BJOG An International Journal of Obstetrics and Gynaecology

Royal College of Obstetricians & Gynaecologists

Prevention and Management of Postpartum Haemorrhage

Green-top Guideline No. 52

December 2016

Please cite this paper as: Mavrides E, Allard S, Chandraharan E, Collins P, Green L, Hunt BJ, Riris S, Thomson AJ on behalf of the Royal College of Obstetricians and Gynaecologists. Prevention and management of postpartum haemorrhage. BJOG 2016;124:e106–e149.

DOI: 10.1111/1471-0528.14178

Prevention and Management of Postpartum Haemorrhage

This is the second edition of this guideline, which was published in 2009 under the same title. The 2009 guideline was based on an earlier guideline on the management of postpartum haemorrhage (PPH) developed in 1998 under the auspices of the Scottish Committee of the Royal College of Obstetricians and Gynaecologists (RCOG) and updated in 2002.[1]

Executive summary of recommendations

Prediction and prevention of PPH

What are the risk factors for developing PPH and how can they be minimised?

Risk factors

Risk factors for PPH may present antenatally or intrapartum; care plans must be modified as and when risk factors arise. ✓

Clinicians must be aware of risk factors for PPH and should take these into account when counselling women about place of delivery. ✓

Women with known risk factors for PPH should only be delivered in a hospital with a blood bank on site. D

Minimising risk – treating antenatal anaemia

Antenatal anaemia should be investigated and treated appropriately as this may reduce the morbidity associated with PPH. [*New 2016*] D

Minimising risk – reducing blood loss at delivery

Uterine massage is of no benefit in the prophylaxis of PPH. [*New 2016*] A

Prophylactic uterotonics should be routinely offered in the management of the third stage of labour in all women as they reduce the risk of PPH. A

For women without risk factors for PPH delivering vaginally, oxytocin (10 iu by intramuscular injection) is the agent of choice for prophylaxis in the third stage of labour. A higher dose of oxytocin is unlikely to be beneficial. A

For women delivering by caesarean section, oxytocin (5 iu by slow intravenous injection) should be used to encourage contraction of the uterus and to decrease blood loss. B

Ergometrine–oxytocin may be used in the absence of hypertension in women at increased risk of haemorrhage as it reduces the risk of minor PPH (500–1000 ml). C

For women at increased risk of haemorrhage, it is possible that a combination of preventative measures might be superior to syntocinon alone to prevent PPH. [*New 2016*] ✓

Clinicians should consider the use of intravenous tranexamic acid (0.5–1.0 g), in addition to oxytocin, at caesarean section to reduce blood loss in women at increased risk of PPH. [*New 2016*] A

How should PPH be managed?

Identification of the severity of haemorrhage

Clinicians should be aware that the visual estimation of peripartum blood loss is inaccurate and that clinical signs and symptoms should be included in the assessment of PPH. [*New 2016*] C

Communication and multidisciplinary care

Communication with the woman

Communication with the patient and her birthing partner is important, and clear information of what is happening should be given from the outset. [*New 2016*] ✓

Who should be informed when the woman presents with PPH?

Relevant staff with an appropriate level of expertise should be alerted of PPH. [*New 2016*] ✓

The midwife in charge and the first-line obstetric and anaesthetic staff should be alerted when women present with minor PPH (blood loss 500–1000 ml) without clinical shock. ✓

A multidisciplinary team involving senior members of staff should be summoned to attend to women with major PPH (blood loss of more than 1000 ml) and ongoing bleeding or clinical shock. ✓

Resuscitation

Measures for minor PPH

Measures for minor PPH (blood loss 500–1000 ml) without clinical shock: ✓

- **intravenous access (one 14-gauge cannula)**
- **urgent venepuncture (20 ml) for:**
  - **group and screen**
  - **full blood count**
  - **coagulation screen, including fibrinogen**
- **pulse, respiratory rate and blood pressure recording every 15 minutes**
- **commence warmed crystalloid infusion.**

Measures for major PPH

Full protocol for major PPH (blood loss greater than 1000 ml) and continuing to bleed or clinical shock (see Appendix III): ✓

- **A and B – assess airway and breathing**
- **C – evaluate circulation**
- **position the patient flat**
- **keep the woman warm using appropriate available measures**
- **transfuse blood as soon as possible, if clinically required**
- **until blood is available, infuse up to 3.5 l of warmed clear fluids, initially 2 l of warmed isotonic crystalloid. Further fluid resuscitation can continue with additional isotonic crystalloid or colloid (succinylated gelatin). Hydroxyethyl starch should not be used.**
- **the best equipment available should be used to achieve rapid warmed infusion of fluids**
- **special blood filters should not be used, as they slow infusions.**

Blood transfusion

There are no firm criteria for initiating red cell transfusion. The decision to provide blood transfusion should be based on both clinical and haematological assessment. [*New 2016*] ✓

Selection of red cell units for transfusion

Major obstetric haemorrhage protocols must include the provision of emergency blood with immediate issue of group O, rhesus D (RhD)-negative and K-negative units, with a switch to group-specific blood as soon as feasible. [*New 2016*] D

If clinically significant red cell antibodies are present, close liaison with the transfusion laboratory is essential to avoid delay in transfusion in life-threatening haemorrhage. [*New 2016*] D

All delivery units, especially small units without a blood bank on site, should maintain a supply of group O, RhD-negative blood. [*New 2016*] ✓

Intraoperative cell salvage should be considered for emergency use in PPH associated with caesarean section and with vaginal delivery. [*New 2016*] D

Blood components

Transfusion of fresh frozen plasma (FFP)

If no haemostatic results are available and bleeding is continuing, then, after 4 units of red blood cells, FFP should be infused at a dose of 12–15 ml/kg until haemostatic test results are known. [*New 2016*] D

If no haemostatic tests are available, early FFP should be considered for conditions with a suspected coagulopathy, such as placental abruption or amniotic fluid embolism, or where detection of PPH has been delayed. [*New 2016*] ✓

If prothrombin time/activated partial thromboplastin time is more than 1.5 times normal and haemorrhage is ongoing, volumes of FFP in excess of 15 ml/kg are likely to be needed to correct coagulopathy. [*New 2016*] D

Clinicians should be aware that these blood components must be ordered as soon as a need for them is anticipated, as there will always be a short delay in supply because of the need for thawing. [*New 2016*] ✓

Fibrinogen

A plasma fibrinogen level of greater than 2 g/l should be maintained during ongoing PPH. [*New 2016*] C

Cryoprecipitate should be used for fibrinogen replacement. [*New 2016*] D

Transfusion of platelets

During PPH, platelets should be transfused when the platelet count is less than 75×10^9/l based on laboratory monitoring. [*New 2016*] D

Is there a role for antifibrinolytic drugs?

Consideration should be given to the use of tranexamic acid in the management of PPH. [*New 2016*] B

Is there a role for recombinant factor VIIa (rFVIIa) therapy?

The routine use of rFVIIa is not recommended in the management of major PPH unless as part of a clinical trial. [*New 2016*] ✓

Monitoring and investigation in major PPH: what investigations should be performed and how should women be monitored?

Full protocol for monitoring and investigation in major PPH (blood loss greater than 1000 ml) and ongoing haemorrhage or clinical shock: D

- **immediate venepuncture (20 ml) for:**
  - **cross-match (4 units minimum)**
  - **full blood count**
  - **coagulation screen, including fibrinogen**
  - **renal and liver function for baseline**
- **monitor temperature every 15 minutes**
- **continuous pulse, blood pressure recording and respiratory rate (using oximeter, electrocardiogram and automated blood pressure recording)**
- **Foley catheter to monitor urine output**
- **two peripheral cannulae, 14 gauge**
- **consider arterial line monitoring (once appropriately experienced staff available for insertion)**
- **consider transfer to intensive therapy unit once the bleeding is controlled or monitoring at high dependency unit on delivery suite, if appropriate**
- **recording of parameters on a modified early obstetric warning score (MEOWS) chart (see Appendix IV)**
- **acting and escalating promptly when abnormal scores from a MEOWS chart are observed**
- **documentation of fluid balance, blood, blood products and procedures.**

What is the role of the anaesthetist in the management of PPH?

The management of PPH requires a multidisciplinary approach: the anaesthetist plays a crucial role in maintaining haemodynamic stability and, if necessary, in determining and administering the most appropriate method of anaesthesia. [*New 2016*] D

What methods should be employed to arrest the bleeding?

Clinicians should be prepared to use a combination of pharmacological, mechanical and surgical methods to arrest PPH. These methods should be directed towards the causative factor. [*New 2016*] D

What pharmacological and mechanical strategies can be used?

When uterine atony is perceived to be a cause of the bleeding, then a sequence of mechanical and pharmacological measures should be instituted in turn until the bleeding stops. ✓

What surgical treatments can be employed to arrest the bleeding?

If pharmacological measures fail to control the haemorrhage, surgical interventions should be initiated sooner rather than later. D

Intrauterine balloon tamponade is an appropriate first-line 'surgical' intervention for most women where uterine atony is the only or main cause of haemorrhage. C

Conservative surgical interventions may be attempted as second line, depending on clinical circumstances and available expertise. C

It is recommended that a laminated diagram of the brace suture technique be kept in theatre. ✓

Resort to hysterectomy sooner rather than later (especially in cases of placenta accreta or uterine rupture). C

Ideally and when feasible, a second experienced clinician should be involved in the decision for hysterectomy. ✓

How should secondary PPH be managed?

In women presenting with secondary PPH, an assessment of vaginal microbiology should be performed (high vaginal and endocervical swabs) and appropriate use of antimicrobial therapy should be initiated when endometritis is suspected. [*New 2016*] D

A pelvic ultrasound may help to exclude the presence of retained products of conception, although the diagnosis of retained products is unreliable. [*New 2016*] C

Surgical evacuation of retained placental tissue should be undertaken or supervised by an experienced clinician. D

Risk management

Training and preparation: what measures can be taken to ensure optimal management of PPH?

Every maternity unit should have a multidisciplinary protocol for the management of PPH. [*New 2016*] ✓

All staff involved in maternity care should receive training in the management of obstetric emergencies, including the management of PPH. B

Training for PPH should be multiprofessional and include team rehearsals. [*New 2016*] B

All cases of PPH involving a blood loss of greater than 1500 ml should be the subject of a formal clinical incident review. D

Documentation

Accurate documentation of a delivery with PPH is essential. ✓

Debriefing

An opportunity to discuss the events surrounding the obstetric haemorrhage should be offered to the woman (possibly with her birthing partner/s) at a mutually convenient time. ✓

1. Purpose and scope

Primary postpartum haemorrhage (PPH) is the most common form of major obstetric haemorrhage. The traditional definition of primary PPH is the loss of 500 ml or more of blood from the genital tract within 24 hours of the birth of a baby.[2] PPH can be minor (500–1000 ml) or major (more than 1000 ml). Major can be further subdivided into moderate (1001–2000 ml) and severe (more than 2000 ml). In women with lower body mass (e.g. less than 60 kg), a lower level of blood loss may be clinically significant.[3] The recommendations in this guideline apply to women experiencing a primary PPH of 500 ml or more.

Secondary PPH is defined as abnormal or excessive bleeding from the birth canal between 24 hours and 12 weeks postnatally.[4] This guideline also includes recommendations specific to the management of secondary PPH.

Women with pre-existing bleeding disorders and women taking therapeutic anticoagulants are at increased risk of PPH; this guideline does not include specific recommendations for the management of such situations or for managing haemorrhage in women who refuse blood transfusion. Guidance on these topics is available from other sources.[5–8]

This guideline has been developed primarily for clinicians working in consultant-led obstetric units in the UK; recommendations may be less appropriate for other settings where facilities, resources and routine practices differ. There is increasing emphasis on the availability of births at home or in midwife-led units.[9] Obstetricians and midwives should develop guidelines for the management of obstetric emergencies that may occur in the community, including PPH. This is beyond the scope of this guideline.[10]

This guideline is restricted in scope to the management of PPH; the management of antepartum haemorrhage is the subject of the RCOG Green-top Guideline No. 63.[11] The prevention and management of PPH related to placenta praevia and placenta praevia accreta is addressed in Green-top Guideline No. 27,[12] while Green-top Guideline No. 47[13] provides guidance on the appropriate use of blood and blood products in obstetric practice.

2. Introduction and background epidemiology

Obstetric haemorrhage remains one of the major causes of maternal death in both developed and developing countries. The 2011–13 Confidential Enquiries into Maternal Deaths and Morbidity report[3] identified 13 direct deaths due to obstetric haemorrhage in the UK and Ireland; the report places obstetric haemorrhage as the second leading cause of direct maternal deaths. The recommendations from the report focus on basic clinical skills, with prompt recognition of the severity of a haemorrhage and emphasise communication and teamwork in the management of these cases. A systematic review[14] suggests that there may be regional variation in the prevalence of PPH. Standardisation of the measurement of PPH is recommended so that data from different regions are comparable.[15]

3. Identification and assessment of evidence

This guideline was developed in accordance with standard methodology for producing RCOG Green-top Guidelines. The Cochrane Library (including the Cochrane Database of Systematic Reviews and the Database of Abstracts of Reviews of Effects [DARE]), EMBASE, Trip, MEDLINE and PubMed (electronic databases) were searched for relevant randomised controlled trials, systematic reviews and meta-analyses. The search was restricted to articles published between 2007 and September 2015. The databases were searched using the relevant Medical Subject Headings (MeSH) terms, including all subheadings, and this was combined with a keyword search. Search words included 'postpartum h(a)emorrhage', 'factor VII', 'Syntocinon', 'carbetocin', 'carboprost', 'oxytocics', 'uterotonics', 'B-lynch suture', 'uterine artery embolism', 'bilateral internal iliac ligation', 'balloon, Rusch', 'Sengstaken catheters', 'thromboelastography', 'thromboelastometry', 'fibrinogen concentrate', 'point of care testing' and the search limited to humans and the English language. The National Library for Health and the National Guideline Clearinghouse were also searched for relevant guidelines and reviews. Guidelines and recommendations produced by organisations such as the British Committee for Standards in Haematology Transfusion Taskforce and national bodies were considered.

Where possible, recommendations are based on available evidence and the areas where evidence is lacking are annotated as 'good practice points'. Further information about the assessment of evidence and the grading of recommendations may be found in Appendix I.

4. Prediction and prevention of PPH

4.1 What are the risk factors for developing PPH and how can they be minimised?

4.1.1 Risk factors

Risk factors for PPH may present antenatally or intrapartum; care plans must be modified as and when risk factors arise. ✓

Clinicians must be aware of risk factors for PPH and should take these into account when counselling women about place of delivery. ✓

Women with known risk factors for PPH should only be delivered in a hospital with a blood bank on site. D

A number of case–control studies have identified antenatal and intrapartum risk factors for PPH (see Appendix II),[16–26] although most cases of PPH have no identifiable risk factors.[27] These risk factors have been summarised in a 2010 review.[28] Despite methodological limitations, these studies provide a guide to levels of risk, which can help clinicians in their discussions with women about setting for delivery (Table 1). The Confidential Enquiry into Maternal and Child Health[29] has recommended that women with known risk factors for PPH should not be delivered in a hospital without a blood bank on site.

