Postpartum Haemorrhage 3

Diagnosis and treatment of postpartum haemorrhage: a race against time

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Postpartum haemorrhage (PPH) is common, affecting an estimated 13% of women having vaginal birth and 31% of women having caesarean birth. Successful management of PPH requires early and accurate diagnosis and effective treatment. A systematic review found that subjective visual estimation of blood loss misses 52% of PPH diagnoses at vaginal birth (pooled sensitivity 48%, 95% CI 44–53), and probably more at caesarean birth. The WHO–International Federation of Gynecology and Obstetrics–International Confederation of Midwives consolidated guidelines on PPH therefore recommend objective quantification of blood loss with products such as a calibrated blood collection drape. When supported by a robust implementation strategy and a first-response treatment bundle, objective measurement of blood loss and monitoring of vital signs has been shown to diagnose PPH accurately and early, and improve clinical outcomes. Refractory PPH can progress to life-threatening PPH, which should be managed by a multidisciplinary team providing aggressive resuscitation and targeted treatment. Saving the life of a woman with excessive postpartum bleeding is a race against time. The six delays to avoid are: (1) in the diagnosis (by use of objective cumulative blood loss measurement and early trigger criteria), (2) in the first-response treatment (by authorising midwives to administer all components of a standardised bundle of interventions), (3) in the escalation (by use of explicit escalation criteria and red flags), (4) in the use of temporising measures (eg, non-pneumatic anti-shock garment), (5) in the identification and targeted management of any specific causes of bleeding, and (6) in the provision of blood and blood products. Quick actions to avoid these delays can mean the difference between life and death for a woman with PPH.

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This is the third in a **Series** of three papers about postpartum haemorrhage. All papers in the Series are available at thelancet.com/series/series-do/postpartum-haemorrhage

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Introduction

Postpartum haemorrhage (PPH) cannot be accurately predicted or consistently prevented. Although several risk factors have been identified (see the first paper in this Series[1]), existing prediction models have insufficient ability to accurately identify which women will develop PPH.[2,3] Several steps can be taken to prevent PPH (see the second paper in this Series[4]), but none can do so with certainty. PPH therefore remains an unpredictable but common occurrence in labour wards worldwide. An estimated 27 million women have a PPH every year, with 17 million at vaginal birth and 10 million at caesarean birth.[1] As it is such a common complication, all labour wards and operating theatres should be ready to diagnose and treat PPH. However, research and guidance on PPH diagnosis has been severely neglected, which could partly explain why visual estimation of blood loss has established itself as the primary diagnostic method for detecting PPH in clinical practice. PPH is commonly diagnosed by the health-care provider looking under and around the woman (for soaked sheets, pads, and bed linen), visually inspecting the blood loss, and estimating its volume. If the presumed blood loss is 500 mL or more, the woman is diagnosed with PPH and treated, but if it is thought to be less than 500 mL, no diagnosis or treatment is given. Relying on guesswork for such a critical decision has arguably been a fundamental reason for the poor progress in PPH outcomes in the past. A systematic review of test accuracy studies has shown that subjective visual estimation of blood loss misses the diagnosis in more than 50% of women with PPH.[5] To address this fundamental deficiency in PPH management, WHO, in partnership with the

Panel: Search strategy and consensus-building consultations

The recommendations in this Series paper are based on published systematic reviews of the current literature, appraisal of professional body guidelines, and expert group discussions. For the systematic review on prevalence of postpartum haemorrhage (PPH), we searched PubMed, Web of Science, Embase, Google Scholar, Cochrane Database, ClinicalTrials.gov, and the ISRCTN registry databases, from database inception to Aug 11, 2025.[8] We also refer to the Cochrane network meta-analysis on the effectiveness of various combinations of diagnostic and treatment strategies for PPH,[5] and WHO's individual participant data meta-analysis on prognostic accuracy of clinical markers of postpartum bleeding in predicting maternal mortality or severe morbidity.[9] For the review of professional body guidelines, we reviewed the latest WHO–International Federation of Gynecology and Obstetrics–International Confederation of Midwives consolidated guidelines for the prevention, diagnosis, and treatment of PPH;[6] their recommendations on the assessment of postpartum blood loss and use of a treatment bundle for PPH;[10] and the Royal College of Obstetricians and Gynaecologists guidelines for blood transfusions.[11] For expert group meetings, recommendations for this paper were formulated based on an international consensus meeting on PPH held in March, 2023, with a group of 27 key stakeholders from Argentina, Brazil, Kenya, Malawi, Nigeria, Norway, Pakistan, South Africa, Sri Lanka, Tanzania, the UK, and the USA. Agreements were reached through consensus. We also reviewed the international expert consensus on strategies for optimising early detection and obstetric first response management of PPH at caesarean birth.[12]

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Key messages

- Address modifiable risk factors for PPH, particularly anaemia and caesarean sections that are not medically indicated
- Provide routine prophylaxis for PPH with cold-chain maintained oxytocin or heat-stable carbetocin
- Consider dual prophylaxis with oxytocin and misoprostol for women at high risk of PPH
- Apply the reappraised definition of PPH to avoid missed cases
- Use objective methods of blood loss assessment, such as calibrated drapes, to accurately diagnose PPH
- Use first-response treatment bundles to avoid the delays of sequential treatments, and treat multiple concurrent causes of PPH
- Use red flags to identify women diagnosed with PPH who could deteriorate beyond first-response treatment
- Maintain urgency across the spectrum of prevention, diagnosis, and treatment of PPH to avoid missed opportunities

PPH=postpartum haemorrhage.

