

Maternal Deaths from Major Obstetric Hemorrhage in the UK: Changing Evidence from the Confidential Enquiries (1985–2011)

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INTRODUCTION

Tragically, despite the UK having one of the best maternity services in the world, women still die of a variety of causes related to childbirth. To understand better these causes and prevent their recurrence, the UK developed a process of reporting maternal mortality in the middle of the 19th century. It was not until 1952, however, that these Confidential Enquiries into Maternal Deaths began to assess formally the principal causes of maternal deaths, identify avoidable factors and recommend improvements in clinical care and service provision¹. This continuing effort has been recognized as the world's finest medical audit and its presence has not only reshaped maternity services across UK, but also has a broad international influence.

Since 1985–1987, a single report published triennially has incorporated all maternal deaths in England, Wales, Scotland and Northern Ireland. As of 2003, the reports have been titled 'Saving Mothers' Lives'; previously, they were known as 'Why Mothers Die'.

The Confidential Enquiry into Maternal and Child Health (CEMACH) was established in April 2003, replacing the combined CEMD (Confidential Enquiries into Maternal Deaths) and CESDI (Confidential Enquiry into Stillbirths and Deaths in Infancy). The editorial efforts were incorporated into the Centre for Maternal and Child Enquiries (CMACE), a free standing charity in its own right since July 2009, and the triennial report in 2011 was published under the auspices of CMACE².

Of the important causes of maternal death in the UK, major obstetric hemorrhage (MOH) remained the third leading direct cause of maternal death between 1985 and 2005 except in 2000–2002 when it ranked second^{3–9}. In the 2006–2008 report, it ranked as sixth¹⁰.

Although encouraging, this decline is not statistically significant, and there is no place for complacency. It is unfortunate that even with a reduction in maternal deaths from MOH, the majority still result

from substandard care (Figure 1). Occasionally, however, deaths are deemed unavoidable despite excellent care, as some cases have unusual presentations which delay clinical diagnosis and treatment¹⁰.

This chapter follows the trends in maternal death contributed by MOH as described in the Confidential Enquiry reports over the past 23 years (since 1985). Table 1 summarizes the absolute numbers of maternal deaths from different causes of MOH. The evolutions of the different major causes of maternal deaths are outlined below.

PLACENTAL ABRUPTION

Substandard management of complications

Women died due to complications secondary to abruption such as disseminated intravascular coagulopathy (DIC) and end organ failures (renal, hepatic and respiratory including acute respiratory distress syndrome (ARDS)) when these complications were managed inadequately.

In earlier reports, substandard care due to fluid overload resulted in pulmonary edema, highlighting inadequacies in critical care in obstetrics, especially that not involving the anesthetists. However, since 2000–2002 maternal deaths secondary to inadequate supportive care have reduced significantly, although isolated deaths have occurred where abruption

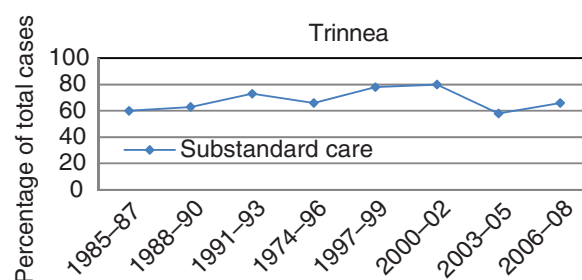


Figure 1 Trends in substandard care

Table 1 Direct deaths by type of obstetric hemorrhage and mortality rate UK: 1985–2008

Triennium	Causes of maternal deaths from MOH					Rate (per 100,000 maternities)
	Placental abruption	Placenta previa	PPH	Genital tract trauma	Total	
1985–1987	4	0	6	6	16	0.71
1988–1990	6	5	11	3	25	1.06
1991–1993	3	4	8	4	19	0.82
1994–1996	4	3	5	5	17	0.77
1997–1999	3	3	1	2	9	0.42
2000–2002	3	4	10	1	18	0.90
2003–2005	2	3	9	3	17	0.80
2006–2008	2	2	5	0	9	0.39

MOH, major obstetric hemorrhage

was complicated with amniotic fluid embolism (2000–2002).