Evidence level 4

The Society of Obstetricians and Gynaecologists of Canada has published a guideline on the prevention and management of PPH.[30] This summarises the causes of PPH as related to abnormalities of one or more of four basic processes – 'the four Ts': tone, trauma, tissue and thrombin. The most common cause of PPH is uterine atony.[27]

Table 1. Risk factors and the associated levels of risk for PPH

Risk factor	The four Ts	OR (95% CI)
Multiple pregnancy	Tone	3.30 (1.00–10.60)[16] 4.70 (2.40–9.10)[24]
Previous PPH	Tone	3.60 (1.20–10.20)[16]
Pre-eclampsia	Thrombin	5.00 (3.00–8.50)[16] 2.20 (1.30–3.70)[31]
Fetal macrosomia	Tone	2.11 (1.62–2.76)[20] 2.40 (1.90–2.90)[24]
Failure to progress in second stage	Tone	3.40 (2.40–4.70)[23] 1.90 (1.20–2.90)[31]
Prolonged third stage of labour	Tone	7.60 (4.20–13.50)[16] 2.61 (1.83–3.72)[20]
Retained placenta	Tissue	7.83 (3.78–16.22)[20] 3.50 (2.10–5.80)[23] 6.00 (3.50–10.40)[24]
Placenta accreta	Tissue	3.30 (1.70–6.40)[23]
Episiotomy	Trauma	4.70 (2.60–8.40)[16] 2.18 (1.68–2.76)[20] 1.70 (1.20–2.50)[24]
Perineal laceration	Trauma	1.40 (1.04–1.87)[20] 2.40 (2.00–2.80)[23] 1.70 (1.10–2.50)[24]
General anaesthesia	Tone	2.90 (1.90–4.50)[31]

4.1.2 Minimising risk – treating antenatal anaemia

Antenatal anaemia should be investigated and treated appropriately as this may reduce the morbidity associated with PPH. D

Guidelines from the National Institute for Health and Care Excellence (NICE)[32] recommend that pregnant women should be offered screening for anaemia. The British Committee for Standards in Haematology[33] has produced guidelines on the investigation and management of anaemia in pregnancy. Haemoglobin (Hb) levels outside the normal UK range for pregnancy (110 g/l at first contact and 105 g/l at 28 weeks) should be investigated and iron supplementation considered if indicated. It is recommended that parenteral iron therapy should be considered antenatally for women with iron deficiency anaemia who do not respond to oral iron.[10] Evidence level 4

A population-based study[34] has indicated an association between antenatal anaemia (Hb less than 90 g/l) and greater blood loss at delivery and postpartum. Evidence level 3

4.1.3 Minimising risk – reducing blood loss at delivery

Uterine massage is of no benefit in the prophylaxis of PPH. A

Prophylactic uterotonics should be routinely offered in the management of the third stage of labour in all women as they reduce the risk of PPH. A

For women without risk factors for PPH delivering vaginally, oxytocin (10 iu by intramuscular injection) is the agent of choice for prophylaxis in the third stage of labour. A higher dose of oxytocin is unlikely to be beneficial. A

For women delivering by caesarean section, oxytocin (5 iu by slow intravenous injection) should be used to encourage contraction of the uterus and to decrease blood loss. B

Ergometrine–oxytocin may be used in the absence of hypertension in women at increased risk of haemorrhage as it reduces the risk of minor PPH (500–1000 ml). C

For women at increased risk of haemorrhage, it is possible that a combination of preventative measures might be superior to syntocinon alone to prevent PPH. ✓

Clinicians should consider the use of intravenous tranexamic acid (0.5–1.0 g), in addition to oxytocin, at caesarean section to reduce blood loss in women at increased risk of PPH. A

Uterine massage

A Cochrane review[35] analysed the effectiveness of uterine massage after birth, and before or after delivery of the placenta, or both, to prevent PPH. Two randomised controlled trials (RCTs) were included and the review found no significant difference between groups. Evidence level 1+

Management of the third stage of labour

Various Cochrane reviews have addressed prophylaxis in the third stage of labour for women delivering vaginally.[35–38] These have established that both active management and the use of prophylactic uterotonics in the third stage of labour reduce the risk of PPH. Active management of the third stage of labour involves the use of interventions (including the use of uterotonics, early clamping of the umbilical cord and controlled cord traction) to expedite delivery of the placenta with the aim of reducing blood loss. In expectant management, signs of placental separation are awaited and the placenta is delivered spontaneously. A Cochrane systematic review[39] found that, for women at mixed levels of risk of bleeding, active management showed a reduction in the average risk of maternal primary haemorrhage at time of birth (more than 1000 ml; average risk ratio [RR] 0.34, 95% CI 0.14–0.87) and maternal Hb less than 90 g/l following birth (average RR 0.50, 95% CI 0.30–0.83). Evidence level 1++

However, active management results in a lower birthweight, reflecting a lower blood volume from early cord clamping.[39] A systematic review and meta-analysis of controlled trials[40] found that delaying clamping for at least 2 minutes is beneficial to the newborn and that the benefits extend into infancy. Therefore, active management of the third stage that includes routine early clamping of the umbilical cord can no longer be recommended. A detailed consideration of the literature relating to the timing of cord clamping can be found in RCOG Scientific Impact Paper No. 14.[41] Guidance from NICE[9] recommends that the umbilical cord should not be clamped earlier than 1 minute from delivery of the baby if there are no concerns over cord integrity or the baby's wellbeing.

Evidence level 1+

Oxytocin and ergometrine–oxytocin

McDonald and colleagues' meta-analysis[36] addressed prophylactic ergometrine–oxytocin versus oxytocin for the third stage of labour. This review indicated that ergometrine–oxytocin (Syntometrine®, Alliance, Chippenham, Wiltshire, UK), oxytocin 5 iu and oxytocin 10 iu have similar efficacy in preventing PPH in excess of 1000 ml. Using the definition of PPH as blood loss of at least 500 ml, ergometrine–oxytocin was associated with a small reduction in the risk of PPH (Syntometrine® versus oxytocin any dose; OR 0.82, 95% CI 0.71–0.95). There were major differences between ergometrine–oxytocin and oxytocin alone in the adverse effects of nausea and vomiting, and elevation of blood pressure, with ergometrine–oxytocin carrying a five-fold increased risk (OR 4.92, 95% CI 4.03–6.00). Thus, the advantage of a reduction in the risk of minor PPH needs to be weighed against the adverse effects associated with the use of ergometrine–oxytocin.

Evidence level 1++

An RCT,[42] using a primary outcome of any treatment of uterine atony or haemorrhage, assessed whether or not a higher dose of oxytocin after vaginal delivery was more effective than a low-dose regimen in preventing PPH after a vaginal delivery. Compared with 10 iu, administering 40 iu or 80 iu of prophylactic oxytocin did not reduce overall PPH treatment when given in 500 ml over 1 hour for vaginal delivery.

Evidence level 1+

Prostaglandins

The use of prostaglandins for the prevention of PPH has been the subject of two Cochrane reviews.[37,38] Neither intramuscular prostaglandins (such as carboprost, a 15-methyl prostaglandin $F_{2\alpha}$ analogue) nor misoprostol (a prostaglandin E_1 analogue given orally or sublingually) were preferable to conventional injectable uterotonics (oxytocin and/or ergometrine) for routine prophylaxis.[37] Furthermore, another systematic review[43] concluded that oxytocin is superior to misoprostol in the prevention of PPH.

Evidence level 1++

Appraisal of the evidence from both the Cochrane reviews, together with consideration of standard practice in the UK, suggests that, for women delivering vaginally, oxytocin 10 iu by intramuscular injection is the regimen of choice for prophylaxis in the third stage of labour. Intramuscular oxytocin should be administered with the birth of the anterior shoulder, or immediately after the birth of the baby and before the cord is clamped and cut. This strategy has been endorsed in the NICE intrapartum care guideline.[9]

Evidence level 1+

Carbetocin

A Cochrane review[44] has addressed the use of a longer-acting oxytocin derivative, carbetocin, in the prevention of PPH. Carbetocin is licensed in the UK specifically for the indication of prevention of PPH in the context of caesarean delivery. Use of carbetocin resulted in a statistically significant reduction in the need for further uterotonics compared with oxytocin for those undergoing a caesarean, but not for vaginal delivery. However, there were no statistically significant differences between carbetocin and oxytocin in terms of risk of PPH.

Evidence level 1++

Guidelines from the Society of Obstetricians and Gynaecologists of Canada[30] recommend that carbetocin (100 micrograms given as an intravenous bolus over 1 minute) should be used for the prevention of PPH in elective caesarean deliveries. Randomised trials[45–50] have compared different uterotonics (oxytocin, ergometrine–oxytocin, misoprostol, carbetocin and 15-methyl prostaglandin $F_{2\alpha}$) for prophylaxis in women delivering by caesarean section. Appraisal of the evidence from these trials, together with consideration of standard practice in the UK, led the development group for the NICE caesarean section guideline[51] to recommend oxytocin 5 iu by slow intravenous injection for prophylaxis in the context of caesarean delivery.

Evidence level 1+

Tranexamic acid

The use of tranexamic acid in the prevention of PPH in women considered to be at low risk of PPH was addressed in a Cochrane review.[52] This found that blood loss greater than 400 or 500 ml was less common in women who received tranexamic acid in addition to the usual uterotonic agent after vaginal birth or caesarean section in a dosage of 1 or 0.5 g intravenously. Tranexamic acid was effective in decreasing the incidence of blood loss greater than 1000 ml in women who had undergone caesarean section (RR 0.43, 95% CI 0.23–0.78; four studies; 1534 women), but not vaginal birth. Mean blood loss until 2 hours postpartum was lower in the group of women who received intravenous tranexamic acid postpartum (mean difference −77.79 ml; 95% CI −97.95 to −57.64; five studies; 1186 women). The authors of the Cochrane review on the use of tranexamic acid in the prevention of PPH conclude that further studies are required to investigate the risk of serious adverse effects, including thromboembolic events, and the use of tranexamic acid in women considered to be at high risk of PPH (see section 5.3.6).

Evidence level 1++

5. How should PPH be managed?

5.1 Identification of the severity of haemorrhage

Clinicians should be aware that the visual estimation of peripartum blood loss is inaccurate and that clinical signs and symptoms should be included in the assessment of PPH. C

As visual estimation often underestimates blood loss,[53,54] more accurate methods may be used, such as blood collection drapes for vaginal deliveries[55] and the weighing of swabs.[56] However, a study[57] comparing visual estimation of blood loss with the use of a collector bag after vaginal delivery concluded that the latter did not significantly reduce the risk of severe PPH. Participating in clinical reconstructions may encourage early diagnosis and prompt treatment of PPH.[58] Written and pictorial guidelines may help staff working in labour wards to estimate blood loss.[59]

Evidence level 2+

Clinical signs and symptoms of hypovolaemia should be included in the assessment of PPH. However, clinicians should be aware that the physiological increase in circulating blood volume during pregnancy means that the signs of hypovolaemic shock become less sensitive in pregnancy.[60] In pregnancy, pulse and blood pressure are usually maintained in the normal range until blood loss exceeds 1000 ml; tachycardia, tachypnoea and a slight recordable fall in systolic blood pressure occur with blood loss of 1000–1500 ml. A systolic blood pressure below 80 mmHg, associated with worsening tachycardia, tachypnoea and altered mental state, usually indicates a PPH in excess of 1500 ml.[61]

Evidence level 4

In nonpregnant patients, the shock index, calculated from the heart rate/systolic blood pressure, has been employed as an early marker of haemodynamic compromise.[61] A retrospective cohort study[62] concluded that the shock index identifies women at risk of adverse outcomes secondary to PPH (e.g. admission to an intensive care unit) and compares favourably with conventional vital signs.

Evidence level 2–

The 2009–12 Confidential Enquiries into Maternal Deaths and Morbidity report[3] highlighted the importance of correlating clinical signs and symptoms expected from different blood loss values to help target decisions on resuscitation, and also emphasised the importance of taking the woman's weight into account. It is of note that the severity of haemorrhage was not recognised in 11 of the 17 (61%) women who died.

Evidence level 4

5.2 Communication and multidisciplinary care

5.2.1 Communication with the woman

Communication with the patient and her birthing partner is important, and clear information of what is happening should be given from the outset. ✓

PPH often occurs unexpectedly and can be very stressful for the woman and her partner or birth attendants; it is crucial that, where feasible, they are kept informed and reassured, if appropriate, of the clinical development and proposed management.

5.2.2 Who should be informed when the woman presents with PPH?

Relevant staff with an appropriate level of expertise should be alerted of PPH. ✓

The midwife in charge and the first-line obstetric and anaesthetic staff should be alerted when women present with minor PPH (blood loss 500–1000 ml) without clinical shock. ✓

A multidisciplinary team involving senior members of staff should be summoned to attend to women with major PPH (blood loss of more than 1000 ml) and ongoing bleeding or clinical shock. ✓

Early involvement of appropriate senior staff (including the anaesthetic team and laboratory specialists) is fundamental to the management of PPH. In minor PPH, the first-line staff should be alerted and in major PPH, the following members of staff should be called and summoned to attend:

- an experienced midwife (in addition to the midwife in charge)
- the obstetric middle grade
- the anaesthetic middle grade
- the on-call clinical haematologist with experience in major haemorrhage
- porters for delivery of specimens/blood.

Furthermore, the consultant obstetrician and consultant anaesthetist should be alerted, and the blood transfusion laboratory should be informed. One member of the team should be assigned the task of recording events, fluids, drugs, blood and components transfused, and vital signs.

Clinicians and blood transfusion staff should liaise at a local level to agree:

- a standard form of words (such as 'we need compatible blood now' or 'group-specific blood') to be used in cases of major obstetric haemorrhage
- a timescale in which to deliver various blood components.

The use of the term 'controlled major obstetric haemorrhage' or 'ongoing major obstetric haemorrhage' may be used to define the urgency to the team.

Senior obstetric staff must be receptive to concerns expressed by less experienced or junior medical practitioners, and by midwives. The RCOG recommends that the consultant obstetrician should attend in person when there is a PPH of more than 1500 ml where the haemorrhage is continuing.[63]

Evidence level 4

5.3 Resuscitation

5.3.1 Measures for minor PPH

Measures for minor PPH (blood loss 500–1000 ml) without clinical shock: ✓

- **intravenous access (one 14-gauge cannula)**
- **urgent venepuncture (20 ml) for:**
  - **group and screen**
  - **full blood count**
  - **coagulation screen, including fibrinogen**
- **pulse, respiratory rate and blood pressure recording every 15 minutes**
- **commence warmed crystalloid infusion.**

5.3.2 Measures for major PPH

Full protocol for major PPH (blood loss greater than 1000 ml) and continuing to bleed or clinical shock (see Appendix III): ✓

- **A and B – assess airway and breathing**
- **C – evaluate circulation**
- **position the patient flat**
- **keep the woman warm using appropriate available measures**
- **transfuse blood as soon as possible, if clinically required**
- **until blood is available, infuse up to 3.5 l of warmed clear fluids, initially 2 l of warmed isotonic crystalloid. Further fluid resuscitation can continue with additional isotonic crystalloid or colloid (succinylated gelatin). Hydroxyethyl starch should not be used.**
- **the best equipment available should be used to achieve rapid warmed infusion of fluids**
- **special blood filters should not be used, as they slow infusions.**

Table 2. Fluid therapy and blood product transfusion (see sections 5.3.3, 5.3.4 and 5.3.5)

Crystalloid	Up to 2 l isotonic crystalloid.
Colloid	Up to 1.5 l colloid until blood arrives.
Blood	If immediate transfusion is indicated, give emergency group O, rhesus D (RhD)-negative, K-negative red cell units. Switch to group-specific red cells as soon as feasible.
Fresh frozen plasma (FFP)	Administration of FFP should be guided by haemostatic testing and whether haemorrhage is continuing: • If prothrombin time (PT) or activated partial thromboplastin time (APTT) are prolonged and haemorrhage is ongoing, administer 12–15 ml/kg of FFP. • If haemorrhage continues after 4 units of red blood cells (RBCs) and haemostatic tests are unavailable, administer 4 units of FFP.
Platelet concentrates	Administer 1 pool of platelets if haemorrhage is ongoing and platelet count less than 75×10^9/l.
Cryoprecipitate	Administer 2 pools of cryoprecipitate if haemorrhage is ongoing and fibrinogen less than 2 g/l.

A high concentration of oxygen (10–15 l/min) via a facemask should be administered, regardless of maternal oxygen concentration. If the airway is compromised owing to impaired conscious level, anaesthetic assistance should be sought urgently. Usually, level of consciousness and airway control improve rapidly once the circulating volume is restored.

Establish two, 14-gauge intravenous lines; a 20 ml blood sample should be taken and sent for diagnostic tests, including full blood count, coagulation screen, urea and electrolytes, and to cross-match packed red cells (4 units). The urgency and measures undertaken to resuscitate and arrest haemorrhage need to be tailored to the degree of shock (Table 2).

The cornerstones of resuscitation during PPH are restoration of both blood volume and oxygen-carrying capacity. Volume replacement must be undertaken on the basis that blood loss is often underestimated.[59,64] Compatible blood (supplied in the form of red cell concentrate) to replace red cell loss should be transfused as soon as available, if necessary. The clinical picture should be the main determinant of the need for blood transfusion and time should not be unnecessarily spent awaiting laboratory results.[65,66] Obstetricians should draw on the expertise of their colleagues in anaesthesia, haematology and transfusion medicine in determining the most appropriate combination of intravenous clear fluids, blood and blood products for continuing resuscitation. Guidance from the British Committee for Standards in Haematology[67] summarises the main therapeutic goals of the management of massive blood loss as maintaining:

Evidence level 4

- Hb greater than 80 g/l
- platelet count greater than 50×10^9/l
- prothrombin time (PT) less than 1.5 times normal
- activated partial thromboplastin time (APTT) less than 1.5 times normal
- fibrinogen greater than 2 g/l.