International Federation of Gynecology and Obstetrics (FIGO) and the International Confederation of Midwives (ICM), has provided clear guidance on the diagnosis of PPH, addressing its definition, blood loss measurement methods, and trigger criteria for clinical action.[6]

As soon as a PPH is diagnosed, prompt and effective first-response treatment must be provided. Such treatment should ideally consist of all relevant effective treatments and be deliverable by all birth attendants, particularly midwives, to avoid delay. Quick and consistent delivery of effective interventions by attending health-care providers can give women with excessive bleeding the best chance of avoiding refractory or life-threatening PPH, and their associated serious complications.[7] Refractory PPH is defined as PPH that has not responded to first-line treatment, and we define life-threatening PPH as PPH that is associated with haemodynamic shock, collapse, or acute organ failure, necessitating life-saving interventions from health-care professionals. We address the diagnosis, first response, and management of refractory and life-threatening PPH in this Series paper, and identify the six time-critical steps in the treatment pathway, which, if implemented consistently, could produce dramatic improvements in PPH outcomes (panel). We conclude with health system issues that are important for improving PPH outcomes.

Diagnosis of postpartum haemorrhage

Diagnosis of PPH is challenging for at least three fundamental reasons: inconsistencies in the definition of PPH, inaccurate measurement approaches, and unclear diagnostic criteria for triggering treatment actions.

Definition of postpartum haemorrhage at vaginal birth and caesarean section

Different definitions for PPH at vaginal birth and caesarean section have evolved over time.[13,14] PPH at vaginal birth is often defined as blood loss of at least 500 mL.[15] The mean blood loss at vaginal birth is 353 mL (SD 324–382; 17 studies; 15 countries; 66 791 women)[8] and the median blood loss is 220 mL (IQR 120–380).[7] A 500 mL blood loss threshold is, therefore, substantially higher than the average blood loss at vaginal birth. A landmark WHO meta-analysis of individual participant data found that blood loss of at least 500 mL was strongly associated with poor clinical outcomes, with a higher risk of the composite outcome of blood transfusion, hysterectomy, and intensive care unit admission or death, when compared with a blood loss of less than 500 mL.[9] The long-standing definition for PPH—with its origin in convention rather than evidence—therefore has validity from a prognostic point of view. However, the problem with this definition being based solely on blood loss is that although a healthy woman might tolerate a 500 mL blood loss with ease, the same loss could be calamitous for a woman with malnutrition and severe anaemia. The 500 mL threshold could miss excessive blood loss in the very women who are most likely to suffer serious adverse outcomes from bleeding. WHO recognised the need to refine the PPH definition and conducted a comprehensive analysis of distributional, prognostic, and therapeutic evidence for variables that could potentially contribute to a PPH definition, as well as an international consultation on the options for a revised definition. The evidence, the international experts' consultation, and the deliberation of the WHO–FIGO–ICM international PPH guideline panel resulted in an updated PPH definition that defined PPH as a blood loss of at least 300 mL plus an abnormal vital sign, or a blood loss of at least 500 mL, whichever occurs first, in the first 24 h after birth. The abnormal vital signs were a pulse >100 beats per min, systolic blood pressure <100 mm Hg, diastolic blood pressure <60 mm Hg, or a shock index >1.

The definition of PPH at caesarean section was previously evaluated by a WHO global experts group in 2022.[12] Guidelines varied widely, citing blood loss thresholds of 500 mL, 750 mL, and 1000 mL, with some relying on blood loss alone, and others on combinations of blood loss and vital signs.[16,17] The international multistakeholder group favoured a PPH definition that was broadly consistent between vaginal birth and caesarean birth. Thus, the criteria suggested for triggering first-response PPH treatment at caesarean section were blood loss of at least 500 mL, or clinical signs of haemodynamic instability.[12] The primary reason for this standardisation is that a blood loss of 500 mL has

a prognostic implication that is unlikely to be substantially different for different modes of childbirth. The common use of the 1000 mL threshold to define PPH at caesarean births could be contributing to the caesarean-related PPH case-fatality rate being more than twice as high as the vaginal birth-related PPH case-fatality rate (see appendix p 39 of the first paper in this Series[1]). The new and standardised definition of PPH at caesarean section is likely to lead to earlier diagnosis of PPH at caesarean section and earlier initiation of first-response treatment, with anticipated better outcomes.

Quantification of blood loss

A Cochrane systematic review of studies of PPH diagnosis found that subjective visual estimation of blood loss missed 52% of women with PPH (pooled sensitivity 48%, 95% CI 44–53; moderate certainty; four studies; 196 305 women).[5] Missing more than half of PPHs should be a global scandal, but subjective visual estimation is a commonly accepted practice worldwide. Neither training nor experience seems to improve the diagnostic performance of the approach.[18] By contrast, objective blood loss assessment methods, such as calibrated blood collection drapes, are highly accurate in assessing cumulative blood loss and diagnosing PPH.[5] The same Cochrane review that assessed the accuracy of the subjective visual estimation method also assessed the accuracy of calibrated blood collection drapes for diagnosing PPH, and found this objective method missed only 7% of women with PPH (pooled sensitivity 93%, 92–93; 2 studies; 53762 women).[5] The WHO–FIGO–ICM guideline on PPH therefore recommends objective quantification of blood loss for all women.[10] Subjective visual estimation of blood loss should have no place in modern maternity practice. Calibrated blood collection drapes measure cumulative blood loss accurately,[5] are easy to use,[19] and can be part of a cost-effective strategy[20] (figure 1). The drapes can be used after all vaginal births, including assisted births. The drape should be applied under the woman's buttocks right after childbirth to exclude amniotic fluid, but before delivery of the placenta, and should be kept for at least 1 h after childbirth.[22] If bleeding is ongoing after 1 h, the drape should be kept in place for an additional hour. The drape can be tied around the woman's waist to allow her to adjust her position and move around. Cumulative blood loss volumes and vital signs should be checked at least every 15 min during this period.[22] Almost all PPHs occur within 90 min of childbirth;[22] this schedule will therefore capture most women with PPH.