Substandard care occurred in one case (1991–1993) after cesarean section for abruption when the patient developed bowel perforation secondary to active ulcerative colitis that was managed inappropriately by not involving surgeons at an early stage⁵.

Complex clinical scenarios

Challenging cases included management of intra-uterine fetal death in women with previous uterine scars where differentiation between scar dehiscence and abruption delayed onset of appropriate treatment.

Other contributory factors

In the 1997–1999 report, a maternal death was considered unavoidable in a case of placental abruption where contributory factors (domestic violence and pulmonary hypertension) were present⁶. Such occurrences are rare and no further fatal outcomes of a similar nature have been reported to date.

PLACENTA PREVIA

Lack of consultant involvement

In late 1980s and early 1990s, a common cause of the provision of substandard care was the undertaking of a cesarean section for placenta previa by inexperienced obstetric registrars and, in a few instances, by inexperienced anesthetists. These conditions were accompanied by poor postoperative care and monitoring which led to delays in detecting intraperitoneal hemorrhage. Since 2000–2002, however, consultant (anesthetist and obstetrician) involvement in the management of placenta previa, especially in elective case therapy, has improved⁸.

Inadequate diagnosis of placenta previa/accreta

The 1991–1993 report highlighted that less than optimal quality ultrasound scans could miss detection of low-lying placenta, especially in cases where the pelvic

anatomy was distorted. This led to many unexpected findings of placenta previa/accreta during emergency cesarean sections which were followed by MOH and maternal mortality⁵.

Thereafter, subsequent recommendations emphasized the importance of confirming placental location in all cases, especially in women with previous uterine scars (cesarean section, myomectomy, uterine surgery). Later reports showed significant improvement in assessing placental location and in the diagnosis of morbidly adherent placenta.

Management of morbidly adherent placenta

The problem of placenta previa/accreta appears to be increasing, perhaps reflecting the increasing number of operative births. One key recommendation is to ensure that all women with previous cesarean sections undergo placental localization with ultrasound. Additional investigations are warranted using trans-abdominal and transvaginal probes and magnetic resonance imaging (MRI) if persisting anterior placenta previa is found. Although this is a standard practice in most UK units, it is not followed universally⁹. Despite excellent preoperative planning and management in placenta accreta/percreta, women still die from MOH and surgical complications as optimum management is still not uniform and often patients receive operations that may not be optimal for the site of the placental invasion (see Chapters by Palacios at the beginning of the book).

Failure to admit women with placenta previa at term

The 1994–1996 report⁶ highlighted the importance of admitting women with placenta previa at term, especially in the presence of vaginal bleeding. Lessons were learnt and there were no further maternal deaths from this factor.

POSTPARTUM HEMORRHAGE

Deaths from PPH continue to outnumber those from antepartum hemorrhage.

Cesarean section (intra- and postoperative)

Lack of surgical competency

Inadequate primary hemostasis during cesarean section, followed by massive postoperative intraperitoneal hemorrhage, has been a constant and important cause of maternal mortality in most reports.

Inexperience of the trainees was highlighted since the 1994–1996 reports, whereby inexperienced trainees performed complex cesarean sections without adequate supervision leading to catastrophic complications in the immediate postoperative period. Although this may have been due to the introduction of a new training structure for the junior obstetric trainees, the

involvement of more senior and experienced consultant obstetricians has been repeatedly emphasized in subsequent reports^{5–7}. This has been followed by improvements in consultant involvement in recent reports^{8–10}, especially in elective cases.

Control of hemorrhage and resuscitation

Failure to seek consultant help early and delay in decision-making for radical surgery (such as hysterectomy) was crucial in many maternal deaths throughout the reports. The 1997–1999 report first mentioned conservative surgical techniques such as B-Lynch sutures and internal iliac artery ligations.

Some obstetric consultants may not have the necessary surgical skills such as cesarean hysterectomy. In these cases, early involvement of experienced gynecology consultants has been strongly recommended.

Lack of clinical leadership and poor communication between multidisciplinary teams also has been highlighted, especially since the 1997–1999 report, as contributing to the substandard care in emergency situations⁷.