5.3.3 Fluid replacement

Fluid replacement is a crucial component of PPH treatment, although a dilutional coagulopathy may occur when large volumes of crystalloid, colloid or red cells are used with insufficient transfusion of fresh frozen plasma (FFP) and platelets. Traditionally, a total volume of 3.5 l of clear fluids (up to 2 l of warmed isotonic crystalloid as rapidly as possible, followed by up to a further 1.5 l of warmed colloid if blood is still not available) comprises the maximum that should be infused while awaiting compatible packed red cells.[1] While there is controversy as to the most appropriate fluids for volume resuscitation,[68–70] the nature of fluid infused is of less importance than rapid administration and warming of the infusion.[71] The woman needs to be kept warm using appropriate measures to prevent hypothermia which in turn could exacerbate acidosis.[72]

Evidence level 4

There have been no RCTs comparing the use of colloids with other replacement fluids for the resuscitation of women with PPH. Guidelines from the World Health Organization (WHO)[73] recommend that intravenous fluid replacement for PPH should be with isotonic crystalloids in preference to colloids. A Cochrane review[74] compared colloids with crystalloids for fluid resuscitation in critically ill, nonpregnant patients (patients with burns, trauma or following surgery). This review concluded that resuscitation with colloids was not associated with an improvement in survival and that the use of one particular colloid, hydroxyethyl starch, might increase mortality.

Evidence level 1++

5.3.4 Blood transfusion

There are no firm criteria for initiating red cell transfusion. The decision to provide blood transfusion should be based on both clinical and haematological assessment. ✓

The use of blood and blood products in obstetric practice is addressed in the RCOG Green-top Guideline No. 47.[13] There are no firm criteria for initiating red cell transfusion[75,76] and the decision to provide blood transfusion should be based on both clinical and haematological assessment. While blood transfusion is almost always required when the Hb is less than 60 g/l and rarely required when the Hb is more than 100 g/l, patients with acute haemorrhage can have normal Hb and clinical evaluation in this situation is, therefore, extremely important. Between 2009 and 2012,[3] there were at least three maternal deaths where an acute point of care Hb measurement result is thought to have falsely reassured staff. Furthermore, the Serious Hazards of Transfusion reporting scheme has highlighted the risk of errors in using near patient testing of Hb measurements to guide transfusion.[77] While single Hb/haematocrit estimations may be misleading and can lead to delays in initiating red cell transfusion, serial measurements may be helpful to monitor ongoing progress. Guidelines from the European Society of Anaesthesiology[78] recommend that repeated measurements of serum lactate and base deficit, together with haematocrit/Hb, are made during haemorrhage and resuscitation to assess tissue perfusion and oxygenation; however, it has not yet been shown whether the outcome of severe bleeding can be improved if volume resuscitation is guided by serum lactate concentration and base deficit.

Evidence level 4

Selection of red cell units for transfusion.

Major obstetric haemorrhage protocols must include the provision of emergency blood with immediate issue of group O, rhesus D (RhD)-negative and K-negative units, with a switch to group-specific blood as soon as feasible. D

If clinically significant red cell antibodies are present, close liaison with the transfusion laboratory is essential to avoid delay in transfusion in life-threatening haemorrhage. D

All delivery units, especially small units without a blood bank on site, should maintain a supply of group O, RhD-negative blood. ✓

Intraoperative cell salvage should be considered for emergency use in PPH associated with caesarean section and with vaginal delivery. D

Pregnant women (and women of childbearing age) who are RhD negative must only receive RhD-negative blood to avoid the risk of D alloimmunisation.[79] Previous blood transfusion is an important cause of alloimmunisation, with antibodies other than anti-D, in particular anti-K, causing severe haemolytic disease of the fetus and newborn.[80] Accordingly, unless a woman is known to be K positive, only K-negative blood should be used for transfusion in women of childbearing age.[79] The aim of antibody screening is to determine the presence of red cell antibodies of likely clinical significance. In addition to the risk of haemolytic disease of the fetus and newborn,[80] these red cell antibodies may have implications for the selection of blood for transfusion in the mother owing to the risk of haemolytic transfusion reactions, and the laboratory should select red cell units negative for the relevant antigen for cross-matching. Close liaison with the transfusion laboratory is essential, with input if needed from the clinical haematology team and specialist advice from the national blood service.

Evidence level 4

All delivery units, especially small units without a blood bank on site, should maintain a supply of group O, RhD-negative blood, as this might offer the only means of restoring oxygen-carrying capacity within an acceptable timescale. The minimum number of units of group O, RhD-negative, K-negative blood to be maintained on site should be agreed within local protocols and should reflect the likely period of delay in the arrival of further supplies should an emergency arise; small delivery units remote from the nearest blood bank will require a larger minimum supply than those a short distance from a blood bank.

Cross-matching versus electronic issue of blood

The principles of blood grouping, antibody testing and selection of blood in pregnancy are addressed in the RCOG Green-top Guideline No. 47.[13]

The majority of laboratories in the UK now use automated testing for blood grouping and antibody testing with advanced information technology systems for documentation and reporting of results. The hospital transfusion laboratory can readily provide red cells that are ABO and RhD compatible using electronic issue with no cross-matching needed, provided that the patient does not have any antibodies and there are robust automated systems in place for antibody testing and identification of the patient.[79] In this setting, since blood can be readily issued, there is no need to reserve units for individual cases. Where electronic issue is not available, a locally agreed maximum surgical blood ordering schedule should be used to decide how many red cell units should be reserved and available for particular cases, based on the obstetric diagnosis. In unforeseen haemorrhage, group O, RhD-negative and K-negative units must be immediately available for emergency use, with a switch to group-specific blood as soon as feasible.

Evidence level 4

Cytomegalovirus (CMV) status

In elective transfusion in the antenatal period, CMV-seronegative products should be used to avoid transmission of CMV to the fetus, although, the UK policy of universal leucocyte depletion substantially reduces the risk of CMV transmission.[81,82] In an emergency, such as PPH, standard leucocyte-depleted components should be given to avoid delay, and CMV-negative blood or platelets are not needed for transfusion during delivery or in the postpartum period.[82]

Evidence level 4

Intraoperative cell salvage

Intraoperative cell salvage (the process whereby blood shed during an operation is collected, filtered and washed to produce autologous red blood cells [RBCs] for transfusion to the patient) is commonly being used in cardiac, orthopaedic and vascular surgery with a relative reduction of blood transfusion of 38% and an absolute risk reduction of 21%. Cell salvage does not appear to impact adversely on clinical outcomes.[83,84] Several bodies have endorsed cell salvage in obstetric practice, including NICE,[85] the Centre for Maternal and Child Enquiries (CMACE)[10] and the Association of Anaesthetists of Great Britain and Ireland.[86] It has been proposed that cell salvage should be considered for emergency use in PPH associated with both caesarean section and vaginal delivery.[87] Although large prospective trials of cell salvage with autotransfusion in obstetrics are lacking to date, no single serious complication leading to poor maternal outcome has been directly attributed to its use. A large RCT is currently in progress comparing intraoperative cell salvage with donor blood transfusions (standard care) during caesarean section in women at risk of haemorrhage (SALVO study, UKCRN ID14032).[88]

Evidence level 4

5.3.5 Blood components

There are limited data to inform best clinical practice for the management of haemostatic impairment during PPH, but the principle of management is to prevent and treat haemostatic abnormalities during bleeding, but not to correct abnormalities in nonbleeding women. It is not known whether haemostasis should be corrected to normality for pregnant or nonpregnant women.

Methods to assess haemostatic impairment during PPH include clinical observation, laboratory-based tests (PT, APTT, Clauss fibrinogen and platelet count) and point of care testing.[89] Studies in patients following surgery show that laboratory or point of care testing leads to appropriate use of blood components[90] and both may be used simultaneously. Coagulopathies may evolve rapidly and repeated testing (such as every 30 minutes) during continued bleeding and observation of trends are more useful than single measurements.

Routine coagulation tests are widely available and have well-regulated quality control.[89,91] They include PT, APTT, Clauss fibrinogen assay and platelet count. However, turnaround times are often too slow to be clinically useful in acute and rapidly evolving bleeds, and inevitably reflect the past haemostatic status of the woman. Clauss fibrinogen should always be measured as part of the routine coagulation screen because it falls early and may be reduced to a clinically significant level despite a normal PT/APTT.[89,91,92] Platelet number should be measured as part of the full blood count.

Evidence level 3

Point of care testing using viscoelastometry, such as thromboelastography (TEG®, Haemonetics, Braintree, Massachusetts, USA) and rotational thromboelastometry (ROTEM®, Tem, Munich, Germany), combined with an agreed treatment algorithm, has been associated with decreased blood loss and blood product use, both outside and within the obstetric setting.[89,93,94] The main advantage is that results are known sooner than for laboratory tests. Point of care testing using TEG® and ROTEM® has been recommended by the Obstetric Anaesthetists' Association/Association of Anaesthetists of Great Britain and Ireland.[95] However, NICE has concluded that there is insufficient evidence to recommend the routine adoption of viscoelastometric point of care testing in the management of PPH.[96] If used, a quality control protocol should be agreed with the haematology laboratory.

Evidence level 4

Transfusion of FFP

If no haemostatic results are available and bleeding is continuing, then, after 4 units of RBCs, FFP should be infused at a dose of 12–15 ml/kg until haemostatic test results are known.

D

If no haemostatic tests are available, early FFP should be considered for conditions with a suspected coagulopathy, such as placental abruption or amniotic fluid embolism, or where detection of PPH has been delayed.

✓

If PT/APTT is more than 1.5 times normal and haemorrhage is ongoing, volumes of FFP in excess of 15 ml/kg are likely to be needed to correct coagulopathy.

D

Clinicians should be aware that these blood components must be ordered as soon as a need for them is anticipated, as there will always be a short delay in supply because of the need for thawing.

✓

Formulaic protocols, such as 1:1 or 6:4 RBC:FFP, based on data derived from traumatic bleeding, have been advocated for the management of major haemorrhage.[69,71] However, there is no evidence that this improves outcomes in PPH. The drawbacks of early FFP are that the majority of women with PPH will have normal coagulation at the time of administration,[97–99] and that it is associated with an increased risk of transfusion-associated circulatory overload (TACO)[100] and transfusion-related acute lung injury.[101] FFP results in relatively small increments in fibrinogen level, and to increase the level rapidly, cryoprecipitate or fibrinogen concentrate are required.[102]

There are limited data on the utility of laboratory and point of care coagulation tests to guide FFP replacement during PPH. Abnormal PT/APTT suggests progression towards significant haemostatic impairment, while PT/APTT greater than 1.5 times normal demonstrate that severe and established haemostatic impairment has occurred.[67,68,103]

Evidence level 4

If the PPH has stopped, no FFP is required. If haemorrhage is ongoing and the last PT/APTT results are available and are prolonged, 12–15 ml/kg of FFP should be requested and infused with the aim of maintaining the PT/APTT at less than 1.5 times normal.[68] If the PT/APTT is greater than 1.5 times normal, a larger volume of FFP is likely to be required to correct these parameters,[104] and this may be associated with an increased risk of TACO. If the PT/APTT are normal, then no FFP is required, although repeated testing should be performed if bleeding persists.

If the results of haemostatic tests are not available and haemorrhage is continuing then, after 4 units of RBCs have been transfused, FFP should be infused at a dose of 12–15 ml/kg and 6:4 RBC:FFP transfusion maintained until tests of haemostasis are available. Such empirical use of FFP is in line with published guidance.[67,68,71,105] FFP transfusion earlier than this could be considered for placental abruption or amniotic fluid embolism, because these situations are associated with early coagulopathy[106,107] or if diagnosis of PPH has been delayed.

Evidence level 4

In rare cases of massive bleeding where women have been given 8 or more units of RBCs and they continue to bleed, and still no coagulation results or platelet counts are available, then 2 pools of cryoprecipitate and 1 pool of platelets should be infused.[108]

Evidence level 3

Fibrinogen

A plasma fibrinogen level of greater than 2 g/l should be maintained during ongoing PPH.

C

Cryoprecipitate should be used for fibrinogen replacement.

D

Observational studies show that a fibrinogen level of 1.0–1.5 g/l is likely to be too low for adequate haemostasis during ongoing PPH.[97,98,109–111] Fibrinogen below 3 g/l and especially below 2 g/l is associated with progression of bleeding, increased RBC and blood component requirements, and the need for invasive procedures.[109]

Evidence level 2+

A double-blind RCT[112] has shown that pre-emptive infusion of 2 g fibrinogen concentrate in women with 500–1000 ml PPH has no benefit; however, the fibrinogen level at the time of randomisation was greater than 4 g/l in most women.

Evidence level 1

The appropriate fibrinogen intervention trigger or target level is unknown. A pragmatic view based on available evidence is that, during continuing PPH, cryoprecipitate or fibrinogen concentrate should be used to maintain a fibrinogen level of at least 2 g/l, even if PT/APTT are normal. Fibrinogen loss can be replaced by cryoprecipitate or fibrinogen concentrate, although fibrinogen concentrate is not licensed for acquired hypofibrinogenaemia in the UK. Similar clinical outcomes and increments in fibrinogen have been reported for cryoprecipitate and fibrinogen concentrate, but these are based on limited data.[113] It is expected that 2 pools of cryoprecipitate (1 pool is taken from five donors) would increase the fibrinogen level by about 1 g/l. Increasing the fibrinogen level by 1 g/l requires about 60 mg/kg fibrinogen concentrate.[114] Observational studies report improved clinical haemostasis and possible reduced use of FFP and post-transfusion-related events, such as TACO,[94,115] associated with infusion of fibrinogen, but RCTs are required.[93,113,114,116,117]

Evidence level 3

Transfusion of platelets

During PPH, platelets should be transfused when the platelet count is less than 75 × 10^9/l based on laboratory monitoring.

D

There is general consensus that platelets should be transfused at a trigger of 75 × 10^9/l to maintain a level greater than 50 × 10^9/l during ongoing PPH.[68,71]

Evidence level 4

5.3.6 Is there a role for antifibrinolytic drugs?

Consideration should be given to the use of tranexamic acid in the management of PPH. B

A large RCT[118] found that early administration of tranexamic acid in the management of trauma in nonpregnant patients resulted in a significant reduction in death from haemorrhage. The dose employed in this study was 1 g intravenously over 10 minutes followed by an infusion of 1 g over 8 hours. One RCT[119] assessed the role of high-dose tranexamic acid in PPH. Women with PPH greater than 800 ml following vaginal delivery were randomly assigned to receive tranexamic acid (loading dose 4 g over 1 hour, then infusion of 1 g/hour over 6 hours) or not; the study concluded that high-dose tranexamic acid can reduce blood loss, fall in Hb and the need for blood transfusion. The study was not powered to address safety issues and specifically, the risk of the treatment causing deep vein thrombosis. Evidence level 1+

A Cochrane review[2] on treatments for PPH found that trials testing the effectiveness of tranexamic acid were too small to draw meaningful conclusions. A large trial[120] is currently in progress aiming to determine the effect of early administration of tranexamic acid on mortality, hysterectomy and other morbidities in women with PPH. The dose of tranexamic acid employed in this trial is 1 g by intravenous injection; a second dose may be given after 30 minutes.

5.3.7 Is there a role for recombinant factor VIIa (rFVIIa) therapy?

The routine use of rFVIIa is not recommended in the management of major PPH unless as part of a clinical trial. ✓

rFVIIa (NovoSeven®, Novo Nordisk, Bagsværd, Denmark) is an expensive product that is licensed in the UK for the treatment of bleeding episodes in patients with specific inherited bleeding disorders. Outwith its licence, it has been used primarily in the management of uncontrolled haemorrhage in the trauma setting. It reduces blood loss through enhancement of tissue factor-dependent coagulation. Its effectiveness is markedly diminished by hypothermia, acidosis and low platelets, so effective resuscitation towards normal physiology is a prerequisite of its use.[121] Evidence level 3

There are only poor quality data from anecdotal reports or patient registries to support its use.[122] Systematic reviews of case series and observational studies have examined the use of rFVIIa in PPH.[123,124] In a review of the literature regarding the use of rFVIIa in the treatment of PPH, Ahonen[122] concluded that rFVIIa should not be used to compensate for inadequate blood transfusion therapy; administration of blood and blood products, as well as management of uterine atony, are essential in the treatment of PPH before considering administration of rFVIIa. A 2015 open-label RCT[125] (n = 84) found that administration of rFVIIa lowered the risk of requiring second-line therapies by 44% (RR 0.56, 95% CI 0.42–0.76) compared with controls (no rFVIIa) in women with PPH in whom uterotonics had failed to arrest the bleeding. All 84 women survived, but two women in the intervention group experienced a venous thromboembolism (2/42). Evidence level 1+

A study[126] investigating the safety of rFVIIa when employed on an off-label basis to treat life-threatening haemorrhage found a significant increase in the risk of arterial, but not venous, thromboembolic events when compared with placebo (5.5% versus 3.2%).

The use of rFVIIa may be considered as a treatment for life-threatening PPH, but should not delay or be considered a substitute for a life-saving procedure, such as embolisation or surgery, or transfer to a referral centre.

