Violent suicide is an indicator of clear intent and underlying significant mental disorder. Any expression of violent suicidal thoughts in pregnancy or the postpartum period should be taken seriously, and mental health services should have a low threshold for initial and ongoing assessment.

There was little documentary evidence that clinicians involved in these women's care were aware of this association. Indeed, one woman who died by hanging had presented to the Emergency Department the previous day with evidence of having used a ligature to attempt to harm herself. In another instance, a woman with a red flag of new and persistent expressions of incompetency as a mother, who also had a maternal family history of severe mental illness, jumped to her death.

Access services such as Psychiatric Liaison, Crisis and Street Triage Teams should alert specialist Perinatal Mental Health Teams to any referrals of self-harm in pregnant or postpartum women that they have received to allow triage regarding the need for specialist follow-up. N

Involvement of Multiple Teams

Given the nature of modern mental health services, it is not surprising that in a number of instances there were multiple mental health teams involved in a woman's care. Consistent with findings in previous reports, a lack of knowledge of perinatal mental health was identified in serious incident reviews. Assessment of complex or seriously unwell women was only undertaken by junior clinicians in all women for whom records were available for review, but note that the lack of availability of mental health records may mean that consultant psychiatrist review took place but was not documented in emergency department or maternity records.

Reviewers considered that capacity of Perinatal Mental Health Teams to be involved with urgent assessment in working hours would have been beneficial. Accepting that referral numbers are increasing with service expansion in all four UK nations and the Republic of Ireland, such capacity would need to be developed with commissioners/health boards.

Commissioning bodies should ensure that providers of specialist Perinatal Mental Health Teams have sufficient resource to advise, and in complex or high risk cases, be involved, in assessments when in normal working hours. N

A new finding was difficulties for women transferring from Child and Adolescent Mental Health Teams to Adult Community Mental Health Teams. Difficulties during this transition have been recognised elsewhere (Goselink, Olsson et al. 2022), particularly the differing approaches to engagement. In some areas of paediatrics joint clinics are held to manage the transition from child to adult services. Some paediatric clinics (such as Epilepsy) also offer pre-pregnancy advice to women preparing for transition to adult services. Such approaches should be considered in mental health.

Sleep and Stigma

Several women had unusually severe insomnia, despite medical intervention to address this.

A non-English speaking woman contacted her health visitor at three months postpartum concerned about her baby. She herself had not slept for over a week. She was directed to the Emergency Department where the psychiatric liaison team did not identify any low mood using a telephone interpreter. She was not referred to a specialist Perinatal Mental Health Team. She was commenced on an antidepressant but did not continue it as she was breastfeeding. A week later her health visitor referred her to the Perinatal Mental Health Team. She was called by a member of the specialist team within the week after referral, who offered a talking therapy

which she declined. She was also referred again to the specialist team who suggested she should be advised to attend the emergency department but did not attempt to coordinate an urgent assessment. She died by jumping from a height three days later.

Sleep disturbance is very common in relation to mental illness and a broader range of psychological difficulties. However, in these women the severity of insomnia was very marked and persisted despite the use of hypnotic medication. Severe sleep disturbance should lead clinicians to consider further assessment for underlying severe mental illness. Give consideration to a longitudinal assessment, particularly where a woman's insomnia is not responding to medication.

Assess women with persistent and severe insomnia carefully for signs of underlying mental illness. N

The women described in the vignette above also illustrated some concerns that stigma around mental health, which may be relatively more prevalent in some cultures compared to others, may have influenced the willingness of women or their families to be open about mental health concerns. This has been recognised in previous reports. Likewise, it has also been evident that concern about the involvement of social services, or the potential removal of a child, has also been a factor influencing openness about mental health or ongoing substance misuse difficulties.

Be alert to factors, such as cultural stigma or fear of child removal, which may influence the willingness of a woman or her family to disclose symptoms of mental illness, thoughts of self-harm or substance misuse. N

Use of electronic records

Over the past decade, records shared with the Enquiry reflect the general transition towards electronic notes. Whilst hand written records could be brief (or even illegible) at times, reviewers have been concerned that the format of some electronic records systems are both restrictive and prescriptive. The use of tick boxes, in particular, is quite widespread in assessments and leaves little opportunity for description or qualification. When attempting to understand the decision making process of clinicians, the brevity of typed notes and lack of reflection made it difficult to know whether clinicians had consciously weighed known risk factors, such as the red flags described in previous Enquiries. Mental health professionals should make greater reflection on their assessments rather than simply describing the presentation. Mental health in a woman with a history of mental health problems should be commented on, in the same manner as commenting on physical health if the woman had an existing physical health condition.

Allow sufficient opportunity in electronic records systems for free text written comment rather than relying solely on 'tick boxes'. Where a woman has a history of mental health difficulties, make a brief (as a minimum) comment on mental health. N

Pandemic-related isolation

A highly vulnerable woman with a complex psychosocial history died following a drugs overdose two weeks after a first trimester miscarriage. Her history included emotionally unstable personality disorder, depression and post-traumatic stress disorder, following an abusive and violent relationship.

The local midwife's report described the challenges of this woman's life eloquently and with great insight and compassion. The woman tried throughout her life to overcome the challenges she faced. She was making good progress but was deeply affected by the social isolation caused by the restrictions during the pandemic, leading to a relapse in her recovery. Recovery is a process, and lapses are a normal part of the process. To minimise lapses, people need consistent, experienced clinical and social care, but the changes as a result of the pandemic meant that this was not possible for this woman.

3.5 Conclusions

A pattern of multiple adversity remains extremely common in women who die through suicide, substance misuse, homicide and accidental death. The importance of thorough, over-arching assessments which do not simply consider the woman's presentation 'in the moment' are as important in these women as they are in women with psychosis who may not have such a background history. Professional sensitive enquiry about underlying factors such as substance misuse and domestic abuse remains an important part of the risk assessment and clinicians need to remain mindful as to reasons why such information may not be disclosed.

The increased rate of teenage maternal suicides remains a significant concern. This was first identified in the 2017-19 report (Knight, Bunch et al. 2021). Teenage women are most likely of any age group to die by violent means outside of pregnancy and this emphasises the additional specialist care these women need.

Many of the women who died through either suicide or substance misuse struggled to engage with services. Multiple services were frequently involved and given the underlying difficulties with engagement there is a need for agencies to work closely together when planning contacts to maximise the likelihood of attendance and engagement.

Several women with multiple and complex problems received good care with professionals working hard in a multi-agency fashion to engage and to try and reduce the risks that were recognised. Assessors felt that improvements in care might have made a difference to outcome for 69% of women who died by suicide (18/26 with sufficient information to classify care) and 35% of women who died from substance misuse (9/26 with sufficient information to classify care).

3.6 Existing recommendations requiring improved implementation

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

Women should receive continuity of mental health care. Where more than one mental health team is involved, there should be a clearly identified individual who co-ordinates care (Saving Lives, Improving Mothers' Care 2018) (Knight, Bunch et al. 2018)

Consider previous history, pattern of symptom development and ongoing stressors when assessing immediate risk and management of women with mental health symptoms. Plans should address immediate, short-term and long-term risk (Saving Lives, Improving Mothers' Care 2021) (Knight, Bunch et al. 2021)

New expressions or acts of violent self-harm are 'red flag' symptoms and should always be taken seriously (Saving Lives, Improving Mothers' Care 2015) (Knight, Tuffnell et al. 2015)

There should be an expectation of early consultant psychiatrist involvement in the assessment and management of high-risk women and of women exhibiting sudden alterations in mental state in late pregnancy or the early puerperium (Saving Lives, Improving Mothers' Care 2015) (Knight, Tuffnell et al. 2015)

Establish triage processes to ensure that women with mental health concerns can be appropriately assessed, including face-to-face if necessary, and access specialist perinatal mental health services in the context of changes to the normal processes of care due to COVID-19. Perinatal mental health services are essential and face to face contact will be necessary in some circumstances. There is a clear role for involvement of the lead mental health obstetrician or midwife in triage and clinical review (Saving Lives, Improving Mothers' Care 2020) (Knight, Bunch et al. 2020)

Ensure specialist services have the capacity to assess and manage all women who require secondary care mental health services, and be able to adjust for the altered (generally lowered) thresholds for assessment in the perinatal period. This should not prevent shared management of women already engaged with another service, where that is in their best clinical interests (Saving Lives, Improving Mothers' Care 2021) (Knight, Bunch et al. 2021)

Ensure perinatal mental health services do not exclude patients on the basis of diagnosis, where they would ordinarily be seen by general adult mental health teams (Saving Lives, Improving Mothers' Care 2021) (Knight, Bunch et al. 2021)

Ask the woman about domestic abuse in a kind, sensitive manner at the first antenatal (booking) appointment, or at the earliest opportunity when she is alone. Ensure that there is an opportunity to have a private, one-to-one discussion (NICE Guideline NG201 Antenatal care) (National Institute for Health and Care Excellence 2021)