Intraoperative cumulative blood loss assessment at caesarean section requires a gravimetric approach for swabs and linen, and a volumetric approach for blood collected in suction canisters. The dry weights of mops, swabs, and linen used at caesarean section should be known so that these can be deducted from the weight of blood-soaked materials to accurately calculate the cumulative blood loss. The fluid collected in suction canisters should have the volume of amniotic fluid and any irrigation fluid deducted to obtain the correct volume of cumulative blood loss. The operating team should be vigilant for vaginal blood loss concealed by surgical drapes. Measurement of blood loss and vital signs must occur in real-time to allow the surgeon and anaesthetist to detect and respond to excessive blood loss promptly. A colorimetric blood loss assessment technology, which scans and processes images of blood-soaked swabs and suction canisters in real-time during caesarean section, is currently being evaluated in an ongoing study. Such a technology could simplify operating theatre workflows, provide automated ongoing readouts of blood loss intraoperatively, and have built-in alerts to warn of women with excessive blood loss. Postoperative blood loss assessment is more complex as the bleeding can be internal into the abdomen and therefore concealed; global experts convened by WHO have therefore suggested that postoperative PPH could be detected primarily by frequently monitoring the woman's vital signs and other clinical signs of internal bleeding, supplemented by cumulative objective blood loss assessment of any revealed blood loss.[12]

See Online for appendix

First-response treatment of postpartum haemorrhage

Early diagnosis and prompt treatment are essential to avert morbidity and mortality from PPH. WHO's updated definition enables early diagnosis of PPH; however, if early diagnosis is not linked to prompt and effective treatment, better outcomes cannot be expected. The E-MOTIVE intervention combines an early diagnosis strategy with a bundle of effective interventions, supported with a robust implementation approach, to address PPH at vaginal birth.[7] The first E in E-MOTIVE

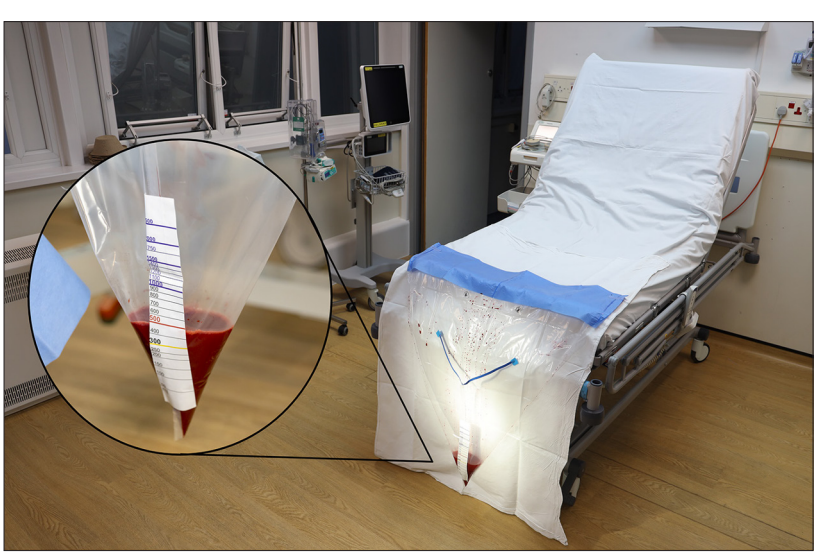

Figure 1: **Ammalife calibrated blood collection drape**
Courtesy of Kimal, UK.[21]

refers to early and accurate diagnosis of PPH by use of a calibrated blood collection drape. First-response treatment is initiated on the basis of one of three diagnostic criteria being met: (1) clinical judgement that the bleeding is excessive (ie, a clinical prompt), (2) an objectively measured blood loss of at least 300 mL plus abnormal vital signs or atonic uterus (an early treatment prompt), and (3) a blood loss of at least 500 mL (a safety net prompt). The first-response treatment is a bundle of interventions called MOTIVE,[6] representing uterine massage, oxytocic drugs, tranexamic acid, intravenous fluids, and examination of the genital tract (figure 2). This comprehensive bundle works in multiple ways: uterine massage promotes uterine tone and expels any clots in the uterus that might be hindering uterine contraction. Oxytocic drugs stimulate uterine contraction and address uterine atony, while tranexamic acid antagonises fibrinolysis. Intravenous fluids re-expand plasma volume, and examination helps to identify the source of bleeding and provide targeted treatment. This bundle of interventions addresses multiple PPH causes that could be acting concurrently. Although the term bundle is used loosely by many to mean a collection of interventions, the Health Foundation and the US Institute for Healthcare Improvement defined bundle as a technical term[23] for a set of evidence-based interventions for a defined patient population and care setting that should be implemented together (ie, each component of the bundle should be applied to every patient, every time). For instance, an algorithm cannot be classified as a care bundle, as all elements of an algorithm are not applied to every woman—some are only applied if a woman meets specific criteria. Neither is a package of quality improvement initiatives that consists of preventive and treatment elements, where preventive elements might be applied to all women, but treatment elements only to those who meet certain diagnostic criteria. MOTIVE is a classic treatment bundle in that all elements are mandated: uterine massage, oxytocic drugs, tranexamic acid, intravenous fluids, and examination should be provided to every woman, every time, as long as the trigger criteria for treatment have been met.