5.4 *Monitoring and investigation in major PPH: what investigations should be performed and how should women be monitored?*

Full protocol for monitoring and investigation in major PPH (blood loss greater than 1000 ml) and ongoing haemorrhage or clinical shock: D

- **immediate venepuncture (20 ml) for:**
  - **cross-match (4 units minimum)**
  - **full blood count**
  - **coagulation screen, including fibrinogen**
  - **renal and liver function for baseline**
- **monitor temperature every 15 minutes**
- **continuous pulse, blood pressure recording and respiratory rate (using oximeter, electrocardiogram and automated blood pressure recording)**
- **Foley catheter to monitor urine output**
- **two peripheral cannulae, 14 gauge**
- **consider arterial line monitoring (once appropriately experienced staff available for insertion)**
- **consider transfer to intensive therapy unit once the bleeding is controlled or monitoring at high dependency unit on delivery suite, if appropriate**
- **recording of parameters on a modified early obstetric warning score (MEOWS) chart (see Appendix IV)**
- **acting and escalating promptly when abnormal scores from a MEOWS chart are observed**
- **documentation of fluid balance, blood, blood products and procedures.**

Continuous physiological monitoring is necessary and the recording of parameters over time on a flow chart that will give the reader good visual cues on the clinical progress of the patient (Appendix IV). The need to continually re-evaluate the woman's physiological condition, even when bleeding appears to have stopped, is essential to recognise continuing bleeding.

The presence of a central line not only provides a means of accurate central venous pressure monitoring, but also a route for rapid fluid replacement. Nevertheless, the threshold for instituting invasive monitoring has been controversial, with some authorities advising early recourse to central venous pressure monitoring[127–129] and others advocating caution.[76,130] The 2000–02 report of the UK Confidential Enquiries into Maternal Deaths (CEMD)[29] included the recommendation: 'Central venous and direct arterial pressure monitoring should be used when the cardiovascular system is compromised by haemorrhage or disease'. Central venous pressure monitoring requires early involvement of a senior skilled anaesthetist, who will usually take responsibility for this aspect of management. The use of ultrasound is more likely to make the procedure safer,[29] as this procedure carries significant morbidity and mortality.[131] Once bleeding is under control, transfer to an intensive care or high dependency unit on delivery suite should be considered, depending on the severity of the blood loss (see section 5.6.3).

Evidence level 4

It is also important that once the bleeding is arrested and any coagulopathy is corrected, chemical thromboprophylaxis is administered, as there is a high risk of thrombosis. Alternatively, anti-embolism stockings, foot impulse devices or intermittent pneumatic compression devices can be used if chemical thromboprophylaxis is contraindicated, for example, in cases of thrombocytopenia.[132]

Evidence level 4

5.5 *What is the role of the anaesthetist in the management of PPH?*

The management of PPH requires a multidisciplinary approach: the anaesthetist plays a crucial role in maintaining haemodynamic stability and, if necessary, in determining and administering the most appropriate method of anaesthesia.

D

Anaesthetists play an important role in the multidisciplinary team involved in the management of patients with PPH. A senior anaesthetist should be consulted early to help assess, initiate and continue prompt resuscitation of these patients, using their expertise in fluid and transfusion therapy as well as their experience in managing critically ill patients.[10]

If the patient needs to go to theatre for a surgical intervention, an experienced anaesthetist should promptly assess the patient in order to decide on the most suitable mode of anaesthesia, depending on the patient's haemodynamic status. Central neuraxial anaesthesia has become the anaesthetic technique of choice in the obstetric population and this has resulted in a reduction in maternal mortality.[133]

Evidence level 4

While general anaesthesia in obstetric patients is associated with increased morbidity and mortality when compared with regional anaesthesia due to the physiological changes that occur in pregnancy,[9] it may be preferable in patients who are haemodynamically unstable or who have a coagulopathy.

The patient may need high dependency or intensive care in the postoperative period. An obstetric early warning score system would help in the early identification of continuous bleeding, especially in cases which are not apparent, as recommended by CMACE (see Appendix IV).[131]

5.6 *What methods should be employed to arrest the bleeding?*

Clinicians should be prepared to use a combination of pharmacological, mechanical and surgical methods to arrest PPH. These methods should be directed towards the causative factor.

D

Careful clinical examination is required to determine the cause of PPH (see Table 1 and Appendix II for the risk factors and causes of PPH). A 2014 Cochrane review[2] addressing the treatment of primary PPH found no trials evaluating surgical techniques or radiological interventions for women with primary PPH that were unresponsive to pharmacological methods. Thus, recommendations on treatment strategies are based on observational data and consensus only.

Evidence level 4

5.6.1 What pharmacological and mechanical strategies can be used?

When uterine atony is perceived to be a cause of the bleeding, then a sequence of mechanical and pharmacological measures should be instituted in turn until the bleeding stops.

✓

The most common cause of primary PPH is uterine atony.[27] The initial management of PPH should, therefore, involve measures to stimulate myometrial contractions. The following mechanical and pharmacological measures should be instituted/administered in turn:[2]

- palpate the uterine fundus and rub it to stimulate contractions ('rubbing up the fundus')
- ensure that the bladder is empty (Foley catheter, leave in place)
- oxytocin 5 iu by slow intravenous injection (may have repeat dose)
- ergometrine 0.5 mg by slow intravenous or intramuscular injection (contraindicated in women with hypertension)
- oxytocin infusion (40 iu in 500 ml isotonic crystalloids at 125 ml/hour) unless fluid restriction is necessary
- carboprost 0.25 mg by intramuscular injection repeated at intervals of not less than 15 minutes to a maximum of eight doses (use with caution in women with asthma)
- misoprostol 800 micrograms sublingually.

The simple mechanical and physiological measures of 'rubbing up the fundus' and emptying the bladder to stimulate uterine contraction represent first-line management of PPH. No published studies have been identified to provide an evidence base for these interventions; nevertheless, professional consensus supports their continued use.[134]

Evidence level 4

Despite decades of empirical use in clinical practice, there are no trials comparing ergometrine with oxytocin as first-line agents for the treatment of PPH. It seems appropriate to use both agents, although oxytocin is to be preferred initially, especially in women with hypertension or pre-eclampsia. Previous guidance[1] advocated an initial dose of 10 iu oxytocin by slow intravenous injection for treatment (rather than prophylaxis) of PPH. The British National Formulary recommends a dose of 5 iu 'by slow intravenous injection (dose may be repeated)'.[135] The 1997–99 report of the UK CEMD highlighted the risk of profound hypotension that may be associated with oxytocin injection.[136] This guideline has adopted the CEMD recommendation that 'When given as an intravenous bolus the drug should be given slowly in a dose of not more than 5 iu'. This dosage is in line with guidance from other authorities.[30,135]

There are no trials comparing the prostaglandin carboprost (15-methyl prostaglandin $F_{2\alpha}$) with other uterotonic agents. Two case series from the USA,[137,138] comprising 26 and 237 cases, respectively, have reported on the use of carboprost in the successful management of PPH, without resort to surgical interventions in 85% and 95% of cases. Two of the four failures in the smaller series were associated with placenta accreta. If bleeding occurs at the time of caesarean section, intramyometrial injection of carboprost may be used (although not licensed). It is also possible to inject intramyometrial carboprost through the abdominal wall in the absence of laparotomy. The recommended dose is 250 micrograms intramuscularly. This may be repeated every 15 minutes to a total dose of 2 mg (eight doses). However, if significant atonic haemorrhage continues after a third dose of carboprost, without significant improvement (i.e. 30 minutes or more after the first dose was given), the team should consider transfer to the operating theatre for examination under anaesthesia, with an awareness of the impending need for laparotomy and/or hysterectomy.

Evidence level 3

Two systematic reviews,[2,139] which includes the 2014 Cochrane review, focused on misoprostol to treat PPH and examined the optimal route and dosage, and its efficacy. Compared with 40 iu oxytocin infusion, 800 micrograms sublingual misoprostol was associated with a significant increase in the number of women who had blood loss of at least 1000 ml (RR 2.65, 95% CI 1.04–6.75) and who required blood transfusion (RR 1.47, 95% CI 1.02–2.14). The review authors concluded that oxytocin infusion should be recommended as first-line treatment for primary PPH. When used following prophylactic uterotonics, misoprostol and oxytocin infusion work similarly.

Evidence level 1+

A study[140] of women in early pregnancy demonstrated that regardless of the route of administration (vaginal, sublingual or rectal), misoprostol took 1.0–2.5 hours to increase uterine tone. Clinicians should be aware of this delay in the clinical effect of misoprostol. Guidelines from WHO[141] and the International Federation of Gynecology and Obstetrics[142] recommend that in the management of PPH, misoprostol is administered sublingually.

Evidence level 4

5.6.2 What surgical treatments can be employed to arrest the bleeding?

If pharmacological measures fail to control the haemorrhage, surgical interventions should be initiated sooner rather than later. D

Intrauterine balloon tamponade is an appropriate first-line 'surgical' intervention for most women where uterine atony is the only or main cause of haemorrhage. C

Conservative surgical interventions may be attempted as second line, depending on clinical circumstances and available expertise. C

It is recommended that a laminated diagram of the brace suture technique be kept in theatre. ✓

Resort to hysterectomy sooner rather than later (especially in cases of placenta accreta or uterine rupture). C

Ideally and when feasible, a second experienced clinician should be involved in the decision for hysterectomy. ✓

The use of pharmacological agents other than those detailed should not delay recourse to surgery. Once the decision is made to embark on surgical haemostasis, the most appropriate choice of procedure will depend, in part, on the experience and expertise of available staff.

Compression of the aorta may be a temporary but effective measure to allow time for resuscitation to catch up with the volume replacement and the appropriate surgical support to arrive. The judgement of senior clinicians, taking into account the individual woman's future reproductive aspirations, is required in deciding the appropriate sequence of interventions.

The management of placenta praevia accreta is associated with significant morbidity and guidance is available in the RCOG Green-top Guideline No. 27.[12]

5.6.2.1 Uterine balloon tamponade

Tamponade using various types of hydrostatic balloon catheter has superseded uterine packing for the control of atonic PPH.[143] Case series have used a Foley catheter,[144] Bakri balloon,[145] Sengstaken–Blakemore oesophageal catheter[146,147] and a condom catheter.[148] The urological Rusch balloon has been described as preferable by virtue of larger capacity, ease of use and low cost.[149] A detailed protocol for uterine tamponade using the Rusch balloon is available.[149] The 2014 Scottish Confidential Audit of Severe Maternal Morbidity report identified 339 women who had an estimated blood loss of 2500 ml or higher; in 82 cases, balloon tamponade was employed, successfully avoiding hysterectomy in 75 (91%) women.[150] This success rate is of the same order as that reported in other case series.

Evidence level 3

Some of the reports of balloon tamponade[148,151] describe the intervention as the 'tamponade test'. A 'positive test' (control of PPH following inflation of the balloon) indicates that laparotomy is not required, whereas a 'negative test' (continued PPH following inflation of the balloon) is an indication to proceed to laparotomy. The concept of balloon tamponade as a 'test' serves to affirm its place as first-line 'surgical' management. There is no clear evidence on how long the balloon tamponade should be left in place. In most cases, 4–6 hours of tamponade should be adequate to achieve haemostasis and ideally it should be removed during daytime hours, in the presence of appropriate senior staff, in case further intervention is necessary.[146,147]

Evidence level 4

A systematic review concluded that uterine balloon tamponade is an effective treatment for PPH in resource-poor settings.[152]

Evidence level 2++

5.6.2.2 Haemostatic suturing

Several case series[153] have been published describing success with haemostatic brace sutures. The best known version, described by B-Lynch in 1997,[154] requires hysterotomy for its insertion and is particularly suitable when the uterus has already been opened for a caesarean section. A review published in 2005[155] summarised nine case series of B-Lynch suturing (a total of 32 cases), reporting success in all but one case.

In 2002, Hayman et al.[156] described a modified compression suture which does not require hysterotomy, and success in 10/11 women managed with this suture has been reported.[157] Other authors have described variants on these techniques.[158,159] Double vertical compression sutures have proved effective in treating PPH due to atony and placenta praevia. This may have a dual action of reducing uterine blood flow and compressing the bleeding surface.[160]

Evidence level 3

A prospective population-based study of 211 women treated with a uterine compression suture to control PPH concluded that the overall failure rate of sutures leading to hysterectomy was 25%.[161] There was no difference in failure rate among B-Lynch, modified B-Lynch and other suture techniques. Risk factors for a hysterectomy included increasing age and vaginal delivery. In addition, a prolonged delay of 2–6 hours between delivery and uterine compression suture was independently associated with a four-fold increased risk of hysterectomy. This emphasises the need for careful postpartum evaluation of blood loss to avoid prolonged delay in haemorrhage recognition.

The 2014 Scottish Confidential Audit of Severe Maternal Morbidity report[150] identified 21 cases where haemostatic brace suturing was used for the management of PPH (greater than or equal to 2500 ml); hysterectomy was averted in 16 (76%) women. Again, this success rate is of the same order as that reported in other case series.

Evidence level 3

These observational data suggest that haemostatic suture techniques are effective in controlling severe PPH and in reducing the need for hysterectomy. In the absence of comparative data to demonstrate that any one variant is superior to another, obstetricians are encouraged to familiarise themselves with one technique under the supervision of an experienced colleague. It is recommended that a laminated diagram of the brace suture technique be kept in theatre.

A systematic review[162] has concluded that compression sutures are associated with a low complication rate. A higher risk of uterine ischaemia appeared to be caused when the procedure was combined with vessel ligation. No negative impact on fertility has been reported.

Case series have reported the combined use of haemostatic suturing and balloon tamponade in the management of PPH.[163–165]

Evidence level 3

5.6.2.3 Stepwise uterine devascularisation and internal iliac artery ligation

Stepwise uterine devascularisation describes the successive ligation of (i) one uterine artery, (ii) both uterine arteries, (iii) low uterine arteries, (iv) one ovarian artery and (v) both ovarian arteries, in the management of PPH.[166] The original case series[167] of 103 patients with intractable PPH not responding to medical management was effective in all cases without the need for hysterectomy, leading some clinicians to propose that stepwise uterine devascularisation should be the first-line conservative surgical treatment to control PPH.

When internal iliac artery ligation is being considered, a senior gynaecologist or vascular surgeon should be informed and involved since this technique requires a high degree of surgical skill and training, and may be associated with ureteric injury. A case series described 84 women with PPH from various causes who underwent internal iliac artery ligation as the first-line surgical intervention. Hysterectomy was subsequently required in 33 (39%) women.[168]

A study of 45 women following internal iliac artery ligation suggests that subsequent fertility and pregnancy outcomes are not impaired.[169]

Evidence level 3

A systematic review[170] of fertility outcomes following the surgical management of PPH concluded that uterine devascularisation techniques, including internal iliac artery ligation, did not adversely affect future fertility, although, the number of studies and quality of evidence was limited.

Evidence level 2++

5.6.2.4 Selective arterial occlusion or embolisation by interventional radiology

A large retrospective study[171] has evaluated arterial embolisation in 251 patients after PPH. It was successful in arresting the bleeding in 86.5% (217/251). The analysis suggested that caesarean section delivery, disseminated intravascular coagulation and transfusion of more than 10 units of packed red cells were related to failed embolisation.

Evidence level 3

The logistics of performing arterial occlusion or embolisation where the equipment or an interventional radiologist may not be available mean that uterine balloon tamponade is a more appropriate first-line treatment.

Follow-up studies of 17[172] and 25[173] women who underwent arterial embolisation for treatment of PPH suggest that the intervention does not impair subsequent menstruation, fertility and obstetric outcomes. Selective arterial occlusion may also be effective after failed internal iliac artery ligation.[174]

Evidence level 3

5.6.2.5 Hysterectomy

The decision for hysterectomy should be made by an experienced consultant clinician and the decision preferably discussed with a second experienced clinician when feasible.[29] Early recourse to hysterectomy is recommended, especially where bleeding is associated with placenta accreta or uterine rupture.[12] Hysterectomy should not be delayed until the woman is in extremis or while less definitive procedures with which the surgeon has little experience are attempted. The procedure should be carried out by a surgeon who is experienced in carrying out hysterectomies. Subtotal hysterectomy is the operation of choice in many instances of PPH requiring hysterectomy, unless there is trauma to the cervix or a morbidly adherent placenta in the lower segment.

Evidence level 4

Sequential reports of the Scottish Confidential Audit of Severe Maternal Morbidity from 2003 until 2012, summarised in the final 2014 publication,[150] have shown a statistically significant fall in the proportion of women with PPH (with blood loss greater than or equal to 2500 ml) requiring a hysterectomy to control the bleeding, and an increase in the use of conservative surgical techniques.