In women facing multiple adversity, changes in frequency or nature of presentations may reflect worsening mental state or the emergence of new complications (such as alcohol or substance misuse or interpersonal violence), and should prompt renewed attempts at engagement, diagnosis and care co-ordination. (Saving Lives, Improving Mothers' Care 2018) (Knight, Bunch et al. 2018)

Decisions on continuing, stopping or changing medication in pregnancy should be made only after careful review of the benefits and risks of doing so, to both mother and infant (Saving Lives, Improving Mothers' Care 2018) (Knight, Bunch et al. 2018)

If psychotropic medication has been discontinued in advance of, or during, pregnancy, ensure women have an early postnatal review to determine whether they should recommence medication, carried out either by the GP or mental health service depending on the level of pre-existing mental health care (Saving Lives, Improving Mothers' Care 2021) (Knight, Bunch et al. 2021)

When prescribing drugs for associated mental health conditions to people who self-harm, take into account the toxicity of the prescribed drugs in overdose. For example, when considering antidepressants, selective serotonin reuptake inhibitors (SSRIs) may be preferred because they are less toxic than other classes of antidepressants (NICE Clinical Guideline 133) (National Institute for Health and Care Excellence 2020)

Loss of a child, either by miscarriage, stillbirth and neonatal death or by the child being taken into care increases vulnerability to mental illness for the mother and she should receive additional monitoring and support (Saving Lives, Improving Mothers' Care 2015) (Knight, Tuffnell et al. 2015)

Services should develop or adapt clear protocols and methods for sharing information, both within and between agencies, about people at risk of, experiencing, or perpetrating domestic violence and abuse. This is even more important with increasing use of electronic records to ensure all agencies involved in a woman's care are aware of her risk of domestic abuse. This would be further facilitated by support for the intra-operability of systems to support information sharing through electronic records (Saving Lives, Improving Mothers' Care 2020) (Knight, Bunch et al. 2020)

There is an urgent need to establish pathways for release of mental health records with the Chief Medical Officers and Departments of Health of Ireland and the four UK nations. Records for all women who die during or in the year after pregnancy who have had contact with mental health services should be released directly to MBRRACE-UK from risk/governance departments. (Saving Lives, Improving Mothers' Care 2018) (Knight, Bunch et al. 2018)

Ensure local incident review teams are multidisciplinary in composition and that investigations are carried out across organisational structures where indicated (Saving Lives, Improving Mothers' Care 2021) (Knight, Bunch et al. 2021)

Consider ways of ensuring that, for each woman who misuses substances:

- Progress is tracked through the relevant agencies involved in her care
- Notes from the different agencies involved in her care are combined into a single document
- There is a coordinated care plan (NICE Guideline CG110) (National Institute for Health and Care Excellence 2010)

GPs should inform maternity services of any past psychiatric history and maternity services should ensure that the GP is made aware of a woman's pregnancy and enquire of the GP about past psychiatric history (Saving Lives, Improving Mothers' Care 2015) (Knight, Tuffnell et al. 2015)

Women with substance misuse are often more vulnerable and at greater risk of relapse in the postnatal period, even if they have shown improvement in pregnancy. Ensure they are reviewed for re-engagement in the early postpartum period where they have been involved with addictions services in the immediate preconception period or during pregnancy (Saving Lives, Improving Mothers' Care 2021) (Knight, Bunch et al. 2021)

4. Messages on caring for women with multiple morbidities

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

4.1 New recommendations for care

Consider skills and drills training on the management of diabetic ketoacidosis in pregnancy to ensure that all maternity staff are aware of the symptoms and signs of diabetic ketoacidosis. **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.

Develop guidance on ketone testing in pregnancy and the subsequent response to an abnormal test **[ACTION: Royal Colleges of Obstetricians and Gynaecologists, Midwives, Physicians and General Practitioners]**.

Ensure that guidance on the management of diabetic ketoacidosis in pregnancy is included in all guidelines used outside of the maternity setting **[ACTION: Joint British Diabetes Societies for Inpatient Care]**.

Ensure the appropriate national Maternity Early Warning Score is used to monitor a pregnant woman wherever in the hospital she receives care **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.

4.2 Background

As these reports have repeatedly showed, most women who die during or after pregnancy in the UK have multiple physical and mental health co-morbidities as well as social complexity. The presence of multiple long-term conditions has been recognised as an important focus of health research more widely (National Institute for Health and Care Research 2021), because of the differing needs for care and adverse impacts on the outcomes of each individual disease condition. The focus of this MBRRACE-UK morbidity enquiry was to investigate the health and care needs of pregnant women with multiple morbidities and was complemented by a confidential enquiry into diabetic ketoacidosis (DKA) in pregnancy funded as part of an NIHR project (reference PB_PG_0817_20004) (Diguisto, Strachan et al. 2022). Findings from both enquiries are presented here.

4.3 The women whose care was reviewed

The women whose care was reviewed were identified through a UK Obstetric Surveillance System (UKOSS) study of diabetic ketoacidosis in pregnancy conducted between April 2019 and September 2020. Over this period, 82 women were identified with DKA, 6.3 per 100,000 maternities. Records for all 82 women were sought for inclusion in the confidential enquiry. No records (n=8) were available from Northern Ireland due to the requirement for consent to be obtained before records could be released and lack of staff capacity in the context of the pandemic. Records were not forthcoming for a further 13 women, thus the care of 61 women was examined for the purposes of this chapter. The definition for women to be included in the MBRRACE-UK multimorbidity enquiry was women with DKA who also had either pre-existing hypertension or thyroid disease, however, 41% of women with DKA without either pre-existing hypertension or thyroid disease had other pre-existing physical or mental health co-morbidities and can be considered multi-morbid. This chapter therefore describes the messages for the care of the whole cohort, which includes lessons in relation to several intersecting co-morbidities as well as diabetes.

4.4 Overview of care and new lessons to be learned

Note that all messages concerning the care of women with multimorbidity related to improving implementation of existing guidance; findings are therefore only presented in supplementary material.

Recognition of DKA

A multiparous woman with poorly controlled diabetes and episodes of DKA pre-pregnancy booked with an HbA1c of 80mmol/mol. She had multiple admissions with hyperglycaemia and impending DKA needing IV insulin infusions. On her last admission at 29 weeks she presented with abdominal pain and reduced fetal movements. She had high capillary ketones of 3.3mmol/l and a blood glucose of 8.9mmol/L. It was not recognised that she had DKA until her condition worsened with acute abdominal pain and vomiting. Her blood glucose rose to 22mmol and even higher capillary ketones of 6.3mmols and an arterial pH of 7.1 She underwent an emergency caesarean section but her baby required extensive resuscitation and died 24 hours later. M

There were several women in this enquiry who were admitted with DKA that was not promptly recognised or treated appropriately which contributed to poor fetal and neonatal outcomes. DKA in pregnancy is associated with a high maternal and perinatal death rate and should be treated as an obstetric emergency and requires a multidisciplinary approach. DKA can occur with lower glucose levels in the presence of raised ketones. Pregnant women with diabetes who present with signs and symptoms associated with DKA (Mohan, Baagar et al. 2017) should have DKA excluded, noting that occasionally DKA may be the first presentation of diabetes in pregnancy.

Consider skills and drills training on the management of diabetic ketoacidosis in pregnancy to ensure that all maternity staff are aware of the symptoms and signs of diabetic ketoacidosis. N

Ketonaemia

A 30 year old woman with no history of diabetes presented to the Emergency department at 24 weeks of gestation with vomiting and a headache. Urine dipstick showed 3+ ketones. There was concern about a venous sinus thrombosis so she underwent CT head, in addition to receiving intravenous rehydration. She was discharged home without repeat ketone testing, fetal assessment or glucose measurement. Two days later she was readmitted with severe DKA and an intrauterine death was confirmed. M

There is an absence of guidelines about ketone testing in pregnancy. Urinary ketones can be an indicator of pathology but are most commonly identified when multi-test urine dipsticks are being used solely for the detection of proteinuria and therefore often overlooked. Abnormal urinary ketones should prompt capillary glucose and ketone measurement. A venous blood gas is advised if either of these is abnormal or if capillary ketone testing is not easily available to check for acidosis. Capillary ketone testing is preferred as this is more accurate and can provide closer information about hour-by-hour changes in ketone level. Assessors felt that if the significance of this woman's urinary ketones had been recognised and acted on, the stillbirth of her baby might have been prevented.

Develop guidance on ketone testing in pregnancy and the subsequent response to an abnormal test. N

DKA is an obstetric emergency

DKA is an obstetric emergency as it carries a risk of mortality and morbidity for the pregnant woman and the fetus (Diguisto, Strachan et al. 2022). In three women admitted with DKA there were delays in recognition and treatment of the DKA which assessors felt had contributed to their babies being stillborn. While there are clear Joint British Diabetes Societies for Inpatient Care (JBDS-IP) guidelines for management of DKA in adults (Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2021), they do not contain any specific guidance concerning management of DKA in pregnancy, which include specifics such as the occurrence of euglycaemic ketoacidosis, as well as considerations around fetal monitoring and decisions concerning delivery. Some considerations concerning DKA

in pregnancy are included in the JBDS-IP guideline on managing diabetes and hyperglycaemia during labour and birth (Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2022) but this is clearly not widely available in acute medical settings.