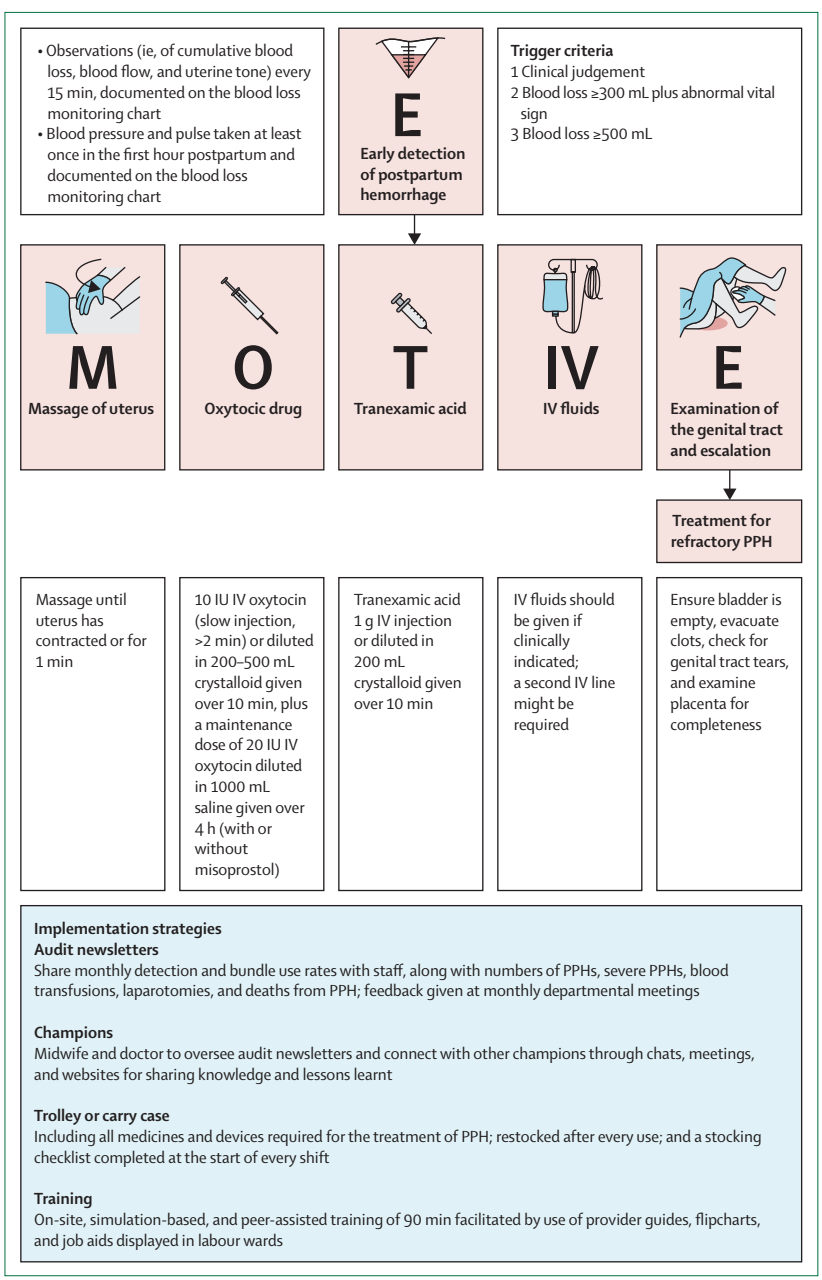

***Figure 2*: E-MOTIVE treatment bundle for vaginal births**
Reproduced from Gallos et al.[7] PPH=postpartum haemorrhage. IU=international units. IV=intravenous.

The E-MOTIVE intervention might be conceptually sound, but does it work in practice? A large, multicountry, cluster-randomised, controlled study was conducted to test the E-MOTIVE intervention, supported with an implementation strategy that consisted of on-site interprofessional training and drills, PPH trolleys or carry cases (figure 3), local champions to promote and support the intervention, and an audit and feedback system. The trial found that E-MOTIVE resulted in a 60% reduction in the primary composite outcome of blood loss exceeding 1000 mL, laparotomy for PPH, or maternal death from PPH (RR 0·40, 95% CI 0·32–0·50).[7] The blood transfusion rate for bleeding was 29% lower with the E-MOTIVE intervention (RR 0·71, 0·55–0·90). Although the study was not powered for the mortality outcome, available data suggested a reduction in mortality (RR 0·73, 0·40–1·31). E-MOTIVE was also found to be feasible, acceptable, and cost-effective.[19,20] WHO therefore recommends objective quantification of blood loss with a calibrated blood collection drape and bundled treatment as the strategy for early diagnosis and first-response treatment of PPH at vaginal birth.[6]

The E-MOTIVE intervention is likely to require adaptations for caesarean births. Health-care providers would need to rely on objective measurement of blood loss, using either a combined gravimetric and volumetric

approach, or a validated colorimetric system. The first-response treatment is likely to involve a bundle of interventions, consisting of mechanical compression of the uterus, additional uterotonic drugs, tranexamic acid, intravenous fluids, targeted surgical sutures, and examination to identify and address the source of bleeding. An evaluation of an adapted E-MOTIVE intervention for the caesarean birth context, called the E-MASTER intervention, has recently commenced. The first "E" in E-MASTER refers to early and accurate diagnosis of PPH by use of an objective blood loss assessment method. MASTER is a first-response treatment bundle consisting of mechanical compression or massage of the uterus, additional or alternative uterotonic drugs, targeted surgical sutures, tranexamic acid, examination and escalation, and resuscitation.