Evidence level 3

5.6.3 Intensive and high dependency units and post-PPH care

The 2006–08 CMACE report[10] identified that three deaths were due to lack of optimal care following PPH, and in particular, a lack of routine observation in the postpartum period. Sequential reports[10,131] have recommended the use of MEOWS charts to alert caregivers to abnormal trends in haemodynamic measurements.

Evidence level 4

A prospective audit[175] of the management of major PPH (defined in the audit as blood loss of 2500 ml or more, transfused 5 or more units of packed red cells or received treatment for coagulopathy) found that the majority of women received high dependency care on the labour ward, while only 21% were admitted to intensive care. The authors concluded that care for these women may be better provided by obstetricians and anaesthetists on the labour ward, a view that others have shared.[176]

Evidence level 3

6. How should secondary PPH be managed?

In women presenting with secondary PPH, an assessment of vaginal microbiology should be performed (high vaginal and endocervical swabs) and appropriate use of antimicrobial therapy should be initiated when endometritis is suspected. D

A pelvic ultrasound may help to exclude the presence of retained products of conception (RPOC), although the diagnosis of retained products is unreliable. C

Surgical evacuation of retained placental tissue should be undertaken or supervised by an experienced clinician. D

The causes of secondary PPH are numerous and include endometritis, RPOC and subinvolution of the placental implantation site.[177,178] The management of women presenting with secondary PPH should include an assessment of their haemodynamic status, an assessment of the blood loss and an evaluation of the woman's concerns (for example, is her bleeding becoming inconvenient because it has persisted longer than she had expected?). Evidence level 4

Investigations should include bacteriological testing for endometritis (high vaginal swab), although a low yield of positive vaginal swab results has been reported in patients with secondary PPH.[179] In contrast, Pather et al.[180] found a high incidence of abnormal vaginal microbiology (52%) and endometritis in their case series, supporting the practice of routine assessment of vaginal microbiology and appropriate use of antimicrobial therapy in women presenting with secondary PPH. Evidence level 3

A Cochrane review investigated the effect of different antibiotic regimens for the treatment of postpartum endometritis.[181] This review concluded that a combination of clindamycin and gentamicin is appropriate, and that once uncomplicated endometritis has clinically improved with intravenous therapy, there is no additional benefit from further oral therapy. The management of women presenting with secondary PPH and sepsis is addressed in the RCOG Green-top Guideline No. 64b.[182] Evidence level 1–

Pelvic ultrasound scans are commonly performed on women presenting with secondary PPH to identify any RPOC. Case series[180,183–186] have reported a wide range of sensitivities and specificities of ultrasound in the detection of RPOC (44–94% and 16–92%, respectively). These series suggest that the presence of an echogenic mass and a thickened 'endometrium' is associated with RPOC. In a prospective observational study[187] of 79 women with secondary PPH, Mulic-Lutvica and Axelsson concluded that an echogenic mass in the uterine cavity and an anteroposterior diameter of the cavity above the 90th centile (approximately 25 mm on days 1–7 postpartum) was associated with RPOC. Since the range of sensitivities and specificities of ultrasound in the detection of RPOC is so wide, the clinical findings, including the degree of bleeding and whether the cervical os is open, should be taken into account before the decision to undertake surgery is made. It has been proposed that colour flow Doppler imaging should be included in the evaluation of the postpartum uterus, although, there is no strong evidence to support its use;[178] its use may facilitate the diagnosis of pseudoaneurysms and arteriovenous malformations, which are rare but recognised causes of secondary PPH.[188–190] Evidence level 3

Surgical evacuation of the uterus for RPOC is not without morbidity and can result in uterine perforation (1.5%)[180,191] and Asherman's syndrome.[192] It is, therefore, recommended that surgical evacuation of retained placental tissue should be undertaken or supervised by an experienced clinician. An appropriately trained clinician may consider performing uterine evacuation under direct ultrasound guidance.

Evidence level 3

A 2002 Cochrane review (assessed as up-to-date in January 2008) addressed treatments for secondary PPH.[4] No trials were identified which met the review group's inclusion criteria and no recommendations were made regarding effective treatments. Uterotonics, such as misoprostol and ergometrine, have been recommended in the management of secondary PPH, although evidence to support their use is limited.[178] Transcatheter arterial embolisation[193] and balloon tamponade[194] have been employed in cases of secondary PPH with ongoing bleeding.

7. Risk management

7.1 *Training and preparation: what measures can be taken to ensure optimal management of PPH?*

Every maternity unit should have a multidisciplinary protocol for the management of PPH. ✓

All staff involved in maternity care should receive training in the management of obstetric emergencies, including the management of PPH. B

Training for PPH should be multiprofessional and include team rehearsals. B

All cases of PPH involving a blood loss of greater than 1500 ml should be the subject of a formal clinical incident review. D

To ensure optimal management of PPH, every unit should have a multidisciplinary protocol with which staff should be familiar (see section 5). Updates on the management of obstetric emergencies (including the management of PPH) are a proactive approach to risk management. Skills drills should ensure that all members of staff, including those working in the transfusion laboratory, are aware of their role in the management of PPH. A systematic review[195] of the effectiveness of multidisciplinary simulation training in obstetric emergencies (including PPH) showed that teamwork training in a simulation setting resulted in improvement of knowledge, practical skills, communication and team performance. Training in a simulation centre did not further improve outcome compared with training at a local unit.

Evidence level 2++

The RCOG recommends that all cases of PPH with an estimated blood loss of more than 1500 ml should be the subject of a formal clinical incident review.[196]

Evidence level 4

7.2 *Documentation*

Accurate documentation of a delivery with PPH is essential. ✓

Accurate documentation is important for further clinical management, continuity of care and team work. In addition, inadequate documentation can contribute to the likelihood of there being medicolegal consequences.[197] The team member recording events on the structured proforma, the scribe, is crucial in the management of PPH (see Appendix V); the proforma is effectively a checklist of available interventions, and team leaders should communicate with the scribe during the PPH to ensure that no steps have been omitted. PPH should be notified through a clinical incident reporting or risk management system.

Evidence level 4

It is important to record:

- the staff in attendance and the time they arrived
- the sequence of events
- the administration of different pharmacological agents, their timing and sequence
- the time of surgical intervention, where relevant
- the condition of the mother throughout the different steps
- the timing of the fluid and blood products given.

7.3 *Debriefing*

An opportunity to discuss the events surrounding the obstetric haemorrhage should be offered to the woman (possibly with her birthing partner/s) at a mutually convenient time. ✓

After obstetric emergencies, women can be psychologically affected by postnatal depression or fear of further childbirth. Major PPH can be traumatic to women and their families and has been associated with the subsequent development of post-traumatic stress disorder.[198] Women who have experienced a major PPH should be offered an opportunity to discuss the events surrounding their delivery. A discussion of future pregnancy, including the likelihood of a repeat PPH and any fears regarding pregnancy and childbirth that the woman may have should be addressed. This should include arrangements for appropriate investigations as necessary, such as testing for coagulopathies if there are other indicators and screening for the rare complication of postpartum hypopituitarism (Sheehan syndrome) secondary to hypotension.[199]

Evidence level 4

8. Recommendations for future research

- RCTs are required to identify the best drug combinations, route and dose of uterotonics for the treatment of primary PPH.
- The role of viscoelastometric point of care tests using TEG® and ROTEM® in the management of PPH requires evaluation.
- Studies are required to determine the optimal ratio of packed red cells to FFP in the management of obstetric haemorrhage.

- Studies are required to determine the role of fibrinogen concentrate in the management of PPH.
- The role of prothrombin complex concentrate in the management of PPH requires evaluation.
- RCTs are required to investigate the role of uterotonic agents (misoprostol and ergometrine) in the management of secondary PPH.

9. Auditable topics

- The proportion of women who are screened for antenatal anaemia (100%).
- The proportion of women who are offered uterotonics for the third stage of labour (100%).
- The proportion of women undergoing an assessment of risk factors for PPH when they present in labour (100%).
- Appropriate documentation of management, especially with the timing of events for women who have had PPH (100%).
- Notification to the risk management team of women with PPH involving a blood loss greater than 1500 ml (100%).
- Proportion of the multidisciplinary team who have undergone skills drills training in PPH (100%).

10. Useful links and support groups

- Royal College of Obstetricians and Gynaecologists. *Heavy bleeding after birth (postpartum haemorrhage). Information for you*. London: RCOG; 2016 [https://www.rcog.org.uk/en/patients/patient-leaflets/heavy-bleeding-after-birth-postpartum-haemorrhage/].
- Royal College of Obstetricians and Gynaecologists. *Blood transfusion, pregnancy and birth. Information for you*. London: RCOG; 2015 [https://www.rcog.org.uk/en/patients/patient-leaflets/blood-transfusion-pregnancy-and-birth/].
- Patient. *Postpartum Haemorrhage* [www.patient.co.uk/showdoc/40000261].
- Netdoctor.co.uk. *I suffered with postpartum haemorrhage* [www.netdoctor.co.uk/ate/womenshealth/207160.html].

References

1. Scottish Obstetric Guidelines and Audit Project. *The Management of Postpartum Haemorrhage: A Clinical Practice Guideline for Professionals involved in Maternity Care in Scotland*. Pilot edition. Glasgow: SOGAP, 1998. [http://healthcareimprovementscotland.org/his/idoc.ashx?docid=84ee51e6-d441-4dba-8ebf-4fa6a2857e0d&version=-1]. Accessed 2015 Jul 2.
2. Mousa HA, Blum J, Abou El Senoun G, Shakur H, Alfirevic Z. Treatment for primary postpartum haemorrhage. *Cochrane Database Syst Rev* 2014;(2):CD003249.
3. Knight M, Tuffnell D, Kenyon S, Shakespeare J, Gray R, Kurinczuk JJ, editors, on behalf of MBRRACE-UK. *Saving Lives, Improving Mothers' Care - Surveillance of maternal deaths in the UK 2011-13 and lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–13*. Oxford: National Perinatal Epidemiology Unit, University of Oxford; 2015.
4. Alexander J, Thomas PW, Sanghera J. Treatments for secondary postpartum haemorrhage. *Cochrane Database Syst Rev* 2002;(1):CD002867.
5. Demers C, Derzko C, David M, Douglas J; Society of Obstetricians and Gynaecologists of Canada. Gynaecological and obstetric management of women with inherited bleeding disorders. SOGC Clinical Practice Guidelines No 163. *J Obstet Gynaecol Can* 2005;27:707–18.
6. Baudo F, de Cataldo F; Italian Association of Haemophilia Centres (AICE): Register of acquired factor VIII inhibitors (RIIA). Acquired factor VIII inhibitors in pregnancy: data from the Italian Haemophilia Register relevant to clinical practice. *BJOG* 2003;110:311–4.
7. The Royal College of Surgeons of England. *Code of Practice for the Surgical Management of Jehovah's Witnesses*. London: The Royal College of Surgeons of England; 2002.
8. The Association of Anaesthetists of Great Britain and Ireland. *Management of Anaesthesia for Jehovah's Witnesses*, 2nd ed. London: AAGBI; 2005.
9. National Institute for Health and Care Excellence. *Intrapartum care: care of healthy women and their babies during childbirth*. NICE clinical guideline 190. Manchester: NICE; 2014.
10. Centre for Maternal and Child Enquiries (CMACE). Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006–08. The Eighth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. *BJOG* 2011;118 Suppl 1:1–203.

11. Royal College of Obstetricians and Gynaecologists. *Antepartum Haemorrhage*. Green-top Guideline No. 63. London: RCOG; 2011.
12. Royal College of Obstetricians and Gynaecologists. *Placenta Praevia, Placenta Praevia Accreta and Vasa Praevia: Diagnosis and Management*. Green-top Guideline No. 27. London: RCOG; 2011.
13. Royal College of Obstetricians and Gynaecologists. *Blood Transfusion in Obstetrics*. Green-top Guideline No. 47. London: RCOG; 2015.
14. Calvert C, Thomas SL, Ronsmans C, Wagner KS, Adler AJ, Filippi V. Identifying regional variation in the prevalence of postpartum haemorrhage: a systematic review and meta-analysis. *PLoS ONE* 2012;7:e41114.
15. Bryant A, Mhyre JM, Leffert LR, Hoban RA, Yakoob MY, Bateman BT. The association of maternal race and ethnicity and the risk of postpartum hemorrhage. *Anesth Analg* 2012;115:1127–36.
16. Combs CA, Murphy EL, Laros RK Jr. Factors associated with postpartum hemorrhage with vaginal birth. *Obstet Gynecol* 1991;77:69–76.
17. Stones RW, Paterson CM, Saunders NJ. Risk factors for major obstetric haemorrhage. *Eur J Obstet Gynecol Reprod Biol* 1993;48:15–8.
18. Al-Zirqi I, Vangen S, Forsen L, Stray-Pedersen B. Prevalence and risk factors of severe obstetric haemorrhage. *BJOG* 2008;115:1265–72.
19. Tsu VD. Postpartum haemorrhage in Zimbabwe: a risk factor analysis. *Br J Obstet Gynaecol* 1993;100:327–33.
20. Bais JM, Eskes M, Pel M, Bonsel GJ, Bleker OP. Postpartum haemorrhage in nulliparous women: incidence and risk factors in low and high risk women. A Dutch population-based cohort study on standard (≥500 ml) and severe (≥1000 ml) postpartum haemorrhage. *Eur J Obstet Gynecol Reprod Biol* 2004;115:166–72.
21. Magann EF, Evans S, Hutchinson M, Collins R, Howard BC, Morrison JC. Postpartum hemorrhage after vaginal birth: an analysis of risk factors. *South Med J* 2005;98:419–22.
22. Magann EF, Evans S, Chauhan SP, Lanneau G, Fisk AD, Morrison JC. The length of the third stage of labor and the risk of postpartum hemorrhage. *Obstet Gynecol* 2005;105:290–3.
23. Sheiner E, Sarid L, Levy A, Seidman DS, Hallak M. Obstetric risk factors and outcome of pregnancies complicated with early postpartum hemorrhage: a population-based study. *J Matern Fetal Neonatal Med* 2005;18:149–54.
24. Sosa CG, Althabe F, Belizán JM, Buekens P. Risk factors for postpartum hemorrhage in vaginal deliveries in a Latin-American population. *Obstet Gynecol* 2009;113:1313–9.
25. Brinsden PR, Clark AD. Postpartum haemorrhage after induced and spontaneous labour. *Br Med J* 1978;ii:855–6.
26. Selo-Ojeme DO, Okonofua FE. Risk factors for primary postpartum haemorrhage. A case control study. *Arch Gynecol Obstet* 1997;259:179–87.
27. World Health Organization. *WHO recommendations for the prevention and treatment of postpartum haemorrhage*. Geneva: WHO; 2012.
28. Oyelese Y, Ananth CV. Postpartum hemorrhage: epidemiology, risk factors, and causes. *Clin Obstet Gynecol* 2010;53:147–56.
29. Confidential Enquiry into Maternal and Child Health. *Why Mothers Die 2000–2002. The Sixth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom*. London: RCOG Press; 2004.
30. Leduc D, Senikas V, Lalonde AB, Ballerman C, Biringer A, Delaney M, et al.; Clinical Practice Obstetrics Committee; Society of Obstetricians and Gynaecologists of Canada. Active management of the third stage of labour: prevention and treatment of postpartum hemorrhage. SOGC Clinical Practice Guideline No. 235. *J Obstet Gynaecol Can* 2009;31:980–93.
31. Combs CA, Murphy EL, Laros RK Jr. Factors associated with hemorrhage in cesarean deliveries. *Obstet Gynecol* 1991;77:77–82.
32. National Institute for Health and Care Excellence. *Antenatal Care*. NICE clinical guideline 62. Manchester: NICE; 2008.
33. Pavord S, Myers B, Robinson S, Allard S, Strong J, Oppenheimer C; British Committee for Standards in Haematology. UK guidelines on the management of iron deficiency in pregnancy. *Br J Haematol* 2012;156:588–600.
34. Kavle JA, Stoltzfus RJ, Witter F, Tielsch JM, Khalfan SS, Caulfield LE. Association between anaemia during pregnancy and blood loss at and after delivery among women with vaginal births in Pemba Island, Zanzibar, Tanzania. *J Health Popul Nutr* 2008;26:232–40.
35. Hofmeyr GJ, Abdel-Aleem H, Abdel-Aleem MA. Uterine massage for preventing postpartum haemorrhage. *Cochrane Database Syst Rev* 2013;(7):CD006431.
36. McDonald SJ, Abbott JM, Higgins SP. Prophylactic ergometrine-oxytocin versus oxytocin for the third stage of labour. *Cochrane Database Syst Rev* 2004;(1):CD000201.
37. Tunçalp Ö, Hofmeyr GJ, Gülmezoglu AM. Prostaglandins for preventing postpartum haemorrhage. *Cochrane Database Syst Rev* 2012;(8):CD000494.
38. Oladapo OT, Fawole B, Blum J, Abalos E. Advance misoprostol distribution for preventing and treating postpartum haemorrhage. *Cochrane Database Syst Rev* 2012;(2):CD009336.
39. Begley CM, Gyte GM, Devane D, McGuire W, Weeks A. Active versus expectant management for women in the third stage of labour. *Cochrane Database Syst Rev* 2011;(11):CD007412.
40. Hutton EK, Hassan ES. Late vs early clamping of the umbilical cord in full-term neonates: systematic review and meta-analysis of controlled trials. *JAMA* 2007;297:1241–52.
41. Royal College of Obstetricians and Gynaecologists. *Clamping of the Umbilical Cord and Placental Transfusion*. Scientific Impact Paper No. 14. London: RCOG; 2015.
42. Tita AT, Szychowski JM, Rouse DJ, Bean CM, Chapman V, Nothern A, et al. Higher-dose oxytocin and hemorrhage after vaginal delivery: a randomized controlled trial. *Obstet Gynecol* 2012;119:293–300.
43. Gizzo S, Patrelli TS, Di Gangi S, Carrozzini M, Saccardi C, Zambon A, et al. Which uterotonic is better to prevent the postpartum hemorrhage? Latest news in terms of clinical efficacy, side effects, and contraindications: a systematic review. *Reprod Sci* 2013;20:1011–9.
44. Su LL, Chong YS, Samuel M. Carbetocin for preventing postpartum haemorrhage. *Cochrane Database Syst Rev* 2012;(4):CD005457.
45. Dennehy KC, Rosaeg OP, Cicutti NJ, Krepski B, Sylvain JP. Oxytocin injection after caesarean delivery: intravenous or intramyometrial? *Can J Anaesth* 1998;45:635–9.
46. Munn MB, Owen J, Vincent R, Wakefield M, Chestnut DH, Hauth JC. Comparison of two oxytocin regimens to prevent uterine atony at caesarean delivery: a randomized controlled trial. *Obstet Gynecol* 2001;98:386–90.
47. Lokugamage AU, Paine M, Bassaw-Balroop K, Sullivan KR, El Refaey H, Rodeck CH. Active management of the third stage at caesarean section: a randomised controlled trial of misoprostol versus Syntocinon. *Aust N Z J Obstet Gynaecol* 2001;41:411–4.
48. Chou MM, MacKenzie IZ. A prospective, double-blind, randomized comparison of prophylactic intramyometrial 15-methyl prostaglandin $F_{2\alpha}$, 125 micrograms, and intravenous oxytocin, 20 units, for the control of blood loss at elective cesarean section. *Am J Obstet Gynecol* 1994;171:1356–60.