Correcting the maternal condition is imperative as it will improve both her clinical condition and that of the baby, but, as is frequently seen in these reports, delays due to uncertainty around the care of pregnant women were evident particularly in non-maternity settings. While the fetal heart should be auscultated early, at an appropriate gestation CTG monitoring should be considered until there is improvement in the maternal condition (Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2022). The decision for delivery is complex and is based on multiple factors including the gestational age and the response to treatment of the mother. These additional aspects of care need to be incorporated into the JBDS-IP general adult guidance to ensure pregnant women receive the same standard of care as other adults with DKA.

Ensure that guidance on the management of diabetic ketoacidosis in pregnancy is included in guidelines used outside of the maternity setting. **N**

Pregnancy-specific protocols

A woman with diabetes was admitted to the surgical ward at 26 weeks gestation. Her blood pressure was raised at 140/102 but as a NEWS chart was used, it did not score so was not escalated. At 29 weeks she was admitted with diarrhoea and vomiting and went on to develop DKA. An urgent obstetric review was requested but an intrauterine death was diagnosed. She was admitted to a high dependency unit for the management of the DKA and again a NEWS chart was used. A different IT system was also in place which the maternity team did not have access to. It was only when she was moved to delivery suite that her raised blood pressure was noted and treatment for pre-eclampsia with intravenous labetalol and magnesium sulphate was started. M

When pregnant women are admitted to other areas of a hospital the care they receive should be of the same standard as that in the maternity unit. Recording observations on a NEWS chart gives false assurance, delaying treatment of pregnancy related complications such as pre-eclampsia. UK nations and Ireland have provided guidance and standard obstetric early warning scores (Healthcare Improvement Scotland 2018, Department of Health 2019, NHS England 2022) (for England rollout is expected in early 2023), but it is important to note that observations should be interpreted by reviewing the whole clinical picture and not focusing on one aspect of it. A robust multidisciplinary team review can aid the assessment and management.

Ensure the appropriate national Maternity Early Warning Score is used to monitor a pregnant woman wherever in the hospital she receives care. **N**

4.5 Conclusions

Assessors felt that for 38% of women (23/61), different care might have made a difference to the outcome for them or their baby. This morbidity enquiry clearly shows the additional challenges faced by women with multiple morbidities in pregnancy, which is exacerbated when they receive care by teams who are inexperienced in pregnancy medicine. While all of the women whose care was reviewed for the purposes of this chapter recovered from their DKA episode, many of their babies did not; improved care may have prevented several babies from being stillborn. Diabetes care has been highlighted as an area of improvement in previous perinatal confidential enquiry reports examining the care of stillborn babies (Draper, Kurinczuk et al. 2015). It is also clear that while guidelines exist which aim to optimise care of adults with multimorbidity, this is not yet regularly considered in the context of pregnancy. This must be an important focus for new maternal medicine networks in England and equivalent structures in the devolved nations and Ireland.

4.6 Existing recommendations requiring improved implementation

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

Consider an approach to care that takes account of multimorbidity if the person requests it or if any of the following apply:

- they find it difficult to manage their treatments or day-to-day activities
- they receive care and support from multiple services and need additional services
- they have both long-term physical and mental health conditions
- they frequently seek unplanned or emergency care
- they are prescribed multiple regular medicines (NICE NG56. Multimorbidity: clinical assessment and management) (National Institute for Health and Care Excellence 2016)

[Ensure] adults with an individualised management plan for multimorbidity know who is responsible for coordinating their care (Multimorbidity. NICE Quality standard QS153) (National Institute for Health and Care Excellence 2017)

Establish triage processes to ensure that women with mental health concerns can be appropriately assessed, including face-to-face if necessary, and access specialist perinatal mental health services in the context of changes to the normal processes of care due to COVID-19. Perinatal mental health services are essential and face to face contact will be necessary in some circumstances. There is a clear role for involvement of the lead mental health obstetrician or midwife in triage and clinical review (Saving Lives Improving Mothers' Care rapid report 2020) (Knight, Bunch et al. 2020)

Members of diabetes professional teams providing care or advice to adults with type 1 diabetes should be alert to possible clinical or subclinical depression and/or anxiety, particularly if someone reports or appears to be having difficulties with self-management (NICE Guideline NG17) (National Institute for Health and Care Excellence 2022)

Diabetes professionals should:

- ensure they have appropriate skills to identify and provide basic management of non-severe mental health problems in people from different cultural backgrounds
- be familiar with appropriate counselling techniques and drug therapy, while arranging prompt referral to specialists for people whose mental health problems continue to interfere significantly with their wellbeing or diabetes self-management (NICE Guideline NG17) (National Institute for Health and Care Excellence 2022)

Women with type 1 diabetes and nephropathy are at intermediate risk of venous thromboembolism and antenatal thromboprophylaxis with low molecular weight heparin should be considered (RCOG Green-top Guideline 37a) (Royal College of Obstetricians and Gynaecologists 2015)

Advise women with diabetes who are planning a pregnancy to aim to keep their HBA1c level below 48 mmol/mol (6.5%), if this is achievable without causing problematic hypoglycaemia (NICE 2015 diabetes in pregnancy) (National Institute for Health and Care Excellence 2020)

Information from practitioners, accompanied by an advice leaflet on reduced fetal movement, based on current evidence, best practice and clinical guidelines, to be provided to all pregnant women by 28+0 weeks of pregnancy and reduced fetal movement discussed at every subsequent contact (Saving Babies Lives Care Bundle version 2 2019) (NHS England 2019)

HDU/level 2 facility and/or insertion of central line may be required [for pregnant women with DKA] (request urgent senior review) (JBDS-IP The management of DKA in adults 2021) (Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2021)

For women undergoing planned caesarean birth between 37+0 and 38+6 weeks an informed discussion should take place with the woman about the potential risks and benefits of a course of antenatal corticosteroids. Although antenatal corticosteroids may reduce admission to the neonatal unit for respiratory morbidity, it is uncertain if there is any reduction in respiratory distress syndrome, transient tachypnoea of the newborn or neonatal unit admission overall, and antenatal corticosteroids may result in harm to the neonate which includes hypoglycaemia and potential developmental delay (RCOG Green-top Guideline 74) (Stock, Thomson et al. 2022)

5. Lessons on cardiovascular care

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

5.1 New recommendations for care

Wheeze can be due to pulmonary oedema. Consider wheeze which does not respond to standard asthma management and exertional syncope as red flag symptoms of cardiovascular disease in addition to orthopnoea and chest pain **[ACTION: All health professionals, Professional education programmes]**.

Be aware of the common risk factors for heart disease and venous thromboembolism, such as extreme obesity, and consider on an individual basis whether women should be made aware of the symptoms and signs of heart disease as well as those of venous thromboembolism **[ACTION: All health professionals, Professional education programmes]**.

Ensure maternal medicine networks and their equivalents in the devolved nations and Republic of Ireland can provide appropriate expertise and supervision for all women, including those in rural/remote areas. **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.

Develop guidance for the use of Brain Natriuretic Peptide measurement in pregnancy **[ACTION: Royal Colleges of Obstetricians and Gynaecologists and Physicians]**.

Be aware that women using oral anticoagulation with warfarin may be more safely managed without transition to low molecular weight heparin treatment when having an early termination of pregnancy **[ACTION: All health professionals, Professional education programmes]**.

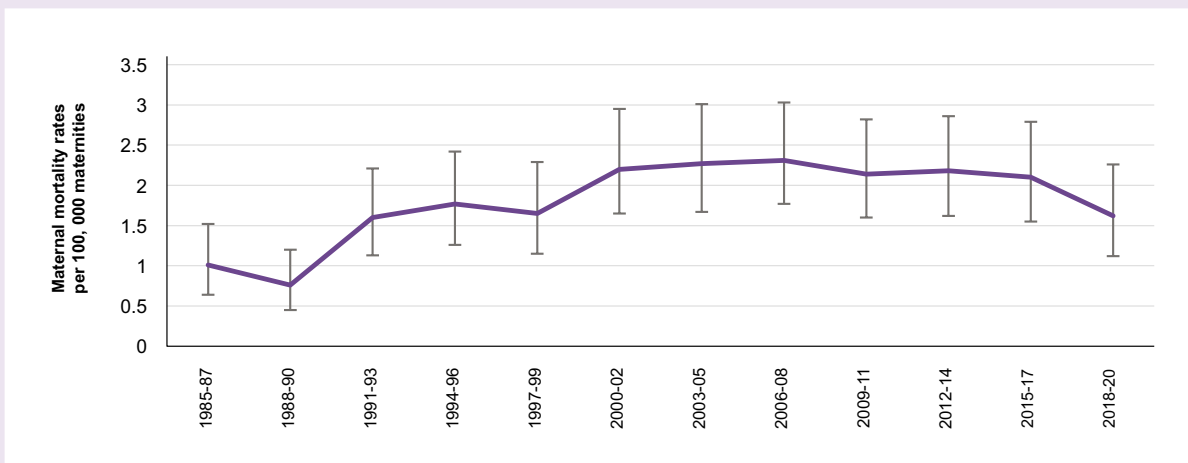
5.2 Background

This report sees a welcome decrease in the overall rate of maternal cardiovascular death, which follows the 2016 MBRRACE-UK report when the importance of awareness of maternal heart disease was first raised (Knight, Nair et al. 2016). Psychiatric disorders and cardiovascular disorders are now responsible for the same number of maternal deaths in the UK; together these two causes represent 30% of maternal deaths occurring in the UK. Cardiovascular disease had been the leading cause of maternal death in the UK for more than 20 years and remains the leading cause of maternal death in other high resource settings (Creanga, Syverson et al. 2017). Women are dying largely from acquired heart disease, likely to be a result of a combination of the changing maternity population, with women entering pregnancy at older ages, with more co-morbid conditions such as obesity and hypertension, alongside specialist multidisciplinary care before and during pregnancy providing better quality care for women with known heart conditions. We now need to ensure that this similar quality of care is provided for women whose cardiac disease becomes evident for the first time during or after pregnancy.