Because postoperative bleeding after caesarean section can be concealed within the abdomen, diagnosis can be difficult. Diagnosis in the postoperative phase relies on frequent observations of vital signs and other clinical signs of internal bleeding, supplemented by cumulative objective assessment of any revealed blood loss. If internal bleeding is suspected, bedside ultrasound scan can help to diagnose excess blood in the abdomen.[12]

PPH is a common complication of childbirth, and women giving birth in any setting should be attended by health-care workers who can diagnose PPH accurately and early, administer the first-response treatment bundle, and make timely referral for advanced care if the bundle fails to stop the bleeding. However, many births still occur outside of formal health facilities or in resource-limited facilities, both of which might be attended by non-skilled providers. Although the use of calibrated drapes for objective quantification of blood loss might not be possible in this context, alternatives such as calibrated bedpans or standardised absorbent cloth mats could offer a practical method for early diagnosis of excessive bleeding. If misoprostol has not been used for prevention, it could be administered as a first-line uterotonic treatment.[6,24,25] Misoprostol is heat-stable; easy to administer orally, sublingually, or rectally; and does not require refrigeration, making it an option for community births. However, early referral to a higher-level facility must be initiated as soon as PPH is suspected or diagnosed so that the full first-response treatment bundle can be administered and, if the bundle fails, treatment for refractory PPH can be provided. Referral pathways should be clearly defined and supported by community education, clear referral criteria, transport plans, and communication systems.

Treatment of refractory or life-threatening postpartum haemorrhage

Refractory PPH is diagnosed if a woman continues to bleed despite first-response treatment. An analysis of 29 539 vaginal births from 23 hospitals in ten countries found 16·2% (497/3061) of women with PPH progressed to have refractory PPH.[26] Life-threatening PPH is diagnosed if a woman's bleeding results in shock, collapse, or acute organ failure.[31] Red flags for life-threatening PPH include drowsiness, confusion, dyspnoea, oliguria, bruising, blood loss ≥1500 mL,[27] pulse >110 beats per min,[9] systolic blood pressure <90 mm Hg,[9] shock index ≥1·7,[28–30] haemoglobin <7 g/dL,[31,32] fibrinogen <2 g/L,[33,34] prothrombin time test with an international normalised ratio ≥1·5,[32,35] and lactate >2·6 mmol/L.[36]

Management of refractory PPH—particularly if it has progressed to become life threatening—starts with taking urgent steps to support the woman's circulation, airway, and breathing. The woman should lie flat and facial oxygen should be provided. We propose a

PPH carry case item	Number of items
Large bore IV cannula	×2
Tourniquet	×2
Alcohol swabs	×6
10 mL sterile water for injection	×4
Medical tape/plaster	×2
TXA 500 mg/5 mL vials or 1 mg/10 mL vials	×10
21G needles (green)	×6
23G needles (blue)	×6
5 mL syringes	×6
10 mL syringes	×8
Additive stickers for IV fluids	×3
1000 mL IV fluids (NaCl or Ringer's Lactate)	×1
500 mL IV fluids (NaCl or Ringer's Lactate)	×2
Giving set	×2
Small packet sterile swabs	×2
Medium packet sterile swabs	×2
Catheter bag	×1
Foley's catheter	×1
Size small sterile gloves	×2
Size medium sterile gloves	×2
Size large sterile gloves	×2
Lignocaine 1% 10 mL	×1
Plastic apron	×1
Cradle device, fully charged	×1

Figure 3: **An example PPH carry case with a checklist of contents**
Oxytocin ampoules are stored in the fridge until required. IV=intravenous. NaCl=sodium chloride. PPH=postpartum haemorrhage. TXA=tranexamic acid.

structured way to approach refractory PPH at vaginal birth (figure 3), consisting of three overlapping phases: assess and act, stabilise, and operate. The assess and act phase has two bundles, one for the top-end operator (usually the anaesthetist, anaesthetic nurse, obstetrician, or midwife) and one for the bottom-end operator (usually the obstetrician or midwife). Each bundle operator has five elements to act on contemporaneously. The top-end operator will need to secure intravenous access; provide additional uterotonics and tranexamic acid; obtain samples for a full blood count, coagulation screen, and cross-matching; and apply a vital sign monitoring device. The bottom-end operator will need to reassess uterine tone, remove any clots in the vagina and cervix, re-examine the genital tract for any trauma, catheterise the woman, and apply a blood collection drape under the buttocks to measure ongoing blood loss (if not already in place).

The stabilise phase requires operators to resuscitate the woman with intravenous fluids, blood, and blood products, and the use of at least one of the temporising approaches for minimising blood loss while preparations are made for further treatment. Temporising measures include bimanual compression of the uterus, uterine tamponade, external aortic compression, or the use of a non-pneumatic anti-shock garment (NASG). If the woman requires transport to another hospital, the use of an NASG is recommended. Coagulopathy should be considered in all women with refractory PPH;[37,38] coagulopathy can occur as a result of massive blood loss and dilution of coagulation factors, or earlier during bleeding in pathologies such as placental abruption or amniotic fluid embolism. Coagulopathy is associated with poor maternal outcomes as obstetric interventions will fail if haemostasis is impaired.