49. Boucher M, Horbay GL, Griffin P, Deschamps Y, Desjardins C, Schulz M, et al. Double-blind, randomized comparison of the effect of carbetocin and oxytocin on intraoperative blood loss and uterine tone of patients undergoing cesarean section. *J Perinatol* 1998;18:202–7.
50. Dansereau J, Joshi AK, Helewa ME, Doran TA, Lange IR, Luther ER, et al. Double-blind comparison of carbetocin versus oxytocin in prevention of uterine atony after cesarean section. *Am J Obstet Gynecol* 1999;180:670–6.
51. National Collaborating Centre for Women's and Children's Health. *Caesarean Section*. London: RCOG; 2011.
52. Novikova N, Hofmeyr GJ, Cluver C. Tranexamic acid for preventing postpartum haemorrhage. *Cochrane Database Syst Rev* 2015;(6):CD007872.
53. Glover P. Blood loss at delivery: how accurate is your estimation? *Aust J Midwifery* 2003;16:21–4.
54. Toledo P, McCarthy RJ, Hewlett BJ, Fitzgerald PC, Wong CA. The accuracy of blood loss estimation after simulated vaginal delivery. *Anesth Analg* 2007;105:1736–40.
55. Patel A, Goudar SS, Geller SE, Kodkany BS, Edlavitch SA, Wagh K, et al. Drape estimation vs. visual assessment for estimating postpartum hemorrhage. *Int J Gynaecol Obstet* 2006;93:220–4.
56. Schorn MN. Measurement of blood loss: review of the literature. *J Midwifery Womens Health* 2010;55:20–7.
57. Zhang WH, Deneux-Tharaux C, Brocklehurst P, Juszczak E, Joslin M, Alexander S; EUPHRATES Group. Effect of a collector bag for measurement of postpartum blood loss after vaginal delivery: cluster randomised trial in 13 European countries. *BMJ* 2010;340:c293.
58. Buckland SS, Homer CS. Estimating blood loss after birth: using simulated clinical examples. *Women Birth* 2007;20:85–8.
59. Bose P, Regan F, Paterson-Brown S. Improving the accuracy of estimated blood loss at obstetric haemorrhage using clinical reconstructions. *BJOG* 2006;113:919–24.
60. Rath WH. Postpartum hemorrhage – update on problems of definitions and diagnosis. *Acta Obstet Gynecol Scand* 2011;90:421–8.
61. Allgöwer M, Burri C. ["Shock index"]. *Dtsch Med Wochenschr* 1967;92:1947–50. German.
62. Nathan HL, El Ayadi A, Hezelgrave NL, Seed P, Butrick E, Miller S, et al. Shock index: an effective predictor of outcome in postpartum haemorrhage? *BJOG* 2015;122:268–75.
63. Royal College of Obstetricians and Gynaecologists. *Responsibility of Consultant On-Call*. Good Practice No. 8. London: RCOG; 2009.
64. Duthie SJ, Ven D, Yung GL, Guang DZ, Chan SY, Ma HK. Discrepancy between laboratory determination and visual estimation of blood loss during normal delivery. *Eur J Obstet Gynecol Reprod Biol* 1991;38:119–24.
65. Ho AM, Karmakar MK, Dion PW. Are we giving enough coagulation factors during major trauma resuscitation? *Am J Surg* 2005;190:479–84.
66. Hirshberg A, Dugas M, Banez EI, Scott BG, Wall MJ Jr, Mattox KL. Minimizing dilutional coagulopathy in exsanguinating hemorrhage: a computer simulation. *J Trauma* 2003;54:454–63.
67. Hunt BJ, Allard S, Keeling D, Norfolk D, Stanworth SJ, Pendry K; British Committee for Standards in Haematology. A practical guideline for the haematological management of major haemorrhage. *Br J Haematol* 2015;170:788–803.
68. British Committee for Standards in Haematology, Stainsby D, MacLennan S, Thomas D, Isaac J, Hamilton PJ. Guidelines on the management of massive blood loss. *Br J Haematol* 2006;135:634–41.
69. Cochrane Injuries Group Albumin Reviewers. Human albumin administration in critically ill patients: systematic review of randomised controlled trials. *BMJ* 1998;317:235–40.
70. Schierhout G, Roberts I. Fluid resuscitation with colloid or crystalloid solutions in critically ill patients: a systematic review of randomised trials. *BMJ* 1998;316:961–4.
71. Association of Anaesthetists of Great Britain and Ireland, Thomas D, Wee M, Clyburn P, Walker I, Brohi K, et al. Blood transfusion and the anaesthetist: management of massive haemorrhage. *Anaesthesia* 2010;65:1153–61.
72. Luna GK, Maier RV, Pavlin EG, Anardi D, Copass MK, Oreskovich MR. Incidence and effect of hypothermia in seriously injured patients. *J Trauma* 1987;27:1014–8.
73. World Health Organization. *WHO guidelines for the management of postpartum haemorrhage and retained placenta*. Geneva: WHO; 2009. [http://apps.who.int/iris/bitstream/10665/44171/1/9789241598514_eng.pdf]. Accessed 2016 Feb 4.
74. Perel P, Roberts I, Ker K. Colloids versus crystalloids for fluid resuscitation in critically ill patients. *Cochrane Database Syst Rev* 2013;(2):CD000567.
75. Murphy MF, Wallington TB, Kelsey P, Boulton F, Bruce M, Cohen H, et al.; British Committee for Standards in Haematology, Blood Transfusion Task Force. Guidelines for the clinical use of red cell transfusions. *Br J Haematol* 2001;113:24–31.
76. United Kingdom Blood Services; Norfolk D, editor. *Handbook of Transfusion Medicine*. 5th ed. Norwich: TSO; 2013.
77. Serious Hazards of Transfusion (SHOT). [www.shotuk.org/]. Accessed 2013 Aug 6.
78. Kozek-Langenecker SA, Afshari A, Albaladejo P, Santullano CA, De Robertis E, Filipescu DC, et al. Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol* 2013;30:270–382.
79. British Committee for Standards in Haematology, Milkins C, Berryman J, Cantwell C, Elliott C, Haggas R, et al. Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories. *Transfus Med* 2013;23:3–35.
80. Royal College of Obstetricians and Gynaecologists. *The Management of Women with Red Cell Antibodies during Pregnancy*. Green-top Guideline No. 65. London: RCOG; 2014.
81. Laupacis A, Brown J, Costello B, Delage G, Freedman J, Hume H, et al. Prevention of posttransfusion CMV in the era of universal WBC reduction: a consensus statement. *Transfusion* 2001;41:560–9.
82. Advisory Committee on the Safety of Blood, Tissues and Organs. *Cytomegalovirus tested blood components - position statement*. London: Department of Health; 2012.
83. Carless PA, Henry DA, Moxey AJ, O'Connell D, Brown T, Fergusson DA. Cell salvage for minimising perioperative allogeneic blood transfusion. *Cochrane Database Syst Rev* 2010;(4):CD001888.
84. Catling SJ, Williams S, Fielding AM. Cell salvage in obstetrics: an evaluation of the ability of cell salvage combined with leucocyte depletion filtration to remove amniotic fluid from operative blood loss at caesarean section. *Int J Obstet Anesth* 1999;8:79–84.
85. National Institute for Health and Clinical Excellence. *Intraoperative blood cell salvage in obstetrics*. NICE interventional procedure guidance 144. Manchester: NICE; 2005.
86. Wee MY, Thomas D, Verma R, Jones J, Catling S, Isaac J, et al.; The Association of Anaesthetists of Great Britain and Ireland. *Blood Transfusion and the Anaesthetist: Intra-operative Cell Salvage*. AAGBI Safety Guideline. London: AAGBI; 2009.
87. Liumbruno GM, Liumbruno C, Rafanelli D. Intraoperative cell salvage in obstetrics: is it a real therapeutic option? *Transfusion* 2011;51:2244–56.
88. Geoghegan J, Middleton L, Moore P, Subseson G, Khan K, Daniels J. Routine cell salvage during elective caesarean section: a pilot randomised trial. *Int J Obstet Anesth* 2015;24:86–7.

89. Solomon C, Collis RE, Collins PW. Haemostatic monitoring during postpartum haemorrhage and implications for management. *Br J Anaesth* 2012;109:851–63.
90. Avidan MS, Alcock EL, Da Fonseca J, Ponte J, Desai JB, Despotis GJ, et al. Comparison of structured use of routine laboratory tests or near-patient assessment with clinical judgement in the management of bleeding after cardiac surgery. *Br J Anaesth* 2004;92:178–86.
91. Allard S, Green L, Hunt BJ. How we manage the haematological aspects of major obstetric haemorrhage. *Br J Haematol* 2014; 164:177–88.
92. Bell SF, Rayment R, Collins PW, Collis RE. The use of fibrinogen concentrate to correct hypofibrinogenaemia rapidly during obstetric haemorrhage. *Int J Obstet Anesth* 2010;19:218–23.
93. Collis RE, Collins PW. Haemostatic management of obstetric haemorrhage. *Anaesthesia* 2015;70 Suppl 1:78–86, e27–8.
94. Mallaiah S, Barclay P, Harrod I, Chevannes C, Bhalla A. Introduction of an algorithm for ROTEM-guided fibrinogen concentrate administration in major obstetric haemorrhage. *Anaesthesia* 2015;70:166–75.
95. Plaat F, Bogod D, Bythell V, Mushambi M, Clyburn P, Lucas N, et al.; Association of Anaesthetists of Great Britain & Ireland; Obstetric Anaesthetists' Association. *OAA / AAGBI Guidelines for Obstetric Anaesthetic Services 2013*. London: AAGBI; 2013.
96. National Institute for Health and Care Excellence. *Detecting, managing and monitoring haemostasis: viscoelastometric point of care testing (ROTEM, TEG and Sonoclot systems)*. NICE diagnostics guidance 13. Manchester: NICE; 2014.
97. Charbit B, Mandelbrot L, Samain E, Baron G, Haddaoui B, Keita H, et al.; PPH Study Group. The decrease of fibrinogen is an early predictor of the severity of postpartum hemorrhage. *J Thromb Haemost* 2007;5:266–73.
98. Collins PW, Lilley G, Bruynseels D, Laurent DB, Cannings-John R, Precious E, et al. Fibrin-based clot formation as an early and rapid biomarker for progression of postpartum hemorrhage: a prospective study. *Blood* 2014;124:1727–36.
99. de Lloyd L, Bovington R, Kaye A, Collis RE, Rayment R, Sanders J, et al. Standard haemostatic tests following major obstetric haemorrhage. *Int J Obstet Anesth* 2011;20:135–41.
100. Li G, Rachmale S, Kojicic M, Shahjehan K, Malinchoc M, Kor DJ, et al. Incidence and transfusion risk factors for transfusion-associated circulatory overload among medical intensive care unit patients. *Transfusion* 2011;51:338–43.
101. Teofili L, Bianchi M, Zanfini BA, Catarci S, Sicuranza R, Spartano S, et al. Acute lung injury complicating blood transfusion in post-partum hemorrhage: incidence and risk factors. *Mediterr J Hematol Infect Dis* 2014;6:e2014.069.
102. Collins PW, Solomon C, Sutor K, Crispin D, Hochleitner G, Rizoli S, et al. Theoretical modelling of fibrinogen supplementation with therapeutic plasma, cryoprecipitate, or fibrinogen concentrate. *Br J Anaesth* 2014;113:585–95.
103. Hiippala ST, Myllylä GJ, Vahtera EM. Hemostatic factors and replacement of major blood loss with plasma-poor red cell concentrates. *Anesth Analg* 1995;81:360–5.
104. Chowdary P, Saayman AG, Paulus U, Findlay GP, Collins PW. Efficacy of standard dose and 30 ml/kg fresh frozen plasma in correcting laboratory parameters of haemostasis in critically ill patients. *Br J Haematol* 2004;125:69–73.
105. Duguid J, O'Shaughnessy DF, Atterbury C, Bolton Maggs P, Murphy M, Thomas D, et al.; British Committee for Standards in Haematology, Blood Transfusion Task Force. Guidelines for the use of fresh-frozen plasma, cryoprecipitate and cryosupernatant. *Br J Haematol* 2004;126:11–28.
106. Tikkanen M. Placental abruption: epidemiology, risk factors and consequences. *Acta Obstet Gynecol Scand* 2011;90:140–9.
107. Levi M. Pathogenesis and management of peripartum coagulopathic calamities (disseminated intravascular coagulation and amniotic fluid embolism). *Thromb Res* 2013;131 Suppl 1:S32–4.
108. Green L, Knight M, Seeney F, Hopkinson C, Collins PW, Collis RE, et al. The haematological features and transfusion management of women who required massive transfusion for major obstetric haemorrhage in the UK: a population based study. *Br J Haematol* 2016;172:616–24.
109. Cortet M, Deneux-Tharaux C, Dupont C, Colin C, Rudigoz RC, Bouvier-Colle MH, et al. Association between fibrinogen level and severity of postpartum haemorrhage: secondary analysis of a prospective trial. *Br J Anaesth* 2012;108:984–9.
110. De Lloyd L, Collins PW, Kaye A, Collis RE. Early fibrinogen as a predictor of red cell requirements during postpartum haemorrhage. *Int J Obstet Anesth* 2012;21 Suppl 1:S13.
111. Gayat E, Resche-Rigon M, Morel O, Rossignol M, Mantz J, Nicolas-Robin A, et al. Predictive factors of advanced interventional procedures in a multicentre severe postpartum haemorrhage study. *Intensive Care Med* 2011;37:1816–25.
112. Wikkelsø AJ, Edwards HM, Afshari A, Stensballe J, Langhoff-Roos J, Albrechtsen C, et al.; FIB-PPH trial group. Pre-emptive treatment with fibrinogen concentrate for postpartum haemorrhage: randomized controlled trial. *Br J Anaesth* 2015;114: 623–33.
113. Ahmed S, Harrity C, Johnson S, Varadkar S, McMorrow S, Fanning R, et al. The efficacy of fibrinogen concentrate compared with cryoprecipitate in major obstetric haemorrhage – an observational study. *Transfus Med* 2012;22:344–9.
114. Gollop ND, Chilcott J, Benton A, Rayment R, Jones J, Collins PW. National audit of the use of fibrinogen concentrate to correct hypofibrinogenaemia. *Transfus Med* 2012;22:350–5.
115. Mallaiah S, Chevannes C, McNamara H, Barclay P. A reply. *Anaesthesia* 2015;70:760–1.
116. Glover NJ, Collis RE, Collins P. Fibrinogen concentrate use during major obstetric haemorrhage. *Anaesthesia* 2010;65: 1229–30.
117. Weinkove R, Rangarajan S. Fibrinogen concentrate for acquired hypofibrinogenaemic states. *Transfus Med* 2008;18:151–7.
118. CRASH-2 collaborators, Roberts I, Shakur H, Afolabi A, Brohi K, Coats T, et al. The importance of early treatment with tranexamic acid in bleeding trauma patients: an exploratory analysis of the CRASH-2 randomised controlled trial. *Lancet* 2011;377:1096–101, 1101.e1–2.
119. Ducloy-Bouthors AS, Jude B, Duhamel A, Broisin F, Huissoud C, Keita-Meyer H, et al.; The EXADELI Study Group. High-dose tranexamic acid reduces blood loss in postpartum haemorrhage. *Crit Care* 2011;15:R117.
120. Shakur H, Elbourne D, Gülmezoglu M, Alfirevic Z, Ronsmans C, Allen E, et al. The WOMAN Trial (World Maternal Antifibrinolytic Trial): tranexamic acid for the treatment of postpartum haemorrhage: an international randomised, double blind placebo controlled trial. *Trials* 2010;11:40.
121. Ahonen J. The role of recombinant activated factor VII in obstetric hemorrhage. *Curr Opin Anaesthesiol* 2012;25:309–14.
122. Alfirevic Z, Elbourne D, Pavord S, Bolte A, Van Geijn H, Mercier F, et al. Use of recombinant activated factor VII in primary postpartum hemorrhage: the Northern European Registry 2000–2004. *Obstet Gynecol* 2007;110:1270–8.
123. Franchini M, Franchi M, Bergamini V, Salvagno GL, Montagnana M, Lippi G. A critical review on the use of recombinant factor VIIa in life-threatening obstetric postpartum hemorrhage. *Semin Thromb Hemost* 2008;34:104–12.