Failure to diagnose intraperitoneal hemorrhage in the postoperative period

This had been an important contributor to delay in resuscitation leading to maternal death. Inexperience of trainees again was highlighted as the most important cause of intraperitoneal hemorrhage in recent reports. Although the need for regular 'fire drills' has been highlighted in reports since 1991–1993⁵, it was the 2003–2005 report that first recommended the modified obstetric early warning system (MEOWS) chart and regular training on maternal collapse. The recommendation was followed by significant improvement in postoperative care, as evident in the latest report. The MEOWS charts are now standard in many UK units⁹.

Improper case selection

Routine booking of women with a high risk of bleeding during delivery/cesarean section was frequently reported till the late 1990s. Maternal deaths as a result of MOH, not surprisingly after cesarean section in cases complicated by severe thrombocytopenia, for example, occurred after booking in small district general hospitals without the facilities of a blood bank and intensive care units^{3–5}.

Instrumental delivery

Genital tract trauma following instrumental delivery leading to maternal death is rare but has been reported on occasion. Substandard care included lack of continuous vigilance by senior obstetricians, including the delegation to a senior house officer (SHO) of the repair of an extensive vaginal tear in a hypotensive patient (1998–2000).

In another instance, a broad ligament hematoma occurred after a difficult instrumental delivery by an SHO, and the woman later died of ARDS (1985–1987). Finally, an intractable atonic PPH followed an instrumental delivery but was unrelated to the procedure (1994–1996).

Spontaneous vaginal delivery

MOH secondary to atonic PPH following spontaneous vaginal delivery has declined since the 1997–1999 report⁵. Previously important contributory factors for atonic PPH were failure of diagnosis of clotting disorders (1985–1987), retained placenta (1988–1990), associated amniotic fluid embolism (AFE) and severe pre-eclamptic toxemia (PET) (1991–1993). Substandard care included delayed transfer to intensive therapy unit (ITU) for adequate supportive care after initial resuscitation.

Uterine rupture

There has been a significant decline in maternal deaths following uterine rupture since the 2003–2005 report. The main causes for uterine ruptures were prescribing high doses of prostaglandin for induction of labor in multiparous women and Syntocinon[®] augmentation in vaginal birth after cesarean section (VBAC)⁹.

Coagulation disorders

Coagulation disorders often complicate MOH. A common cause of substandard care was failure of early diagnosis and treatment of DIC. In earlier reports (1985–1987), the occurrence of DIC was as high as 70% in the cases of maternal death due to MOH. Subsequent reports, however, have shown a decline in coagulation failure (less than 50% in 1988–1990 and approximately 27% in 1991–1993). No specific data have been presented on coagulation failure in association with MOH in subsequent reports. However, the incidence of DIC is still thought to be high, and recent reports repeatedly emphasize the need for early involvement of consultant hematologists in MOH to prevent and treat DIC^{3–10}.

Inaccurate estimation of blood loss

This remains a recurring contributory factor for maternal deaths due to MOH in all triennial reports. Reports since 1993–1995 have emphasized the awareness of health care professionals of the rapidly fatal consequences of MOH. Underestimation of blood loss leads to improper assessment of patients, delayed resuscitation and development of the coagulopathy, leading to maternal death.

In response to this recurring theme, the 2006–2008 report advocated the use of early warning scoring systems. These are used in other clinical areas, but need to be modified to account for the differences in

maternal physiology in pregnancy. It is hoped that they will help in the more timely recognition, treatment and referral of women who have or are developing a critical response to illness. Such systems should not only be used in delivery suite settings, but also in all other clinical areas where pregnant women are managed (e.g. early pregnancy units, emergency departments and critical care).

The vital role of the anesthetic team has been highlighted in almost all reports. During resuscitation, the anesthetists have a major role in monitoring fluid, blood and blood product replacement. Management includes early use of invasive monitoring such as arterial and central venous pressure lines (specifically mentioned since the 1997–1999 report)⁵.

Antenatal care

Correction of anemia

The importance of correcting anemia prior to delivery has been recommended since the 1985–1987 report. Despite this, correcting anemia in women with a high risk of hemorrhage still requires attention.