5.3 The women who died

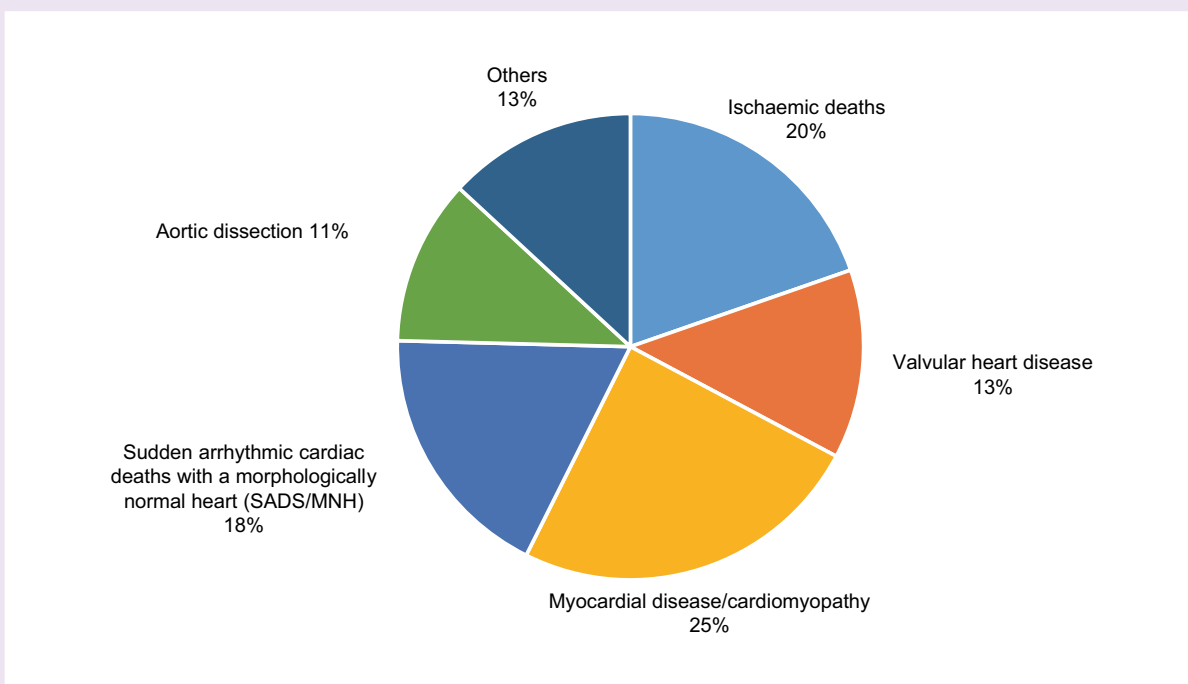
Between 2018-20 the deaths of 61 women from heart disease associated with, or aggravated by, pregnancy were reported to the Enquiry (Table S5.1). Of these, 34 occurred in the UK during pregnancy or within 42 days of the end of pregnancy. This represents a maternal mortality rate from cardiac disease in the UK of 1.62 per 100,000 maternities which is lower, but not significantly so, than the rate for 2015-17 (2.10 per 100,000 maternities) (RR 0.77, 95%CI 0.50-1.19) (Figure 5.1).

Figure 5.1: Maternal mortality from cardiac causes, UK: 1985-2020



Only 10% of women (6/61) who died from cardiovascular causes were recognised to have a pre-existing cardiac problem (Table S5.2). Maternal mortality rates from cardiovascular disease generally increased with age, with women aged 40 or over at six times higher risk of death compared with women aged 25-29 (RR 6.11, 95% CI 2.35-16.03) (Table S5.3). Of particular note, almost half of women who died from cardiovascular causes (29/61) were resident in the most deprived quintile of areas (Table S5.2), which is reflected in a two-fold higher mortality rate from cardiovascular disease compared to women living in the least deprived quintile of areas (RR 2.19, 95% CI 0.93-5.96) (Table S5.3). Overall, a fifth of women (20%) died from ischaemic causes, and a quarter from myocardial disease/cardiomyopathy (25%) (Table S5.4 and Figure 5.2).

Figure 5.2: Causes of cardiovascular deaths, UK and Ireland 2018-20



5.4 Overview of care and new lessons to be learned

Symptoms and signs

An older white British woman was experiencing cough and wheeze when visited at home during the week after she gave birth. Her community midwife attributed this to the inhalational analgesia used during labour. The following week she presented to hospital with increasing symptoms, severe cardiomyopathy was diagnosed and she was admitted. Her condition deteriorated but her care was not escalated. She died a few days later. There was no post-mortem and the final definitive cardiac diagnosis was not clear. Cardiac genetics tests were not performed.

It is likely that this woman's initial cough and wheeze were due to heart failure and pulmonary oedema (cardiac asthma), and it is possible that referral to the hospital at that point might have resulted in a different outcome. Wheeze can be a manifestation of pulmonary oedema. When wheeze is new or when thought to be related to asthma but does not settle with asthma management, pulmonary oedema should be considered. Six of the women who eventually died from myocardial causes had complained about cough, wheeze and/or shortness of breath. Two further women were treated for suspected lower respiratory tract infection.

Wheeze can be due to pulmonary oedema. Consider wheeze which does not respond to standard asthma management and exertional syncope as red flag symptoms of cardiovascular disease in addition to orthopnoea and chest pain N

Thromboprophylaxis

Two extremely obese women who had significant bleeding should have received postpartum thromboprophylaxis according to RCOG guidelines, but their risk was not correctly assessed and no low molecular weight heparin was prescribed. Both collapsed and died from coronary thrombosis a few days after hospital discharge. Similar to the woman described above, these women had clear risk factors for ischaemic heart disease. Risk factors for ischaemic heart disease have significant overlap with those associated with venous thromboembolism. While correct thromboprophylaxis is unlikely to have prevented these women's myocardial infarctions, it is important to be aware of the common risk factors and raise awareness of the symptoms and signs of cardiac disease amongst women who require thromboprophylaxis due to obesity.

Be aware of the common risk factors for heart disease and venous thromboembolism, such as extreme obesity, and consider on an individual basis whether women should be made aware of the symptoms and signs of heart disease as well as those of venous thromboembolism N

Recognition and response

An Asian woman had an uncomplicated term birth. She had no significant medical history other than occasional anxiety attacks. In the postnatal period she made several contacts with her GP surgery. She reported a recurrence of anxiety attacks and was prescribed propranolol which did not help. She had a face to face consultation on the third occasion, tachycardia, hypoxia and basal crepitations were noted and oral antibiotics prescribed for a chest infection. A few days later she presented to the emergency department with vomiting, dehydration and three week history of shortness of breath. Cardiac ultrasound identified severe heart failure with pulmonary oedema due to peripartum cardiomyopathy and she was transferred to a regional cardiac centre. Subsequent escalation of treatment was unsuccessful, and she died a few weeks later.

A feeling of anxiety may be a manifestation of hypoxia and of heart disease, and should not be automatically be assumed to be related to mental health, especially if a previously successful intervention is unhelpful. In the postnatal period, new or deteriorating symptoms may have a pregnancy-related aetiology. It is unclear if a full history was taken to delineate her symptoms before her final presentation, or if the potential importance of hypoxia in a young woman was appreciated. It is worth noting that this woman's care may have been impacted by pandemic-related changes to services. Her remote prescription for propranolol, slow access to her GP, the lack of escalation to mater-

nity or acute settings, and her later presentation to the emergency department may all have been as a consequence of the pandemic and delayed her diagnosis. Assessors felt her options for transfer for more advanced care may also have been impacted.

All healthcare practitioners caring for pregnant and recently delivered women should be familiar with the range of medical disorders including peripartum cardiomyopathy that can occur.