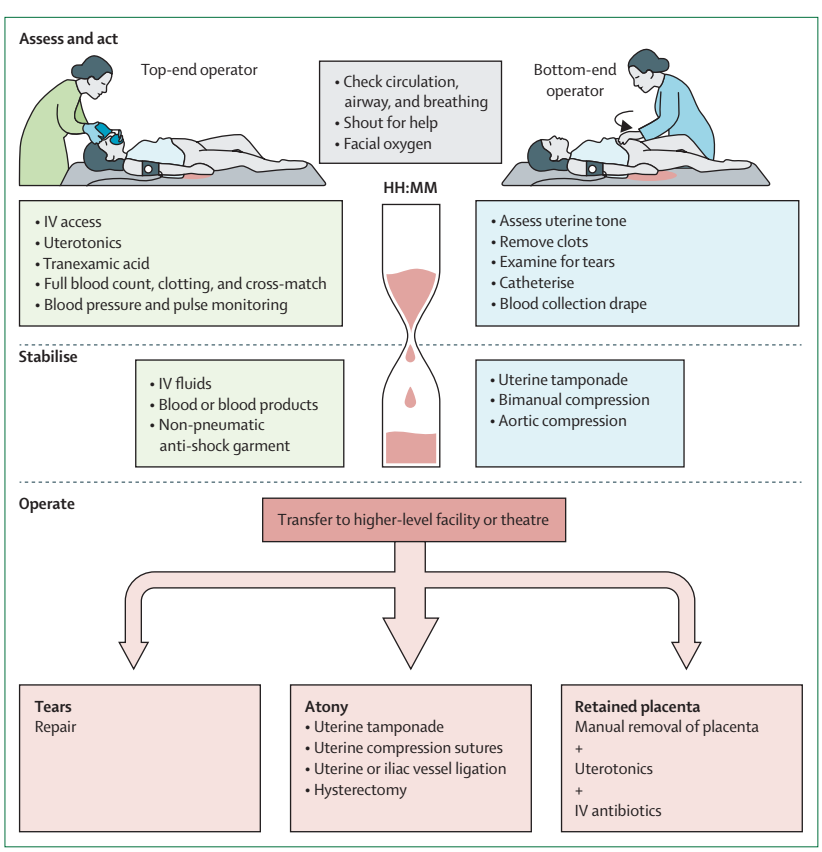

Figure 4: **A structured approach for managing refractory postpartum haemorrhage**
IV=intravenous.

The operate phase generally requires the woman to be transferred promptly to an operating room while resuscitation continues. In the operating room, under anaesthesia, a thorough genital tract examination should be conducted to establish the cause of bleeding. Further management can then be tailored to the cause (or causes; figure 3). Operative management can include manual removal of the placenta, repair of genital tract trauma, uterine tamponade, compression sutures, devascularisation surgery, or hysterectomy. Uterine artery embolisation can also be an option in some well resourced settings if an interventional radiologist is available. Timely action is a critical determinant of outcome; therefore, all actions must be completed quickly, and important timepoints should be noted on the timeline spine (figure 4). Clear protocols, coordinated teamwork, and an enabling environment are essential.

Management of refractory PPH at caesarean section follows the same principles as management at vaginal birth. Identifying the source of bleeding, particularly uterine angle tears or placental bed bleeding, and any evidence of coagulopathy are essential for targeted treatment. Effective stabilisation can be achieved with bimanual compression, uterine tamponade, or a uterine tourniquet (ie, by tying a Foley catheter around the lower uterus[39]). If the woman requires transport to another facility, the uterine tourniquet can be left in situ with the abdomen temporarily closed; an NASG can provide further stabilisation during transport. Definitive treatment will involve repairing tears, brace sutures, devascularisation surgery, or hysterectomy.

Management of life-threatening PPH requires the immediate attendance of the emergency team, which should include senior obstetricians and anaesthetists. The immediate priority is to assess and resuscitate the woman through management of her circulation, airway, and breathing. Bleeding should be controlled, and transfusion of blood and blood products should be done if required. Specific management will be guided by the presentation and cause, but swift temporising with uterine tourniquet and early recourse to hysterectomy might be needed to preserve the woman's life. Postoperative care is likely to require an intensive care setting.

Transfusion of blood and blood products

The circulating blood volume in a pregnant woman is 4·7–7·5 L depending on her BMI.[40] Blood loss during PPH can be so rapid that a woman can lose 1–2 L (or

more) within minutes. Intravenous fluids can re-expand plasma volume, but blood transfusion is often needed to replace the lost blood and prevent serious morbidity and mortality. All birth facilities should therefore strive to have access to a blood bank or have an on-site blood storage unit to hold emergency O RhD-negative blood in stock.

Criteria for blood and blood product transfusion incorporate clinical assessment and haematological tests (done in the laboratory or at the bedside). Women with acute haemorrhage can have a normal haemoglobin concentration until their blood becomes diluted with infused fluids, and thus relying on single blood results to guide transfusion decisions can be misleading. Blood transfusion should be considered if a woman is deemed to have sustained severe PPH (≥1000 mL blood loss), or is haemodynamically unstable, with the therapeutic aim of elevating haemoglobin to at least 70 g/L.[6] Blood loss also can result in dilution of coagulation factors, necessitating transfusion of blood products.[41] Concentrated fibrinogen (ie, cryoprecipitate or fibrinogen concentrate) should be transfused if needed to ensure the woman's Clauss fibrinogen concentration remains above 2 g/L.[11] In PPH with blood loss greater than 1500 mL, transfusion of fibrinogen without testing a woman's fibrinogen concentration has not been shown to improve outcomes.[42–44] In cases of acute obstetric coagulopathy (eg, placental abruption or amniotic fluid embolism), hypofibrinogenaemia occurring early in a bleed is likely due to fibrin and fibrinogen destruction and inhibition,[37] rather than dilution of clotting factors from massive blood loss. Concentrated fibrinogen replacement will be required at an earlier stage to restore haemostasis and avoid ongoing bleeding with the development of mixed coagulopathy (ie, acute obstetric coagulopathy and dilutional coagulopathy). Platelet transfusion should be considered on clinical grounds or if the platelet count is less than 75×10^9/L; the therapeutic aim is to achieve a platelet count of more than 50×10^9/L.[45] Fresh frozen plasma should be used on clinical grounds, if 4 units of blood have been transfused, or to ensure prothrombin time and activated partial prothromboplastin time remain less than 1·5 times the non-pregnant reference ranges. Transfusion of blood and blood products should be guided by clear protocols that are readily available on labour wards and operating theatres. The need for blood and blood products should be anticipated, and early requests should be made to anticipate any delays in provision.