124. Franchini M, Franchi M, Bergamini V, Montagnana M, Salvagno GL, Targher G, et al. The use of recombinant activated FVII in postpartum hemorrhage. *Clin Obstet Gynecol* 2010;53: 219–27.
125. Lavigne-Lissalde G, Aya AG, Mercier FJ, Roger-Christoph S, Chauleur C, Morau E, et al. Recombinant human FVIIa for reducing the need for invasive second-line therapies in severe refractory postpartum hemorrhage: a multicenter, randomized, open controlled trial. *J Thromb Haemost* 2015;13:520–9.
126. Levi M, Levy JH, Andersen HF, Truloff D. Safety of recombinant activated factor VII in randomized clinical trials. *N Engl J Med* 2010;363:1791–800.
127. de Groot AN. Prevention of postpartum haemorrhage. *Baillieres Clin Obstet Gynaecol* 1995;9:619–31.
128. Walker ID, Walker JJ, Colvin BT, Letsky EA, Rivers R, Stevens R; Haemostasis and Thrombosis Task Force. Investigation and management of haemorrhagic disorders in pregnancy. *J Clin Pathol* 1994;47:100–8.
129. Patel N, editor. *Maternal Mortality – the Way Forward. Some Implications of the Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1985-87*. London: RCOG; 1992.
130. Franchini M, Lippi G, Franchi M. The use of recombinant activated factor VII in obstetric and gynaecological haemorrhage. *BJOG* 2007;114:8–15.
131. Confidential Enquiry into Maternal and Child Health. *Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer - 2003-2005. The Seventh Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom*. London: CEMACH; 2007.
132. Royal College of Obstetricians and Gynaecologists. *Reducing the Risk of Venous Thromboembolism during Pregnancy and the Puerperium*. Green-top Guideline No. 37a. London: RCOG; 2015.
133. Palmer SK. Anaesthesia care for obstetric patients in the United States. In: Reynolds F, editor. *Regional Analgesia in Obstetrics: A Millennium Update*. London: Springer-Verlag London; 2000. pp. 3–10.
134. Rajan PV, Wing DA. Postpartum hemorrhage: evidence-based medical interventions for prevention and treatment. *Clin Obstet Gynecol* 2010;53:165–81.
135. Joint Formulary Committee. *British National Formulary*, 69th ed. London: BMJ Group and Pharmaceutical Press; 2015.
136. Lewis G, editor. The National Institute for Clinical Excellence; The Scottish Executive Health Department; The Department of Health, Social Services and Public Safety: Northern Ireland. *Why Mothers Die 1997–1999. The fifth report of the Confidential Enquiries into Maternal Deaths in the United Kingdom*. London: RCOG Press; 2001.
137. Buttino L Jr, Garite TJ. The use of 15 methyl F_2 alpha prostaglandin (Prostin 15M) for the control of postpartum hemorrhage. *Am J Perinatol* 1986;3:241–3.
138. Oleen MA, Mariano JP. Controlling refractory atonic postpartum hemorrhage with Hemabate sterile solution. *Am J Obstet Gynecol* 1990;162:205–8.
139. Hofmeyr GJ, Walraven G, Gülmezoglu AM, Maholwana B, Alfirevic Z, Villar J. Misoprostol to treat postpartum haemorrhage: a systematic review. *BJOG* 2005;112:547–53.
140. Meckstroth KR, Whitaker AK, Bertisch S, Goldberg AB, Darney PD. Misoprostol administered by epithelial routes. Drug absorption and uterine response. *Obstet Gynecol* 2006;108:582–90.
141. Tang J, Kapp N, Dragoman M, de Souza JP. WHO recommendations for misoprostol use for obstetric and gynecologic indications. *Int J Gynaecol Obstet* 2013;121:186–9.
142. International Federation of Gynecology and Obstetrics. *Treatment of Post-Partum Haemorrhage with Misoprostol*. FIGO Guideline Annotated Version. London: FIGO; 2012. [www.k4health.org/toolkits/postpartumhemorrhage/treatment-post-partum-haemorrhage-misoprostol-figo-guideline-annotated]. Accessed 2016 Feb 4.
143. Georgiou C. Balloon tamponade in the management of postpartum haemorrhage: a review. *BJOG* 2009;116:748–57.
144. Ikechebelu JI, Obi RA, Joe-Ikechebelu NN. The control of postpartum haemorrhage with intrauterine Foley catheter. *J Obstet Gynaecol* 2005;25:70–2.
145. Bakri YN, Amri A, Abdul Jabbar F. Tamponade-balloon for obstetrical bleeding. *Int J Gynaecol Obstet* 2001;74:139–42.
146. Chan C, Razvi K, Tham KF, Arulkumaran S. The use of a Sengstaken-Blakemore tube to control post-partum hemorrhage. *Int J Gynaecol Obstet* 1997;58:251–2.
147. Condous GS, Arulkumaran S, Symonds I, Chapman R, Sinha A, Razvi K. The "tamponade test" in the management of massive postpartum hemorrhage. *Obstet Gynecol* 2003;101: 767–72.
148. Akhter S, Begum MR, Kabir Z, Rashid M, Laila TR, Zabeen F. Use of a condom to control massive postpartum hemorrhage. *MedGenMed* 2003;5:38.
149. Keriakos R, Mukhopadhyay A. The use of the Rusch balloon for management of severe postpartum haemorrhage. *J Obstet Gynaecol* 2006;26:335–8.
150. Lennox C, Marr L; Reproductive Health Programme, Healthcare Improvement Scotland. *Scottish Confidential Audit of Severe Maternal Morbidity: reducing avoidable harm. 10th Annual Report.* Edinburgh: Healthcare Improvement Scotland; 2014.
151. Frenzel D, Condous GS, Papageorghiou AT, McWhinney NA. The use of the 'tamponade test' to stop massive obstetric haemorrhage in placenta accreta. *BJOG* 2005;112:676–7.
152. Tindell K, Garfinkel R, Abu-Haydar E, Ahn R, Burke TF, Conn K, et al. Uterine balloon tamponade for the treatment of postpartum haemorrhage in resource-poor settings: a systematic review. *BJOG* 2013;120:5–14.
153. Matsubara S, Yano H, Ohkuchi A, Kuwata T, Usui R, Suzuki M. Uterine compression sutures for postpartum hemorrhage: an overview. *Acta Obstet Gynecol Scand* 2013;92:378–85.
154. B-Lynch C, Coker A, Lawal AH, Abu J, Cowen MJ. The B-Lynch surgical technique for the control of massive postpartum haemorrhage: an alternative to hysterectomy? Five cases reported. *Br J Obstet Gynaecol* 1997;104:372–5.
155. Harma M, Gungen N, Ozturk A. B-Lynch uterine compression suture for postpartum haemorrhage due to placenta praevia accreta. *Aust N Z J Obstet Gynaecol* 2005;45:93–5.
156. Hayman RG, Arulkumaran S, Steer PJ. Uterine compression sutures: surgical management of postpartum hemorrhage. *Obstet Gynecol* 2002;99:502–6.
157. Ghezzi F, Cromi A, Uccella S, Raio L, Bolis P, Surbek D. The Hayman technique: a simple method to treat postpartum haemorrhage. *BJOG* 2007;114:362–5.
158. Hwu YM, Chen CP, Chen HS, Su TH. Parallel vertical compression sutures: a technique to control bleeding from placenta praevia or accreta during caesarean section. *BJOG* 2005;112:1420–3.
159. Kafali H, Demir N, Soylemez F, Yurtseven S. Hemostatic cervical suturing technique for management of uncontrollable postpartum haemorrhage originating from the cervical canal. *Eur J Obstet Gynecol Reprod Biol* 2003;110:35–8.
160. Makino S, Tanaka T, Yorifuji T, Koshiishi T, Sugimura M, Takeda S. Double vertical compression sutures: A novel conservative approach to managing post-partum haemorrhage due to placenta praevia and atonic bleeding. *Aust N Z J Obstet Gynaecol* 2012;52:290–2.

161. Kayem G, Kurinczuk JJ, Alfirevic Z, Spark P, Brocklehurst P, Knight M; U.K. Obstetric Surveillance System (UKOSS). Uterine compression sutures for the management of severe postpartum hemorrhage. *Obstet Gynecol* 2011;117:14–20.
162. Fotopoulou C, Dudenhausen JW. Uterine compression sutures for preserving fertility in severe postpartum haemorrhage: an overview 13 years after the first description. *J Obstet Gynaecol* 2010;30:339–49.
163. Diemert A, Ortmeyer G, Hollwitz B, Lotz M, Somville T, Glosemeyer P, et al. The combination of intrauterine balloon tamponade and the B-Lynch procedure for the treatment of severe postpartum hemorrhage. *Am J Obstet Gynecol* 2012;206:65.e1–4.
164. Yoong W, Ridout A, Memtsa M, Stavroulis A, Aref-Adib M, Ramsay-Marcelle Z, et al. Application of uterine compression suture in association with intrauterine balloon tamponade ('uterine sandwich') for postpartum hemorrhage. *Acta Obstet Gynecol Scand* 2012;91:147–51.
165. Nelson WL, O'Brien JM. The uterine sandwich for persistent uterine atony: combining the B-Lynch compression suture and an intrauterine Bakri balloon. *Am J Obstet Gynecol* 2007;196:e9–10.
166. AbdRabbo SA. Stepwise uterine devascularization: a novel technique for management of uncontrolled postpartum hemorrhage with preservation of the uterus. *Am J Obstet Gynecol* 1994;171: 694–700.
167. Sentilhes L, Gromez A, Descamps P, Marpeau L. Why stepwise uterine devascularization should be first-line conservative surgical treatment to control severe postpartum hemorrhage? *Acta Obstet Gynecol Scand* 2009;88:490–2.
168. Joshi VM, Otiv SR, Majumder R, Nikam YA, Shrivastava M. Internal iliac artery ligation for arresting postpartum haemorrhage. *BJOG* 2007;114:356–61.
169. Nizard J, Barrinque L, Frydman R, Fernandez H. Fertility and pregnancy outcomes following hypogastric artery ligation for severe post-partum haemorrhage. *Hum Reprod* 2003;18:844–8.
170. Doumouchtsis SK, Nikolopoulos K, Talaulikar VS, Krishna A, Arulkumaran S. Menstrual and fertility outcomes following the surgical management of postpartum haemorrhage: a systematic review. *BJOG* 2014;121:382–8.
171. Lee HY, Shin JH, Kim J, Yoon HK, Ko GY, Won HS, et al. Primary postpartum hemorrhage: outcome of pelvic arterial embolization in 251 patients at a single institution. *Radiology* 2012;264:903–9.
172. Salomon LJ, de Tayrac R, Castaigne-Meary V, Audibert F, Musset D, Ciorascu R, et al. Fertility and pregnancy outcome following pelvic arterial embolization for severe post-partum haemorrhage. A cohort study. *Hum Reprod* 2003;18:849–52.
173. Descargues G, Mauger Tinlot F, Douvrin F, Clavier E, Lemoine JP, Marpeau L. Menses, fertility and pregnancy after arterial embolization for the control of postpartum haemorrhage. *Hum Reprod* 2004;19:339–43.
174. Fargeaudou Y, Morel O, Soyer P, Gayat E, Sirol M, Boudiaf M, et al. Persistent postpartum haemorrhage after failed arterial ligation: value of pelvic embolisation. *Eur Radiol* 2010;20:1777–85.
175. Brace V, Kernaghan D, Penney G. Learning from adverse clinical outcomes: major obstetric haemorrhage in Scotland, 2003–05. *BJOG* 2007;114:1388–96.
176. Duffy S, Gaffney G. Maternal admissions to ICU – time to re-evaluate. *Ir Med J* 2001;94:248–9.
177. Neill A, Thornton S. Secondary postpartum haemorrhage. *J Obstet Gynaecol* 2002;22:119–22.
178. Babarinsa IA, Hayman RG, Draycott TJ. Secondary post-partum haemorrhage: challenges in evidence-based causes and management. *Eur J Obstet Gynecol Reprod Biol* 2011;159:255–60.
179. Rome RM. Secondary postpartum haemorrhage. *Br J Obstet Gynaecol* 1975;82:289–92.
180. Pather S, Ford M, Reid R, Sykes P. Postpartum curettage: an audit of 200 cases. *Aust N Z J Obstet Gynaecol* 2005;45:368–71.
181. French L, Smaill FM. Antibiotic regimens for endometritis after delivery. *Cochrane Database Syst Rev* 2004;(4):CD001067.
182. Royal College of Obstetricians and Gynaecologists. *Bacterial Sepsis following Pregnancy*. Green-top Guideline No. 64b. London: RCOG; 2012.
183. Carlan SJ, Scott WT, Pollack R, Harris K. Appearance of the uterus by ultrasound immediately after placental delivery with pathologic correlation. *J Clin Ultrasound* 1997;25:301–8.
184. de Vries JI, van der Linden RM, van der Linden HC. Predictive value of sonographic examination to visualize retained placenta directly after birth at 16 to 28 weeks. *J Ultrasound Med* 2000; 19:7–12.
185. Edwards A, Ellwood DA. Ultrasonographic evaluation of the postpartum uterus. *Ultrasound Obstet Gynecol* 2000;16:640–3.
186. Sadan O, Golan A, Girtler O, Lurie S, Debby A, Sagiv R, et al. Role of sonography in the diagnosis of retained products of conception. *J Ultrasound Med* 2004;23:371–4.
187. Mulic-Lutvica A, Axelsson O. Ultrasound finding of an echogenic mass in women with secondary postpartum hemorrhage is associated with retained placental tissue. *Ultrasound Obstet Gynecol* 2006;28:312–9.
188. Yi SW, Ahn JH. Secondary postpartum hemorrhage due to a pseudoaneurysm rupture at the fundal area of the uterus: a case treated with selective uterine arterial embolization. *Fertil Steril* 2010;93:2048–9.
189. Arab TS, Dy J. Pseudoaneurysm of the vaginal artery as a cause of postpartum haemorrhage. *J Obstet Gynaecol* 2011;31: 185–6.
190. Chitra TV, Panicker S. Pseudoaneurysm of uterine artery: a rare cause of secondary postpartum hemorrhage. *J Obstet Gynaecol India* 2011;61:641–4.
191. King PA, Duthie SJ, Dong ZG, Ma HK. Secondary postpartum haemorrhage. *Aust N Z J Obstet Gynaecol* 1989;29:394–8.
192. Jensen PA, Stromme WB. Amenorrhea secondary to puerperal curettage (Asherman's syndrome). *Am J Obstet Gynecol* 1972;113:150–7.
193. Sharma AM, Burbridge BE. Uterine artery pseudoaneurysm in the setting of delayed postpartum hemorrhage: successful treatment with emergency arterial embolization. *Case Rep Radiol* 2011;2011:373482.
194. Agrawal R, Legge F, Pollard K, Al-Inizi S. Massive secondary postpartum haemorrhage managed with insertion of a Bakri balloon catheter after surgical evacuation of the uterus. *S Afr J Obstet Gynaecol* 2011;17:36–7.
195. Merién AE, van de Ven J, Mol BW, Houterman S, Oei SG. Multidisciplinary team training in a simulation setting for acute obstetric emergencies: a systematic review. *Obstet Gynecol* 2010;115:1021–31.
196. Royal College of Obstetricians and Gynaecologists. *Improving Patient Safety: Risk Management for Maternity and Gynaecology*. Clinical Governance Advice No. 2. London: RCOG; 2009.
197. Penney G, Brace V. Near miss audit in obstetrics. *Curr Opin Obstet Gynecol* 2007;19:145–50.
198. Beck CT. Post-traumatic stress disorder due to childbirth: the aftermath. *Nurs Res* 2004;53:216–24.
199. Dökmetaş HS, Kilicli F, Korkmaz S, Yonem O. Characteristic features of 20 patients with Sheehan's syndrome. *Gynecol Endocrinol* 2006;22:279–83.