Brain Natriuretic Peptide (BNP)

BNP (Brain Natriuretic Peptide) and NT-pro BNP (N-terminal BNP) are biomarkers (neurohormones) that are widely used in the diagnosis, management and assessment of progress of treatment of heart failure of all types, both in the elective and emergency settings. Normal levels of these biomarkers throughout pregnancy have been established over the last decade (Hameed, Chan et al. 2009, Furenas, Eriksson et al. 2020) and pregnancy specific reference intervals have also now been defined (Dockree, Brook et al. 2021). A systematic review and meta-analysis of the diagnostic accuracy of BNP and N-terminal BNP in 13 studies was undertaken by Sheikh et al (Sheikh, Ostadrahimi et al. 2021). Taken together, these studies suggest that measurement of serum levels of BNP or NT-pro BNP can be used as a diagnostic aid to assist in the investigation of women with suspected cardiac disease in pregnancy, as is standard practice in the non-pregnant population (McDonagh, Metra et al. 2021). Assessors felt that there was the potential for use of BNP or NT-pro BNP measurement to aid diagnosis for several women, including the woman whose care is described above.

Develop guidance for the use of Brain Natriuretic Peptide measurement in pregnancy

N

Distance and tertiary care

An older white British woman with a complex medical and mental health history including known cardiac disease presented with an unplanned pregnancy. There was no documentation of pre-pregnancy or contraception counselling following her cardiac diagnosis. She was short of breath at rest throughout most of the pregnancy. In the early third trimester she was admitted with breathlessness and palpitations to her local hospital, echocardiography identified cardiac failure which was treated. Her cardiac function declined further and she was transferred to the regional cardiac centre. There was good multidisciplinary team involvement and she had an uneventful induced birth at term. Contraception was provided. Although she requested an early discharge to be near her family, appropriate investigations were undertaken prior to discharge and she had a plan for follow-up. She died from her cardiomyopathy a few weeks postpartum.

This woman had a significant cardiac condition and multiple co-morbidities. It is not clear that she had received pre-pregnancy advice concerning the potential impact of pregnancy on her cardiac condition, nor had she received contraceptive advice. On initial presentation to the emergency department the severity of her condition was not recognised and there were delays in calling the maternity medical team. However, once the significance of her condition was recognised, she was cared for appropriately at her local hospital and her care was transferred in a timely manner to a specialist centre when she deteriorated. The tertiary centre team made a plan of care for the antenatal, intrapartum and postnatal period. This undoubtedly improved the chances of a good pregnancy outcome, however the location of the specialist centre far away from her home meant she was discharged early wishing to be closer to her family. The reviewers felt that this woman's care was an excellent example of multidisciplinary involvement with appropriate planning and management, but noted the importance of ensuring that new networked maternal medicine services can deliver individualised care for women irrespective of their distance from the tertiary centre.

Ensure maternal medicine networks and their equivalents in the devolved nations and Republic of Ireland can provide appropriate expertise and supervision for all women, including those in rural/remote areas

N

Valve disease

Pre-pregnancy counselling and pregnancy termination

An older woman with a past history of metallic mitral valve replacement and warfarin anticoagulation had a confirmed pregnancy at 6 weeks. She was unsure if she should continue the pregnancy. She was seen for specialist haematology assessment and the warfarin was changed to tinzaparin. Termination of pregnancy was discussed (via an interpreter), but before this could take place she had a thromboembolic stroke. Thrombus was identified on the mitral valve. She deteriorated and died a few months later.

This woman had been in regular contact with her GP prior to pregnancy (monitoring her anticoagulation) but there was no documentation about contraception or pre-conception care. The woman's daughter had been acting as a translator and there may have been a reluctance to discuss aspects of care "through" her. All women on warfarin should be offered effective contraception and a preconception appointment with a specialist should be offered.

Therapeutic anticoagulation during pregnancy is of utmost importance to avoid complications in these patients, bearing in mind that no anticoagulation regimen is ideal and management will require a careful balance between maternal and fetal risks (Vahanian, Beyersdorf et al. 2021).

For this woman who had presented at 6 weeks gestation while on warfarin and opting for a termination, continuation of the warfarin would have limited her risk of adverse outcome.

Be aware that women using oral anticoagulation with warfarin may be more safely managed without transition to low molecular weight heparin treatment when having an early termination of pregnancy. N

5.5 Conclusions

Assessors considered that in almost one third of instances (19/61), different care may have prevented women's deaths. As has been a repeated focus of these reports, raising awareness of the importance of 'red flag' cardiac symptoms, and considering cardiac causes as part of the differential diagnosis for women presenting with pain, wheeze and breathlessness remain the most important actions. Only one in ten women were known to have cardiac disease prior to pregnancy. While the decreased mortality rate from cardiac causes noted in this report gives cautious reasons for optimism, women continue to enter pregnancy with a greater range and number of risk factors for cardiac disease. This emphasises not only the importance of recognition of cardiac disease when it occurs for the first time during and immediately after pregnancy, but also of actions pre-pregnancy to identify and address risk factors.

5.6 Existing recommendations requiring improved implementation

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

A raised respiratory rate, chest pain, persistent tachycardia and orthopnoea are important signs and symptoms of cardiac disease which should always be fully investigated. The emphasis should be on making a diagnosis, not simply excluding a diagnosis. (Saving Lives, Improving Mothers' Care 2016)

Heart failure in cardiomyopathy can develop rapidly and guidelines for the management of acute heart failure and cardiogenic shock apply. For rapid diagnosis and decision-making, a pre-specified management algorithm and expert interdisciplinary team are crucial (2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy) (Regitz-Zagrosek, Roos-Hesselink et al. 2018).

Women [who have had confirmed pre-eclampsia] should be given an individual [postpartum] care plan on hospital discharge that includes:

- **Who will provide follow-up care, including medical review if needed.**
- **Frequency of blood pressure monitoring.**
- **Thresholds for reducing or stopping treatment. (NICE CKS Hypertension in pregnancy) (National Institute for Health and Care Excellence 2022)**

A persistent sinus tachycardia is a ‘red flag’ and should always be investigated, particularly when there is associated breathlessness. (Saving Lives, Improving Mothers’ Care 2019) (Knight, Bunch et al. 2019)

Take a cardiac-specific history and suspect heart failure if there is not another likely cause of any of the following symptoms:

- **Breathlessness when lying down (ruling out aortocaval compression) or at rest**
- **Unexplained cough, particularly when lying down or which produces frothy pink sputum**
- **Paroxysmal nocturnal dyspnoea – being woken from sleep by severe breathlessness and coughing, which may produce pink frothy sputum and is improved by moving to an upright position**
- **Palpitation (awareness of persistent fast heart rate at rest). (NICE Guideline NG121) (National Institute for Health and Care Excellence 2019)**

Think Aorta (Aortic Dissection Awareness UK/Heart Research UK) (Heart Research UK 2017)

When aortic dissection occurs in a young woman, the underlying diagnosis should be assumed to be an inherited aortopathy until proven otherwise (Saving Lives, Improving Mothers’ Care 2016) (Knight, Nair et al. 2016)

A family history of sudden death of a young relative (aged less than 40) is important and may be an indication of inherited cardiac conditions (Saving Lives, Improving Mothers’ Care 2019) (Knight, Bunch et al. 2019)

Anyone with a family history or genetic confirmation of aortopathy or channelopathy should be referred for cardiac assessment before pregnancy (Saving Lives, Improving Mothers’ Care 2019) (Knight, Bunch et al. 2019)

Investigate and treat pregnant and postpartum women the same as non-pregnant women unless there is a clear reason not to (Saving Lives, Improving Mothers’ Care Reports 2014-21) (Knight, Bunch et al. 2021)

Ensure that all clinical staff caring for pregnant or postpartum women, whatever the location of care, are aware of the concerning ‘red flag’ symptoms described in the RCP Acute care toolkit 15: Managing acute medical problems in pregnancy (Saving Lives Improving Mothers’ Care 2021) (Knight, Bunch et al. 2021)

Pregnancy in women with a mechanical valve, especially in the mitral position, is associated with a high risk of maternal and fetal complications, which should be carefully discussed with the patient and family (2021 ESC/EACTS Guidelines for the management of valvular heart disease) (Vahanian, Beyersdorf et al. 2021)

All women with pre-existing cardiac disease (congenital or ischemic) should be offered pre-pregnancy counselling (Saving Lives Improving Mothers’ Care 2016) including contraceptive advice (Saving Lives Improving Mothers’ Care 2019)

Recommendations for the management of atrial fibrillation during pregnancy:

- **Immediate electrical cardioversion is recommended in case of haemodynamic instability or pre-excited atrial fibrillation**
- **Therapeutic anticoagulation with heparin or [warfarin] according to the stage of pregnancy is recommended for patients with atrial fibrillation (2020 ESC Guidelines for the diagnosis and management of atrial fibrillation) (Hindricks, Potpara et al. 2020)**

6. Lessons on prevention and treatment of hypertensive disorders

Marian Knight, Kate Harding, Louise Page, Nicki Pusey and Samantha Holden on behalf of the MBRRACE-UK hypertensive disorders chapter-writing group

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

6.1 New recommendations for care

Ensure that the national Patient Group Direction allowing prescription of aspirin for pregnant women at risk of pre-eclampsia by midwives and pharmacists is widely implemented **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.