Intraoperative cell salvage (ie, where blood lost during surgery is collected, processed, and auto-transfused) could have a role in the management of women at high risk of PPH, particularly in settings with insufficient blood supplies and in women who refuse allogeneic blood transfusion.[46]

Time-critical steps

The three delays model is a well established framework for exploring and addressing maternal morbidity and mortality.[47] The first delay is in deciding to seek care, the second delay is in identifying and reaching a health facility, and the third delay is in receiving effective care once at the facility. Although our focus in this Series paper has been on addressing the third delay, an effective strategy is needed to address the first and second delays too. Such a strategy could include increasing community engagement and birth preparedness, promoting regular antenatal care, improving transportation options for women in difficult-to-reach areas, and strengthening referral pathways.

We identify six delays to avoid in the context of PPH care, once the woman is in a health facility. These delays—and their solutions—are: (1) in the diagnosis (by using objective blood loss devices and clear criteria for treatment), (2) in the first-response treatment (by use of a bundle of interventions), (3) in the escalation (by use of explicit escalation criteria and red flags), (4) in the use of temporising measures (eg, uterine tamponade or NASG), (5) in identifying the specific cause of bleeding for targeted treatment (ie, atony, trauma, retained tissue, abnormal placentation, or clotting abnormality), and (6) in the provision of blood and blood products. Many of these steps can be delivered concurrently to save time, as every minute of delay avoided could mean the difference between life and death for a woman with PPH.

Over the past decade, efforts have been made to improve teamwork, communication, and efficiency in obstetric emergency care and improve outcomes.[48,49] However, further improvements are needed. Modern maternity care must move away from visual estimation guesswork when diagnosing PPH. Clear criteria for action are needed and once a decision to act is made, the full first-response treatment bundle should be used, with all components started within a 15 min window.[50] This 15 min target has been shown to be achievable.[19,50] If first-response treatment does not work, swift escalation to senior team members is essential; the common escalation criteria are uncontrollable bleeding, measured blood loss of at least 1000 mL, haemodynamic shock, extensive genital tract trauma, or the presence of any red flags.[7] Lower-level facilities should have clear referral pathways to higher-level facilities. Visible and consultative leadership, clear protocols (including referral pathways to higher-level facilities), effective on-site inter-professional training, simulation-based drills, effective audit and feedback systems (particularly targeting near-misses [an event in which a woman nearly died but survived a life-threatening complication occurring during pregnancy, childbirth, or within 42 days of the termination of pregnancy[51]]), and quality improvement programmes are the cornerstone of a health-care system that can respond to PPH immediately. Effective regulations that ensure midwives' scope of practice includes early identification of PPH and immediate provision of all components of first-response treatment, without waiting for the approval of doctors, are needed.

Quality-assured medicines and commodities for PPH prevention and treatment should be reliably forecasted and procured through national procurement and distribution plans.

Women can require supportive care after a PPH. A severe PPH is a life-threatening experience that can leave a woman with anxiety[52,53] and psychological trauma.[1] Screening for psychological consequences and providing appropriate postnatal support should be the standard of care. Women who have had a PPH are at risk of impaired breastfeeding and bonding with their newborn, anaemia, infection, sepsis, and thrombosis. A postnatal haemoglobin test at discharge from hospital and 4–6 weeks after childbirth can help identify women who need oral or intravenous iron therapy.

Discussion

Evidence shows that substandard clinical care is a root cause of deaths associated with PPH. Substandard care presents itself in three main ways: missed or delayed PPH diagnosis, slow and fragmented delivery of treatment interventions, and agonisingly late escalation of care. Weak and under-resourced heath systems create the conditions for substandard care. In this Series, we have provided evidence-based approaches to improve diagnosis and treatment. Tremendous global efforts have been made to promote facility-based births; however, being in a facility is of little use to the 52% of women[5] with PPH who would have their diagnosis missed by the current diagnostic approach, which relies on subjective visual estimation of blood loss. High-quality evidence from the E-MOTIVE trial showed that a strategy combining objective blood loss assessment with a first-response bundle of effective treatments and robust implementation strategy, results in substantial improvements in health outcomes.[7]

Measurement of blood loss is of no value unless it is clearly linked to thresholds and prompts to initiate action. The updated, evidence-based WHO–FIGO–ICM definition of PPH provides clear thresholds for first-response treatment. The new definition challenges the exclusive use of the conventional 500 mL blood loss threshold for defining PPH, as such a threshold can overlook the most vulnerable women (eg, those with malnutrition and severe anaemia who decompensate well before losing 500 mL of blood). The additional criterion for PPH (ie, blood loss ≥300 mL plus an abnormal vital sign) can capture these women and enable earlier recognition and treatment of PPH, giving them a better chance of survival. The updated WHO–FIGO–ICM PPH definition prioritises prognostic sensitivity over prognostic specificity, enabling the provision of PPH treatment to previously overlooked women.[9] Provision of effective care will require clear communication, leadership, and teamwork. Respectful care should be the standard, with ongoing and compassionate communication with the woman even during an acute and stressful emergency.