Early booking

Organizational failures with early booking have been highlighted since the 2000–2002 report. The 2003–2005 report specifically raised concerns regarding the adverse effects of late booking for women of ethnic minorities and women who do not speak English.

Women refusing antenatal care

This has contributed to maternal death in almost all triennial reports. These women mainly conceal their pregnancy due to a fear of the child being taken away after birth. Maternal deaths are considered almost unavoidable in such cases, especially if obstetric complications go undetected throughout antenatal period.

Women refusing blood products

In almost all triennial reports, women have died as a result of their religious beliefs and their refusal of blood products. It is inappropriate to influence these women's religious beliefs, but it is important that they are recognized and suitable plans put into place. The 1991–1993 CEMACH report added guidelines for 'The treatment of obstetric haemorrhage in women who refuse blood transfusion'. This was re-issued in 2000–2002 as 'Guidelines for the management and treatment of obstetric haemorrhage in women who decline blood transfusion'. Despite the presence of such guidelines, two deaths occurred in 2003–2005 in women refusing blood products. Specific recommendations included ensuring that guidelines are available to and discussed with all maternity staff. The roles of consultant obstetricians and anesthetic care are paramount in planning antenatal care and delivering these

women. Red blood cell salvage was recognized as a very effective intervention. These women ideally should be delivered in units which are familiar with this practice if they consent to the intervention.

Encouraging improvement in care

Place of care

High risk women need to be cared for in units with on-site blood bank and intensive care facilities. There has been significant improvement with proper case selection in low risk units.

Input from experienced operators

In early reports, it was not uncommon for inexperienced house officers or junior registrars to be managing complicated cases with indirect supervision. This delayed early active intervention with subsequent maternal deaths. With time this has been recognized and addressed, with calls for increased consultant presence on the labor ward. As junior training hours decrease, it is possible that consultants of the future may not have the full range of competencies. Accordingly, it is important to note that the attending clinician should have the appropriate experience as well as seniority.

Newer interventions

The triennial reports have emphasized the safety and effectiveness of the newer techniques such as B-Lynch sutures, intrauterine balloons and interventional radiology⁸.

Recommendations

Early recognition of serious illness and effective, multidisciplinary, team working are key to avoiding potentially avoidable maternal deaths. Highlights of the important recommendations in the last eight reports are summarized in Figure 2.

Maternal morbidity

Since the 2003–2005 report, there has been mention on occasions of severe maternal morbidity following peripartum hysterectomy. The UK Obstetric Surveillance System (UKOSS) data on peripartum hysterectomy 2005–2006 revealed that the most common cause of hemorrhage was uterine atony (53%)¹¹.

Can maternal deaths secondary to MOH be entirely eliminated?

Based on the principles of modern medicine, in an ideal world, no mother should die of MOH. However, the reality may be far from this naive assumption. As noted above, there have been other causes of maternal deaths apart from substandard clinical care. The examples include women refusing blood products