Ensure that women's electronic records can be easily accessed and shared when they receive care in different settings **[ACTION: National Digital Policy Teams, Service Planners/Commissioners, Hospitals/Trusts/Health Boards]**.

Be aware of how to contact the regional maternal medicine lead for urgent advice to ensure multidisciplinary senior review of women who are unwell. **[ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards, All Health Professionals]**.

Be aware of the added risk of fetal compromise when a woman's pregnancy is complicated by both hypertension and diabetes. It is not only babies predicted to be small for gestational age who may be at risk **[ACTION: All health professionals, Professional education programmes]**.

6.2 Background

The number of women who die from hypertensive disorders of pregnancy has been in single figures in the UK and Ireland for the last three triennia. Nevertheless, it is of concern that the mortality rate in this triennium in the UK is now more than four times higher than it was in 2012-14, when only two women died. Hypertensive disorders of pregnancy remain one of the leading causes of maternal death worldwide, and the UK will only maintain its low maternal death rate with continued emphasis on prevention, early detection and optimal management of hypertensive disorders. This will become even more important with increasing numbers of women entering pregnancy with risk factors for hypertensive pregnancy disorders, and multiple morbidities which add complexity to the treatment of co-existing pre-eclampsia, as highlighted in chapter 4 supplementary material. To enhance the messages for improving care of women with hypertensive disorders, for the purposes of this chapter, MBRRACE-UK assessors worked together with members of the HSIB maternity team and considered messages for care arising from HSIB reviews of babies who died or had severe brain injury in association with a maternal hypertensive disorder of pregnancy.

6.3 The women who died

In 2018-2020 eight women died from hypertensive disorders of pregnancy, all either during pregnancy or up to six weeks after the end of pregnancy. The mortality rate in the UK remains low (0.38/100,000, 95% CI 0.16-0.75) but is four times higher than in the 2012-14 triennium when the rate was at its lowest (0.09/100,000 maternities, 95% CI 0.01-0.31) (RR 4.46, 95% CI 0.89-43.1).

Two women died following intracranial haemorrhage in association with HELLP syndrome, two women died from Acute Fatty Liver of Pregnancy (AFLP), and two died following eclamptic seizures. Two women died from pulmonary oedema; both died at home and neither woman's death was associated with intravenous fluid administration. The care of three women who died was potentially impacted by pandemic-related factors, including remote consultation and concern around hospital attendance.

HSIB reviews where maternal hypertensive pregnancy disorders were considered an associated cause were examined. All available reviews of the care of babies who died were assessed (4 babies who were stillborn and 8 who died in the neonatal period), together with all reviews of the care of babies with severe brain injury from Black, Asian, Mixed and other ethnic minority groups (13 babies), and a sample, stratified by English region, of reviews of the care of babies with severe brain injury from White ethnic groups (15 babies) (40 babies in total).

6.4 Overview of care and new lessons to be learned

Aspirin

A woman with a history of pre-eclampsia booked for consultant care and was recommended by her midwife to commence aspirin. She attended a consultant appointment in the second trimester and was given a proforma letter advising that aspirin should be prescribed. Her GP did not receive this for a further three weeks and therefore aspirin prescription was delayed. She developed severe pre-eclampsia in the third trimester with pulmonary oedema from which she died.

Despite the knowledge that low dose aspirin (75-150mg) reduces the risk of pre-eclampsia having been widespread for many years (and included in the NICE 2013 quality standard), a number of women described in this report were not receiving low dose aspirin, or received it later in pregnancy than advised. This may be due to a lack of knowledge amongst those health professionals who see these women in early pregnancy (midwife, GPs, obstetricians and non-maternity clinicians), or a difficulty in accessing aspirin or a reluctance among women to take medication. It is noted that although aspirin can be purchased as an over the counter medication it is not “licensed” in pregnancy, thus pharmacists in the UK are unable to dispense it for pre-eclampsia prophylaxis. As a result the only options for at risk women are to buy it on the pretence it is for someone else, or to have it prescribed by their GP. This causes delay in starting this medication or raises concerns among women that there may be risk from taking aspirin. This problem was also noted in HSIB reports into babies who died or had severe brain injury. Missed opportunities to prescribe aspirin in a timely fashion were also identified from the HSIB reviews of babies’ care.

A woman was identified as having two moderate risk factors for pre-eclampsia at her first trimester booking visit. She was primiparous and had a family history of pre-eclampsia. Although the antenatal risk factors were correctly identified aspirin was not prescribed. She developed pre-eclampsia at 35 weeks. Her baby underwent therapeutic cooling after an emergency birth. M

The 2019 MBRRACE-UK report recommended that a national Patient Group Direction, including advice relating to safe, timely and cost-effective local implementation, should be developed to ensure consistent high quality care by allowing midwives to supply aspirin to eligible women in line with NICE Guidance (Knight, Bunch et al. 2019). A national Patient Group Direction was released in February 2022 (NHS Specialist Pharmacy Service 2022) and it is now essential that this is widely implemented. This will enable both midwives and pharmacists to prescribe aspirin for pregnant women with recognised risk factors and hence ensure all women can access aspirin as early as possible to benefit from its preventive effect.

Ensure that the national Patient Group Direction allowing prescription of aspirin for pregnant women at risk of pre-eclampsia by midwives and pharmacists is widely implemented. N

Continuity of records

The woman described in the previous vignette had separate admissions to different hospitals in different parts of the country in the third trimester before she died. In these instances she was admitted with a severe headache and raised blood pressure which settled, and on one occasion she was treated with labetalol. Assessors felt that the fact that she was unable to share her medical records from the first admission at a unit remote from her home, meant that the severity of her pre-eclampsia was not recognised in subsequent admissions. This is likely to become an increasing problem as electronic records replace hand held paper records unless it can be ensured that electronic records can be shared and are accessible when required. Sharing of records with her GP may also have ensured she received an earlier aspirin prescription.

Ensure that women's electronic records can be easily accessed and shared when they receive care in different settings. **N**

Senior Support and a holistic review

A woman gave birth preterm. In the subsequent 24 hours she was severely oliguric despite 6 litres of intravenous fluid. She became extremely oedematous and developed mild hypertension, with abnormal liver and renal function. She was referred to critical care three days later. She died from AFLP before the regional liver team were able to advise on suitability for transfer and specialist hepatic care.

While an acute deterioration (such as massive postpartum haemorrhage or an eclamptic seizure) may be more obvious to recognise and respond to, a slow deterioration, especially postnatally in a mother who may appear initially reasonably well, is more difficult to recognise and diagnose. In women who are not responding to standard care it is vital that the multidisciplinary team (obstetric, anaesthetic and where relevant obstetric medicine consultants) review the patient together and take a holistic view, taking into account the whole history, the clinical findings and the results of investigations. It is important not to be misled by incidental findings (such as a Covid positive swab). Early referral to the critical care team and escalation for regional expert advice and management may increase the chance of considering more unusual diagnoses that require specialist management.

Be aware of how to contact the regional maternal medicine lead for urgent advice to ensure multidisciplinary senior review of women who are unwell. **N**

Additional messages for care of women with hypertensive disorders identified from HSIB reviews of the care of babies who died or had severe brain injury

Note that most lessons for care identified from HSIB reviews related to improving implementation of existing guidance; the majority of findings are therefore only presented in supplementary material.

Pre-eclampsia and gestational diabetes

A multiparous woman met the criteria for testing for gestational diabetes in pregnancy. This was not completed. During the pregnancy a rise in the symphysis-fundal height (SFH) trajectory was noted, to above the 90th centile. The estimated fetal weight on ultrasound was around the 80th centile. The SFH trajectory continued over the 90th centile.

The woman was admitted to a midwifery led unit in labour at term. Her blood pressure on admission was 150/110mmHg but she did not have proteinuria. An assessment was made that she was in the latent phase of labour and monitoring of the fetal heart rate was commenced using intermittent auscultation every 30 minutes. Her blood pressure remained high and was attributed to her being in pain.

When her waters broke meconium was seen. Shortly afterwards there was a fetal bradycardia and she had an emergency caesarean birth after transfer to the obstetric unit. The baby's birthweight was on the 20th centile. The baby required resuscitation following birth and was transferred to the neonatal unit. Cerebral function monitoring was abnormal and therapeutic cooling commenced. A neonatal MRI showed changes consistent with hypoxic ischaemic encephalopathy. **M**

Hypertensive disorders of pregnancy and diabetes share links to the metabolic syndrome. Women with risk factors for the metabolic syndrome have an increased chance of developing pre-eclampsia or pregnancy induced hypertension and gestational diabetes during pregnancy. As highlighted in chapter 4, co-existence of diabetes and pre-eclampsia adds complexity to women's management as requirements for management of the two conditions may be conflicting. The placental dysfunction of pre-eclampsia leads to compromised oxygen delivery at a time when the accelerated metabolism of the fetus of a woman with diabetes means oxygen demands are greater. Similarly,

the tendency of diabetes to lead to larger babies and that of hypertensive disorders of pregnancy to lead to smaller babies, in combination, may lead to a baby being born on a birth centile within the expected range who has unrecognised fetal growth restriction. This may impact on the baby's ability to cope with the demands of labour, as in this instance, and on the accuracy of the clinical team's intrapartum risk assessment.