Appendix I: Explanation of guidelines and evidence levels

Clinical guidelines are: 'systematically developed statements which assist clinicians and patients in making decisions about appropriate treatment for specific conditions'. Each guideline is systematically developed using a standardised methodology. Exact details of this process can be found in Clinical Governance Advice No. 1 *Development of RCOG Green-top Guidelines* (available on the RCOG website at www.rcog.org.uk/green-top-development). These recommendations are not intended to dictate an exclusive course of management or treatment. They must be evaluated with reference to individual patient needs, resources and limitations unique to the institution and variations in local populations. It is hoped that this process of local ownership will help to incorporate these guidelines into routine practice. Attention is drawn to areas of clinical uncertainty where further research may be indicated.

The evidence used in this guideline was graded using the scheme below and the recommendations formulated in a similar fashion with a standardised grading scheme.

Classification of evidence levels

1++	High-quality meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias
1–	Meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a high risk of bias
2++	High-quality systematic reviews of case–control or cohort studies or high-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal
2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal
2–	Case–control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal
3	Non-analytical studies, e.g. case reports, case series
4	Expert opinion

Grades of recommendations

A	At least one meta-analysis, systematic reviews or RCT rated as 1++, and directly applicable to the target population; or A systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++ directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+ directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+

Good practice point

✓	Recommended best practice based on the clinical experience of the guideline development group

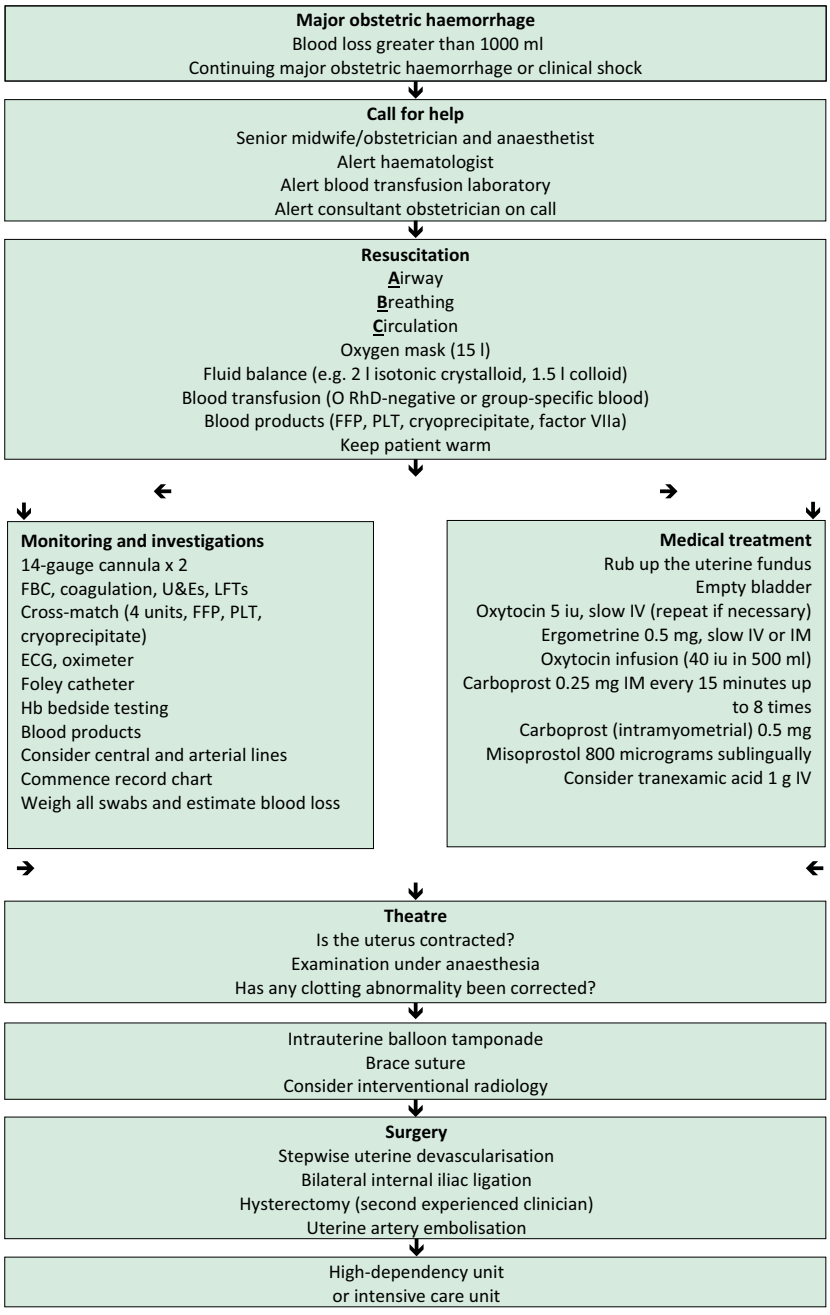
Appendix II: The causes of PPH[30]

The four Ts	Risk factors/notes
Tone: abnormalities of uterine contraction	
Overdistension of uterus	Polyhydramnios, multiple gestation, macrosomia
Intra-amniotic infection	Fever, prolonged rupture of membranes
Functional/anatomic distortion of uterus	Rapid labour, prolonged labour, fibroids, placenta praevia, uterine anomalies
Uterine relaxants, e.g. magnesium and nifedipine	Terbutaline, halogenated anaesthetics, glyceryl trinitrate
Bladder distension	May prevent uterine contraction
Tissue: retained products of conception	
Retained cotyledon or succenturiate lobe	
Retained blood clots	
Trauma: genital tract injury	
Lacerations of the cervix, vagina or perineum	Precipitous delivery, operative delivery
Extensions, lacerations at caesarean section	Malposition, deep engagement
Uterine rupture	Previous uterine surgery
Uterine inversion	High parity with excessive cord traction
Thrombin: abnormalities of coagulation	
Pre-existing states	
Haemophilia A	History of hereditary coagulopathies or liver disease
Idiopathic thrombocytopenic purpura	Bruising
von Willebrand's disease	
History of previous PPH	
Acquired in pregnancy	
Gestational thrombocytopenic	Bruising
Pre-eclampsia with thrombocytopenia e.g. HELLP	Elevated blood pressure
Disseminated intravascular coagulation	
a) Gestational hypertensive disorder of pregnancy with adverse conditions	Coagulopathy
b) in utero fetal demise	Fetal demise
c) severe infection	Fever, neutrophilia/neutropenia
d) abruption	Antepartum haemorrhage
e) amniotic fluid embolus	Sudden collapse
Therapeutic anticoagulation	History of thromboembolic disease

Abbreviations: HELLP haemolysis, elevated liver enzymes and low platelet count; **PPH** postpartum haemorrhage.

Appendix III: A flow chart of the different steps for the management of major PPH

Resuscitation, monitoring, investigation and treatment should occur simultaneously



Abbreviations: ECG electrocardiogram; **FBC** full blood count; **FFP** fresh frozen plasma; **Hb** haemoglobin; **IV** intravenous; **IM** intramuscular; **LFTs** liver function tests; **PLT** platelets; **PPH** postpartum haemorrhage; **RhD** rhesus D; **U&Es** urea and electrolytes.

Appendix IV: Obstetric early warning chart

OBSTETRIC EARLY WARNING CHART. **FOR MATERNITY USE ONLY**

NAME: _____ **DOB:** _____

CHI: **WARD:**

CONTACT DOCTOR FOR EARLY INTERVENTION IF PATIENT TRIGGERS ONE RED OR TWO YELLOW SCORES AT ANY ONE TIME

	Date :																		
	Time :																		
RESP (write rate in corresp. box)	>30																		>30
	21-30																		21-30
	11-20																		11-20
	0-10																		0-10
Saturations	90-100%																		90-100%
	<90%																		<90%
O2 Conc.	%																		%
■ Temp	39																		39
	38																		38
	37																		37
	36																		36
	35																		35
■ HEART RATE	170																		170
	160																		160
	150																		150
	140																		140
	130																		130
	120																		120
	110																		110
	100																		100
	90																		90
	80																		80
	70																		70
	60																		60
	50																		50
	40																		40
Systolic blood pressure	200																		200
	190																		190
	180																		180
	170																		170
	160																		160
	150																		150
	140																		140
	130																		130
	120																		120
	110																		110
	100																		100
	90																		90
	80																		80
	70																		70
	60																		60
	50																		50
Diastolic blood pressure	130																		130
	120																		120
	110																		110
	100																		100
	90																		90
	80																		80
	70																		70
	60																		60
	50																		50
	40																		40
Passed Urine	Y or N																		Y or N
Lochia	Normal																		Normal
	Heavy / Foul																		Heavy / Foul
Proteinuria	2+																		2+
	> 2+																		> 2+
Liquor	Clear / Pink																		Clear / Pink
	Green																		Green
NEURO RESPONSE (✓)	Alert																		Alert
	Voice																		Voice
	Pain / Unresponsive																		Pain / Unresponsive
Pain Score (no.)	2-3																		2-3
	0-1																		0-1
Nausea (✓)	YES (✓)																		YES (✓)
	NO (✓)																		NO (✓)
Looks unwell	YES (✓)																		YES (✓)
Looks unwell	NO (✓)																		NO (✓)
Total Yellow Scores																			
Total Red Scores																			

Appendix V: Example obstetric haemorrhage chart

Time of call-out: ..... Call-out by: ..... Date: .....

Team member	Name	Time arrived
On-call obstetric consultant		
On-call obstetric registrar		
On-call obstetric ST1-2/GPVTS/FY		
On-call anaesthetic consultant		
On-call anaesthetic registrar		
On-call operating department practitioner		
Alert blood transfusion laboratory		
On-call gynaecology ST1-2/GPVTS/FY		
Senior midwife		
Midwife		
Porter		
Cell saver technician		

Drug	Dose	Time
Oxytocin	5 iu slow IV	
Ergometrine	500 micrograms/1 ampule (if normal BP) IM IV	
Oxytocin infusion	40 iu in 500 ml physiological saline IV via infusion pump at 125 ml/hour	
Carboprost	0.25 mg IM (dose 1)	
Carboprost	0.25 mg IM (dose 2)	
Carboprost	0.25 mg IM (dose 3)	
Carboprost	0.25 mg IM (dose 4)	
Carboprost	0.25 mg IM (dose 5)	
Carboprost	0.25 mg IM (dose 6)	
Carboprost	0.25 mg IM (dose 7)	
Carboprost	0.25 mg IM (dose 8)	
Misoprostol	800 micrograms SL or 1000 micrograms PR	
Tranexamic acid	1 g IV	

Blood sent	Time	Observations		
		Time	**Pulse**	**BP**
FBC				
Cross-match units				
Coagulation screen				
Placenta delivered **Yes** ☐ **No** ☐				
Urinary catheter with urometer				
Fluids				
Type	Volume	Time		

Initial management	Time
Oxygen given	
Bed head down	
IV cannula no. 1	
IV cannula no. 2	
Further interventions	**Time**
Transfer to theatre	
Intrauterine balloon tamponade	
Brace suture	
Interventional radiology called	
Stepwise uterine devascularisation	
Bilateral internal artery ligation	
Hysterectomy	

Abbreviations: BP blood pressure; **FBC** full blood count; **FY** Foundation Year doctor; **GPVTS** trainee in general practice; **IM** intramuscular; **IV** intravenous; **PR** per rectum; **SL** sublingual; **ST** specialty trainee.

Adapted from the Chelsea and Westminster Hospital Haemorrhage pro forma.

This guideline was produced on behalf of the Royal College of Obstetricians and Gynaecologists by:
Ms E Mavrides MRCOG, London; Dr S Allard, NHS Blood and Transplant and Barts Health NHS Trust, London; Dr E Chandraharan FRCOG, London; Professor P Collins, Cardiff University; Dr L Green, Consultant Haematologist, NHS Blood and Transplant and Barts Health NHS Trust, London; Professor BJ Hunt, King's College London; Mr S Riris MRCOG, London; and Dr AJ Thomson MRCOG, Paisley, Scotland

and peer reviewed by:
Advisory Committee on the Safety of Blood, Tissues and Organs, London; Dr J Ahonen, Helsinki University Hospital, Helsinki, Finland; Dr TSA Arab, Jeddah University, Jeddah, Kingdom of Saudi Arabia; Sir S Arulkumaran FRCOG, London; Dr P Barclay, Liverpool Women's Hospital; British Maternal and Fetal Medicine Society, London; Dr M Boucher, Centre d'Obstétrique-Gynécologie, Montreal, Canada; Bradford Hospitals NHS Foundation Trust; Dr TV Chitra, PSG Institute of Medical Sciences & Research, Coimbatore, India; Dr P Dixit FRCOG, Patna, India; Dr AHD Diyaf MRCOG, Barnstaple; Dr AS Ducloy-Bouthors, Pole d'Anesthésie-Réanimation, Lille, France; Mr DI Fraser FRCOG, Norwich; Dr S Gazzo, University of Padova, Padua, Italy; Mr M Griffiths FRCOG, Luton; Mr HKS Hinshaw FRCOG, Sunderland; Professor C Homer, University of Technology Sydney, Australia; Dr RG Hughes FRCOG, Edinburgh; Dr AJJ Kirkpatrick FRCOG, Frimley; Professor S Kozek-Langenecker, Evangelisches Krankenhaus Vienna, Austria; Dr EF Magann, University of Arkansas for the Medical Sciences, Little Rock, Arkansas, USA; Dr S Makino, Juntendo University School of Medicine, Tokyo, Japan; Dr WL Martin FRCOG, Birmingham; Dr A Mulic-Lutvica, Uppsala University Hospital, Sweden; Dr OT Oladapo, Olabisi Onabanjo University, Sagamu, Nigeria; PSG Institute of Medical Sciences & Research, Coimbatore, India; Dr S Pavord, Leicester Royal Infirmary; Dr PV Rajan, Northwestern University, Chicago, Illinois, USA; Dr W Rath, University Hospital RWTH Aachen, Germany; Dr K Razvi FRCOG, Westcliff-on-Sea; Miss J Rogers, Princess Anne Hospital, Southampton; Royal College of Anaesthetists; Royal College of Midwives; Dr MN Schorn, Vanderbilt University, Nashville, Tennessee, USA; Mr DO Selo-Ojeme FRCOG, Enfield; Ms H Shakur, London School of Hygiene and Tropical Medicine; Dr T Sibanda MRCOG, Wellington, New Zealand; Dr CG Sosa, University of Uruguay, Montevideo, Uruguay; Professor PJ Steer FRCOG, London; Dr L Teofili, Università Cattolica del Sacro Cuore, Rome, Italy; Dr M Tikkanen, University Central Hospital, Helsinki, Finland; Mr DJ Tuffnell FRCOG, Bradford; Dr A Wikkelsø, Herlev Hospital, Herlev Ringvej, Denmark; Dr SW Yi, University of Ulsan, Gangneung, South Korea.

The committee lead reviewer was: Dr PS Arunakumari FRCOG, Basildon.

The chairs of the Guidelines Committee were: Dr M Gupta[1] MRCOG, London; Dr P Owen[2] FRCOG, Glasgow, Scotland; and Dr AJ Thomson[1] MRCOG, Paisley, Scotland.
[1]co-chairs from June 2014 [2]until May 2014.

All RCOG guidance developers are asked to declare any conflicts of interest. A statement summarising any conflicts of interest for this guideline is available from: www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg52/.

The final version is the responsibility of the Guidelines Committee of the RCOG.

The review process will commence in 2019, unless otherwise indicated.