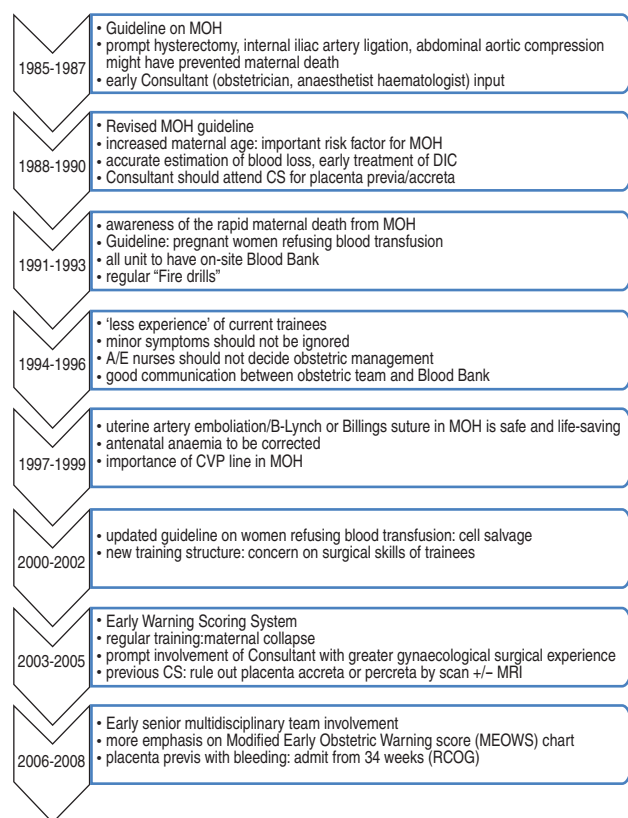


Figure 2 Summary of recommendations from the Confidential Enquiry reports 1985–2008. A/E, accident and emergency; CS, cesarean section; CVP, central venous pressure; DIC, disseminated intravascular coagulopathy; MOH, major obstetric hemorrhage; RCOG, Royal College of Obstetricians and Gynaecologists. Adapted from CEMACH³⁻⁹

and concealed pregnancy, where regardless of excellent care, maternal deaths were deemed unavoidable. Therefore, all health care professionals involved in care of pregnant women should aim towards elimination of substandard care. This may not prevent all maternal deaths but will certainly reduce them significantly.

Actions by professional bodies

To ensure a robust system of preventing maternal morbidity and mortality, the following standards have been laid out by relevant professional bodies (UK).

Royal College of Obstetricians and Gynaecologists (RCOG)¹²

Intervention radiology RCOG has strongly recommended the availability of interventional radiology to prevent and treat MOH. This technique is effective to prevent and treat MOH and reduce transfusion, hysterectomy, maternal morbidity and mortality. It can be used either to embolize bleeding vessels in acute hemorrhage or prophylactically to occlude (with a special balloon) internal iliac or uterine arteries in suspected placenta accreta.

Maternity dash board This is a tool to benchmark activity and monitor performance against the standards for the maternity unit on a monthly basis. It essentially follows the principles of a car dashboard, so that appropriate action can be taken before the car breaks down. The following are monitored as an integral part of the dash board: clinical activity, workforce, clinical outcomes and risk incidents/complaints or patient satisfaction surveys.

Consultant involvement It is quite clear that early consultant involvement is crucial to prevent maternal mortality in MOH. Apart from 24 hour consultant cover in the delivery suite, RCOG has also recommended that in the following situations, the consultant should attend in person, irrespective of the level of the trainee:

- (1) Maternal collapse (such as massive abruption, septic shock);
- (2) Cesarean section for major placenta previa;
- (3) PPH of more than 1.5 liters where:
 - (a) The hemorrhage is continuing and a MOH;
 - (b) The protocol has been instigated;
- (4) Return to theater – laparotomy;
- (5) When requested.

Improving communication Poor communication can lead to fatal consequences. It has been suggested that one-to-one handover should follow the SBAR (situation background assessment recommendation) tool. SHARING (staff, high risk, awaiting theatre, recovery ward, inductions, NICU, gynecology) is a structured form of written handover that takes place at the beginning and end of each shift (between in-coming and out-going on-call teams).

In most UK maternity units, there is an established system of emergency call to get the relevant staff (such as obstetric, anesthetist and hematology on-call teams and porters) in case of a MOH. In such a situation, this is usually by calling the hospital switchboard with the number '2222' and asking for relevant codes (in different units, it is variously called 'MOH call', 'code red' or 'code blue' call).

Guidelines Guidelines have been developed on 'Prevention and management of PPH' and 'Blood transfusion in Obstetrics' to standardize the management of MOH in all maternity units in UK. Figure 3 summarizes the RCOG recommended algorithm in the management of MOH described in the 'Prevention and management of PPH'.

National Patient Safety Agency (NPSA)¹⁴

The placenta previa after cesarean section (PPCS) care bundle All women undergoing cesarean section at high risk of placenta accreta should be managed in