Recognition that it is not only babies predicted to be small for gestational age (below the 10th centile) who may be at risk of compromise during labour is important to be aware of when a woman's pregnancy is complicated by both hypertension and diabetes.

Be aware of the added risk of fetal compromise when a woman's pregnancy is complicated by both hypertension and diabetes. It is not only babies predicted to be small for gestational age who may be at risk of compromise during labour. N

6.5 Conclusions

For three quarters of the women whose care was reviewed for the purposes of this chapter (6/8), different care might have made a difference to their outcome. It is clear that continued attention to enabling women with risk factors to receive aspirin is needed, and to ensure that abnormal blood pressure measurements are not normalised. The reviews of the care of babies who died or had severe brain injury in association with maternal hypertensive pregnancy disorders has emphasised the need to avoid prolonged induction processes. The reviews of morbidity, both in this and previous chapters, have identified the need for renewed focus on fluid management; fluid overload was seen in both women who died reviewed here, amongst the mothers of babies reviewed by HSIB, and amongst the mothers reviewed in chapter 4 who had co-existing diabetes and pre-eclampsia. Details of these areas of guidance requiring improved implementation are available in the online supplementary material. There will be significant numbers of women affected by pre-eclampsia and other hypertensive disorders of pregnancy for the foreseeable future, and we cannot afford to become complacent about their care.

6.6 Existing recommendations requiring improved implementation

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

At the first antenatal (booking) appointment (and later if appropriate), discuss and give information on what antenatal care involves and why it is important (NICE Guideline NG201 Antenatal care) (National Institute for Health and Care Excellence 2021)

When giving women (and their partners) information about antenatal care, use clear language, and tailor the timing, content and delivery of information to the needs and preferences of the woman and her stage of pregnancy. Information should support shared decision making between the woman and her healthcare team, and be:

- offered on a one-to-one or couple basis
- supplemented by group discussions (women only or women and partners)
- supplemented by written information in a suitable format, for example, digital, printed, braille or Easy Read
- offered throughout the woman's care
- individualised and sensitive
- supportive and respectful
- evidence-based and consistent
- translated into other languages if needed (NICE Guideline NG201 Antenatal care) (National Institute for Health and Care Excellence 2021)

Explore the knowledge and understanding that the woman (and her partner) has about each topic to individualise the discussion (NICE Guideline NG201 Antenatal care) (National Institute for Health and Care Excellence 2021)

During labour measure blood pressure hourly in women with hypertension (NICE Guideline NG133 Hypertension in pregnancy) (National Institute for Health and Care Excellence 2019)

Transfer the woman to obstetric-led care if any of the following are observed at any point, unless the risks of transfer outweigh the benefits:

- a single reading of either raised diastolic blood pressure of 110 mmHg or more or raised systolic blood pressure of 160 mmHg or more
- either raised diastolic blood pressure of 90 mmHg or more or raised systolic blood pressure of 140 mmHg or more on 2 consecutive readings taken 30 minutes apart (NICE Intrapartum care guideline CG190) (National Institute for Health and Care Excellence 2014)

If induction is unsuccessful, discuss this with the woman and provide support. Fully reassess the woman's condition and the pregnancy in general, and assess fetal wellbeing using antenatal cardiotocography interpretation (NICE Guideline NG207 Inducing labour) (National Institute for Health and Care Excellence 2021)

If induction is unsuccessful, discuss and agree a plan for further management with the woman, including whether she would like further attempts at induction, taking into account the clinical circumstances and her preferences (NICE Guideline NG207 Inducing labour) (National Institute for Health and Care Excellence 2021)

In women with severe pre-eclampsia, limit maintenance fluids to 80 ml/hour unless there are other ongoing fluid losses (for example, haemorrhage) (NICE Guideline NG133 Hypertension in pregnancy) (National Institute for Health and Care Excellence 2019)

For women with gestational hypertension whose blood pressure is lower than 160/110 mmHg after 37 weeks, timing of birth, and maternal and fetal indications for birth should be agreed between the woman and the senior obstetrician (NICE Guideline NG133 Hypertension in pregnancy) (National Institute for Health and Care Excellence 2019)

For women with pre-eclampsia who are 37 weeks onwards initiate birth within 24-48 hours (NICE Guideline NG133 Hypertension in pregnancy) (National Institute for Health and Care Excellence 2019)

7. Lessons on caring for women with early pregnancy disorders

Roshni Patel and Marian Knight on behalf of the MBRRACE-UK early pregnancy chapter-writing group

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

7.1 New recommendations for care

Vulnerable and young women remain disproportionately represented amongst those who have died from ectopic pregnancy. Ensure care is personalised to provide appropriate additional safety measures [**ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards**].

7.2 Background

Women are still dying from early pregnancy problems. In this report almost all women died from ectopic pregnancy, which remains as frequent cause of maternal death as other pregnancy problems such as hypertensive disorders. Maternal deaths from early pregnancy-related causes may also be secondary to complications of termination of pregnancy, trophoblastic disease and miscarriage.

7.3 The women who died

In 2018-2020, 109 women died whilst less than 24 weeks gestation or after a pregnancy that ended at less than 24 weeks in the United Kingdom and Ireland. Nine of these women died from early pregnancy problems and their care is considered here. No women died from trophoblastic disease. One woman died from complications of an incomplete miscarriage. The remaining eight women who died had ectopic pregnancies. All women who were diagnosed before death died within 48 hours of presentation.

7.4 Overview of care and new lessons to be learned

Managing pregnancy of unknown location

A vulnerable woman presented to the emergency department with a suspected miscarriage. She had taken photographs of the expelled products. She had an ultrasound scan, which showed an empty uterus, and no adnexal masses. Speculum examination confirmed a closed cervical os. Based on these findings and the photographs she was told she had a complete miscarriage and discharged home with the advice to repeat a pregnancy test in two weeks. She was not given any written information and did not have a current GP. She was found dead three weeks later. Post-mortem confirmed intra-abdominal haemorrhage secondary to ruptured ectopic pregnancy.

Women with pregnancy of unknown location warrant particularly close attention and it is essential to adhere to national guidance (National Institute for Health and Care Excellence 2019). Products of conception cannot be diagnosed from photographs. Women should be managed as a pregnancy of unknown location if a pregnancy has not been previously identified on ultrasound scan. Vulnerable women need additional safety netting in place. Where a follow up pregnancy test is required, systems need to be in place to ensure this occurs. If a woman cannot afford a pregnancy test, she should be given a follow-up appointment in the early pregnancy service or provided with a pregnancy test at the time of discharge.

Vulnerable and young women remain disproportionately represented amongst those who have died from ectopic pregnancy. They need additional safety measures incorporated into their care, for example, enhanced follow-up pathways. Each contact with girls or women of childbearing age following miscarriage, prescribing contraception, at

sexually-transmitted infection screening and at smear tests is an opportunity to educate regarding red flag symptoms associated with ectopic pregnancy. The awareness of symptoms may reduce deaths amongst vulnerable women and teenage girls.

Vulnerable and young women remain disproportionately represented amongst those who have died from ectopic pregnancy. Ensure care is personalised to provide appropriate additional safety measures. N

7.5 Conclusions

Assessors concluded that almost all the women who died from an ectopic pregnancy could have had better care, which might have altered the outcome for a third (3/9). Whilst the numbers in this report are small, ectopic pregnancy remains common with a prevalence of approximately 1%. With improved patient and clinician awareness regarding the symptoms of ectopic pregnancy more extra uterine pregnancies could be identified earlier and before collapse occurs. Where women of reproductive age, who may or may not be known to be pregnant, present with collapse, an ectopic pregnancy must be excluded as venous thromboembolism and cardiac disease must not be considered as the only causes. Every opportunity should be taken to ensure women of reproductive age who seek gynaecological or early pregnancy care are aware of the symptoms associated with ectopic pregnancy. It is important that all women know where to seek advice if they are concerned, that early pregnancy services are visible and accessible and welcoming to young and vulnerable women.