The recommendations in this Series are based on the best available evidence. We have published several systematic reviews, and updated several existing ones, in the lead-up to publication of this Series. Furthermore, we have benefited from the extensive literature reviews conducted as part of evidence preparation for the consolidated PPH guidelines jointly issued by WHO, FIGO, and ICM.[6] Where evidence was scant, or of unreliable quality, the recommendations are based on international consensus, elicited through various global workshops and consultations. Such consensus-based recommendations should be re-examined as relevant research evidence becomes available.

Much of the evidence presented in this Series comes from studies of PPH at vaginal births in health facilities, and evidence from caesarean births and home births is scarce. High-quality evidence to guide prevention, diagnosis, and treatment of PPH at caesarean births and home births is urgently needed. For example, methods for objectively measuring blood loss at caesarean section (eg, the colorimetric method) and at home birth (eg, standardised cloth mats that absorb a certain amount of blood per square unit of the material), need evaluation.

Coagulopathy leads to failure of obstetric interventions. Research investigating mechanisms, identification (including point-of-care testing), and treatment of obstetric coagulopathy in all health-care settings is therefore needed to improve care. Urgent research is also needed on broader health system issues, such as the procurement and distribution of essential drugs and equipment, financing models that reduce out-of-pocket costs, the provision of solar-backed power supply for refrigerators (to store oxytocin) and operating theatres, and drone delivery of blood and essential drugs to remote areas.[54]

Specific treatment research priorities include investigating optimal tranexamic acid regimens, the use of carbetocin for treatment of PPH, and comparative effectiveness of different uterine tamponade devices. The PPH Roadmap (2023–30) further highlights the need for implementation research on the barriers and facilitators affecting the adoption and use of evidence-based recommendations, the most effective implementation and advocacy strategies, and strategies for improving access to PPH commodities, all while engaging the health-care industry in the development of medicines, diagnostics, and devices.[55]

The recommendations from this Series focus on maintaining urgency across prevention, diagnosis, and treatment of PPH. Opportunities to modify risk factors for PPH (eg, anaemia) start before a woman becomes pregnant. Once she is pregnant, other risk factors (eg, insufficient antenatal care) can be addressed. Routine prophylaxis with either cold chain-maintained oxytocin, or heat-stable carbetocin should be provided for all women giving birth. If women are identified as being at high risk of PPH, dual prophylaxis with oxytocin plus

misoprostol should be considered. Objective methods of blood loss assessment, such as with a calibrated drape, should be used to diagnose PPH according to the reappraised definition. If PPH is diagnosed, first-response treatment bundles should be used to avoid the delays of sequential treatments. If women with PPH who have had first-response treatment and continue to bleed, red flags should be monitored to identify those who are likely to have severe adverse outcomes.

The principles outlined in this Series represent achievable goals that could transform PPH outcomes globally. The essential knowledge and tools to substantially reduce PPH-related morbidity and mortality now exist; the primary challenge lies in translating this evidence into consistent clinical practice across diverse health-care settings. The required transformation extends beyond merely enhancing individual clinical skills to encompass systemic and systematic changes in health-care delivery and organisational culture. Success will demand sustained commitment from policy makers and health-care leaders, adequate resource allocation, and continuous quality improvement efforts. The ultimate goal—the elimination of preventable maternal deaths from PPH through the consistent application of evidence-based practices worldwide—is within our collective grasp.

Contributors

AC drafted the structure of the paper and wrote the first draft. KNS was responsible for the production of figures 2 and 3. AJD was responsible for the production of figure 4. All coauthors revised the manuscript at least once, contributed to the literature review, and provided important intellectual input. Authors listed on individual papers within the Series contributed only to those specific papers and not to others. All authors had the opportunity to review each completed paper and agree to the inclusion of the paper they coauthored in this Series.

Declaration of interests

SB received industry support from Werfen and Haemonetics to provide devices and consumables free of charge to participating sites in the Obstetric Bleeding Study UK trial, and participated on two annual Postpartum Haemorrhage Advisory Board meetings run by WHO in 2024 and 2025. SM received funding to her academic institution from the Marin Community Foundation and LifeWrap–Non-Pneumatic Anti-Shock Garment International. AW received payment as an expert witness in an ongoing General Medical Council trial of retained placenta; is the co-inventor of a postpartum haemorrhage device, with the patent held by his academic institution (US11278321B2 and EP3116418B1); and is part of a royalty-sharing scheme should any royalties arise. IDG and OTO were members of the WHO Steering Group that oversaw the development of the WHO–International Federation of Gynecology and Obstetrics–International Confederation of Midwives *Consolidated Guidelines for the Prevention, Diagnosis and Treatment of Postpartum Haemorrhage*. OTO is the Project Coordinator for the Research to Expand Access to Heat-stable Carbetocin for the Treatment of Postpartum Haemorrhage (REACH) trial, which received main funding support from Unitaid, complementary funding support from MSD for Mothers, in-kind contributions from the Human Reproduction Programme (salary costs), and in-kind donations of heat-stable carbetocin from Ferring Pharmaceuticals for postpartum haemorrhage prophylaxis and as investigational medicinal products to trial-participating sites. All other authors declare no competing interests.

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