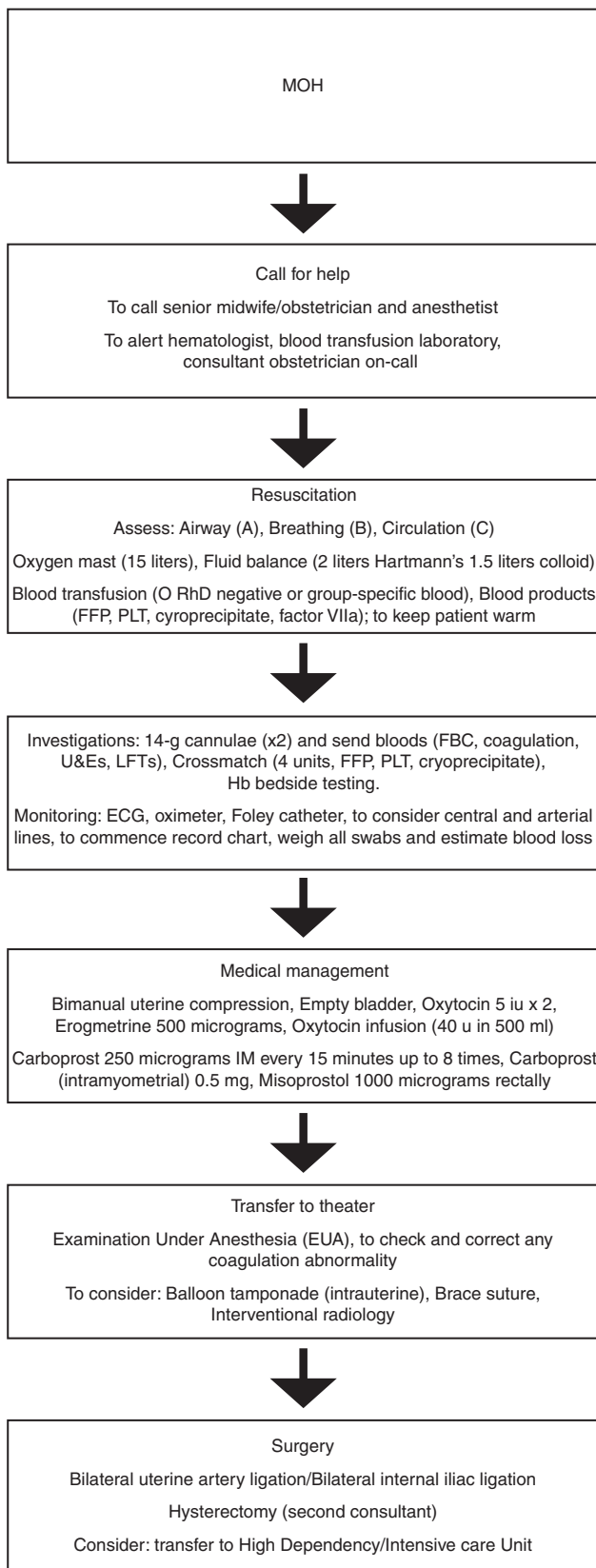


Figure 3 Algorithm to manage PPH/major obstetric hemorrhage¹³. FFP, fresh frozen plasma; PLT, platelets; FBC, full blood count; U&Es, urea and electrolytes; HB, hemoglobin; LFTs, liver function tests; ECG, electrocardiogram

line with this care bundle. The important considerations of the bundle include:

- (1) Consultant obstetrician and anesthetist directly supervising the delivery;
- (2) Blood and blood products available on site;
- (3) Patient's consent for possible interventions (hysterectomy, cell salvage, interventional radiology and leaving placenta *in situ*);
- (4) Multidisciplinary involvement in preoperative planning;
- (5) Local availability of level 2 critical care bed.

SUMMARY

MOH remains an important direct cause of maternal death in the UK. The triennial reports have indicated areas of substandard care and directions for further research and audits. Improvement of care in women with MOH is taking place. For example, blood bank facilities have been made available on site, experienced operators are more readily accessible, and skills and drills have been introduced to facilitate team work and communication.

Even so, the obstetric care team continues to face challenges as not all areas of substandard care have been addressed. Adequate resuscitation in MOH is often 'too little and too late'. The tendency to underestimate the effect of massive blood loss can continue because women in pregnancy can compensate for a period of time and then decompensate very rapidly. It is hoped that early warning scoring systems may address this issue. As the work force becomes more specialized with fewer training hours, appropriately experienced operators must be available to carry out complex surgical procedures. A multidisciplinary approach should be pursued in all aspects of care, anticipating, managing and caring for women at risk of and experiencing PPH.

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