7.6 Existing recommendations requiring improved implementation

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

When diagnosing complete miscarriage on an ultrasound scan, in the absence of a previous scan confirming an intrauterine pregnancy, always be aware of the possibility of a pregnancy of unknown location. Advise these women to return for follow-up (for example, hCG levels, ultrasound scans) until a definitive diagnosis is obtained (NICE guideline NG126) (National Institute for Health and Care Excellence 2019)

Throughout a woman's care, provide the woman and (with her consent) her partner specific evidence-based information in a variety of formats. This should include (as appropriate):

- when and how to seek help if existing symptoms worsen or new symptoms develop, including a 24-hour contact telephone number
- what to expect during the time she is waiting for an ultrasound scan
- what to expect during the course of her care (including expectant management), such as the potential length and extent of pain and/or bleeding, and possible side effects; this information should be tailored to the care she receives

Ensure that sufficient time is available to discuss these issues with women during the course of her care and arrange an additional appointment if more time is needed (NICE guideline NG126) (National Institute for Health and Care Excellence 2019)

Women of reproductive age who present with shock or collapse of unknown cause should have a Focused Assessment with Sonography in Trauma (FAST) scan before they receive thrombolysis. Only surgical care can save these women (Saving Lives, Improving Mothers' Care 2016) (Knight, Nair et al. 2016)

8. Lessons for critical care

Katie Cranfield, Nuala Lucas, Marian Knight and Frank Schroeder on behalf of the MBRRACE-UK critical care chapter-writing group

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

8.1 New recommendations for care

Ensure the appropriate national Maternity Early Warning Score is used to monitor a pregnant woman wherever in the hospital she receives care [**ACTION: Service Planners/Commissioners, Hospitals/Trusts/Health Boards, All Health Professionals**].

Involve the critical care team in antenatal multidisciplinary team planning for women with serious morbidity who may require admission to intensive care after giving birth [**ACTION: All Health Professionals**]

8.2 Background

Looking after critically ill pregnant and postpartum women requires a multidisciplinary team of experts in critical care, obstetrics, midwifery and other medical and surgical disciplines as well as allied hospital services. Women admitted to ICU are often young and previously well, and the deterioration leading to ICU admission is often unexpected. The National Maternity and Perinatal Audit (NMPA) analysis of maternity admissions to intensive care in England, Wales and Scotland identified a rate of 2.75 admissions per 1000 women who were pregnant or recently pregnant (Jardine and NMPA Project Team 2019). Admission to ICU was more likely among women of advanced maternal age, Black ethnicity, BMI over 35kg/m² and parity of 3 or more. Outcomes for obstetric patients admitted to ICU are generally good, with relatively short length of stay, and only a very small proportion requiring an admission lasting longer than seven days. However, the care of women who were reviewed in this chapter nevertheless identified some important messages for learning.

8.3 The women who died

For the purposes of this chapter, the care of 35 women was reviewed. Cardiac disease was the most frequent cause of women's death (11 women), reflecting the fact that it remains the leading cause of maternal death alongside psychiatric disorders. Women who die from mental health-related causes are under-represented amongst those cared for in ICU due to the high proportion who die by violent suicide. Note that this does not represent all women cared for in ITU who died between 2018-20, solely those whose care was reviewed for the purposes of the chapters in this report.

8.4 Overview of care and new lessons to be learned

Identification of critical illness

A woman presented to primary and secondary care several times in the third trimester with tiredness and respiratory symptoms. She was eventually diagnosed with metastatic cancer during an emergency department attendance. She deteriorated rapidly, and a decision was made to expedite birth. Despite being short of breath, she did not have a chest X-ray or blood gas analysis before her caesarean section. Postoperatively she received routine postoperative care in the labour ward. Her continued deterioration was not detected until several hours after she gave birth, when investigations confirmed she had developed an acute kidney injury and liver failure. She was transferred to ITU but died three days later.

A maternity early warning score chart which may have expedited the recognition of this woman's deterioration was not in use. A critical care outreach team could have provided valuable and earlier input into the care of this woman, if her deterioration had been identified.

Ensure the appropriate national Maternity Early Warning Score is used to monitor a pregnant woman wherever in the hospital she receives care. **N**

High risk conditions – planning and peripartum management

A woman developed significant dyspnoea in the third trimester of pregnancy and was diagnosed with pulmonary hypertension. She was immediately transferred to a tertiary centre with experts in the management of pulmonary hypertension. After extensive investigation and multidisciplinary discussion, an elective caesarean section was planned. She was admitted to ITU preoperatively to optimise care. Caesarean section under regional anaesthesia was uneventful until shortly after she gave birth, when she had a cardiac arrest from which she could not be resuscitated.

Despite improvements in therapeutic strategies and management, pulmonary hypertension remains a condition associated with high maternal mortality (Martin and Edwards 2019, Low, Guron et al. 2021). Patients can experience rapid deterioration during pregnancy and particularly at the time of giving birth. Given the risk of significant decompensation in the period surrounding delivery and the first week postpartum, it is vital that critical care specialists are involved in planning care around this period. Particular thought should be given to the location of birth, taking into account plans for ongoing care and management should the patient decompensate during this period. As in this woman's care, it may be appropriate to consider antenatal admission to a critical care unit to optimise care prior to birth, as well as to extend the period of intensive care postpartum. Making women with pulmonary hypertension and similar high-risk conditions aware of the possible need for ICU care as part of pre-pregnancy discussions may be appropriate.

Involve the critical care team in antenatal multidisciplinary team planning for women with serious morbidity who may require admission to intensive care after giving birth.

8.5 Conclusions

As these reports have frequently highlighted, critical care is a treatment, not a place. Early involvement of the critical care outreach team when women deteriorate can facilitate earlier escalation of care, and allows for nuanced discussion of the preferred location of care, taking into account each woman's individual needs. For women with underlying medical co-morbidities who are likely to require critical care, planning ahead and antenatal critical care admission to optimise treatment could be considered. For the women whose care was assessed for the purposes of this chapter, assessors felt that improvements in care might have made a difference to outcome for 49% (17/35). While this assessment relates to improvements across the whole care pathway, it was clear that for some women, better integration of critical care within the multidisciplinary team might have led to the earlier, intensive, care that they needed.

8.6 Existing recommendations requiring improved implementation

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

The recognition and management of severe acute illness requires good multidisciplinary teamwork. An anaesthetist or critical care specialist should be involved early (Saving Mothers' Lives 2011) (Lewis, Cantwell et al. 2011)

The route of escalation to critical care services should be clearly defined and include multidisciplinary discussion. Critical care outreach or an equivalent service should be available to ill women and provide support and education to healthcare professionals delivering enhanced maternal care (Enhanced Maternal Care guidelines 2018) (Maternal Critical Care/Enhanced Maternity Care Standards Development Working Group 2018)

Women with pre-existing medical conditions should have pre-pregnancy counselling by doctors with experience of managing their disorder in pregnancy (Saving Lives, Improving Mothers' Care 2014) (Knight, Kenyon et al. 2014)

A general clinical assessment should be performed to assess malnutrition in the ITU, until a specific tool has been validated. The general clinical assessment should include a nutritional [history], such as unintentional weight loss or a decrease in physical performance before ICU admission. It should also include a physical examination, general assessment of body composition, and muscle mass and strength, if possible. Every critically ill patient staying for more than 48 h in the ICU should be considered at risk for malnutrition (ESPEN Guideline on clinical nutrition in the intensive care unit) (Singer, Blaser et al. 2019)

Referral to the NHS ECMO service should be made for pregnant women or women post-pregnancy using the same criteria as for other adult patients. Where doubt exists about a woman's suitability for ECMO, clinicians should seek advice from their regional ECMO centre early (Saving Lives, Improving Mothers' Care Rapid Report 2021) (Knight, Bunch et al. 2021)

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10. Glossary of terms

AFLP	Acute Fatty Liver of Pregnancy
BMI	Body Mass Index
BNP	Brain Natriuretic Peptide
BP	Blood pressure
CEMD	Confidential Enquiries into Maternal Deaths
CI	Confidence interval
CMACE	Centre for Maternal and Child Enquiries
COVID-19	Coronavirus disease 2019
CT	Computerised Tomography
DKA	Diabetic ketoacidosis
ECMO	Extracorporeal membrane oxygenation
ESC	European Society for Cardiology
hCG	Human chorionic gonadotropin
HELLP	Haemolysis, Elevated Liver enzymes and Low Platelets
HSIB	Healthcare Safety Investigation Branch
HQIP	Healthcare Quality Improvement Partnership
ICD-MM	International Classification of Diseases – Maternal Mortality
ICU	Intensive care unit
ITU	Intensive therapy unit
JBDS-IP	Joint British Diabetes Societies for Inpatient Care
MBRRACE-UK	Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK
MDE	Maternal Death Enquiry
MRI	Magnetic Resonance Imaging
NCAPOP	National Clinical Audit and Patient Outcomes Programme
NEWS	National Early Warning Scores
NICE	National Institute for Health and Care Excellence
NIHR	National Institute for Health and Care Research
NIMACH	Northern Ireland Maternal and Child Health
NMPA	National Maternal and Perinatal Audit
RCM	Royal college of Midwives
RCOG	Royal College of Obstetricians and Gynaecologists
RCP	Royal College of Physicians
RR	Rate ratio
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
UKOSS	UK Obstetric Surveillance System
WHO	World Health Organisation

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