## Postpartum Haemorrhage 2

# Prevention of postpartum haemorrhage: from evidence to implementation at scale

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**Postpartum haemorrhage (PPH) is a leading cause of maternal death. Preventing PPH can spare women from experiencing the trauma and risks of PPH, reduce the strain on overstretched health systems, and probably produce better outcomes than a strategy solely focused on PPH treatment. Prevention of PPH is often interpreted as provision of uterotonic drugs to contract the uterus at the time of childbirth. Although uterotonics are a central strategy for PPH prevention, several other approaches can prevent PPH or ameliorate its severity. These approaches include addressing the unmet need for contraception, remedying anaemia and other modifiable risk factors for PPH, optimising medical conditions that predispose to PPH, and tackling the rise in caesarean births in many countries. Effective delivery of preventive care requires early and regular antenatal care and planned birth at appropriately resourced health facilities. Social and behavioural change interventions for improving contraceptive provision and uptake, targeting adolescents, postpartum women, geographically remote communities, and families on low income, are a priority. Effective interventions to tackle anaemia include the management of heavy menstrual bleeding, pre-pregnancy or antenatal haemoglobin testing and oral or intravenous iron treatment, dietary improvements, and—on rare occasions—blood transfusion. Risk factors for PPH that need attention include high BMI, multiple pregnancy, gestational diabetes, pre-eclampsia, macrosomia, and several medical conditions. Caesarean births are associated with a substantial increase in PPH risk and should therefore only be done when medically indicated. A Cochrane network meta-analysis of 122 trials, with 121 931 women, found that the combinations of oxytocin plus misoprostol, or oxytocin plus ergometrine, were the most effective prophylaxis for PPH when given at the time of childbirth; however, these combinations had a higher risk of side-effects compared with single-drug prophylaxis. Oxytocin and carbetocin were the most effective single drugs for PPH prophylaxis, with minimal side-effects. Single uterotonic prophylaxis with either oxytocin or carbetocin is, therefore, recommended for routine prophylaxis. However, if oxytocin or carbetocin is not accessible, misoprostol is an alternative. Combination prophylaxis with oxytocin plus misoprostol can be considered for women at high risk of PPH. Ergometrine alone and oxytocin plus ergometrine combination are no longer recommended due to hypertension-related safety concerns. A robust implementation approach that engages various stakeholders to promote change, ensures the supply of quality-assured medicines and devices, provides training and support, and secures ongoing political and financial commitment is necessary to translate evidence into global impact.**

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## Introduction

Progression from an uncomplicated birth to a life-threatening postpartum haemorrhage (PPH) is often unpredictable and rapid, frightening and risky for the woman, and demanding for the health-care providers and health system. Furthermore, even the most effective medical and surgical treatment of PPH by highly skilled providers does not guarantee successful outcomes. Therefore, primary prevention of PPH through effective strategies is the ideal goal. Although all instances of PPH cannot be eliminated through preventive strategies, many effective interventions can reduce the chance of a woman having a PPH or diminish its severity and consequences.

Prevention of PPH is often given a narrow focus, with an emphasis on the use of a uterotonic drug to contract the uterus after childbirth. However, such a narrow focus misses several other opportunities to prevent PPH, as highlighted in the first paper in this Series.[1] We therefore take a broad perspective on prevention in this second paper, to include interventions targeting menstrual health (eg, addressing heavy menstrual bleeding to reduce the risk of anaemia in at-risk populations) and reproductive health (eg, meeting the unmet need for contraception), as well as pre-pregnancy, pregnancy, labour and childbirth, and postpartum periods (panel 1).[1]

The preventive steps outlined in this Series paper should be understood in the broader context of the social, economic, structural, and political determinants of health. A health facility that is aiming to prevent PPH with the use of high-quality uterotonic prophylaxis will bring no benefit to a woman who does not have the autonomy, knowledge, or means to seek health care (ie, the first and second delays of the three delays model:[7] delay in deciding to seek care and delay in reaching a health facility). Furthermore, an under-resourced and poorly supported health service might not have cold-chain maintenance for oxytocin injections, or the necessary staff to administer the preventive intervention (ie, the final delay in the three delays model:[7] delay in receiving effective care).

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***Panel 1:*** **Search strategy and consensus-building consultations**

The recommendations are based on published systematic reviews of the current literature, appraisal of professional body guidelines, and expert group discussions. For the systematic review on causes and risk factors of postpartum haemorrhage, we searched MEDLINE, Web of Science, Embase, Cochrane Library, and Google Scholar (last search Nov 30, 2024).[2] We also refer to the latest updated Cochrane network meta-analysis on uterotonic agents for preventing postpartum haemorrhage.[3] 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 postpartum haemorrhage,[4] WHO's comprehensive framework for action in accelerating anaemia reduction,[5] and the Royal College of Obstetricians and Gynaecologists guideline for the diagnosis and management of placenta praevia and placenta accreta.[6] For expert group meetings, recommendations were formulated based on an international consensus meeting on postpartum haemorrhage 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.

Preventive strategies should therefore be supported with contextually appropriate implementation approaches and resources, and integrated into the community and health system, to achieve sustained global benefit. To facilitate evidence-based PPH prevention, we provide various clinical and policy recommendations and highlight potentially important implementation approaches throughout this Series paper.

## Addressing the unmet need for contraception

Women who avoid unwanted or unintended pregnancies by accessing contraception can also avoid pregnancy complications such as PPH. Many women, particularly in low-income and middle-income countries, have unintended pregnancies due to inadequate access to contraception.

The estimated global unmet need for contraception in 2019 was 162·9 million (95% uncertainty interval 155·6–170·2), out of the 1·2 billion women who had a need for contraception.[8] The global unmet need rate was 8·3% (8·0–8·7), but this average hides important disparities; for example, the unmet need in western Europe is 3·5% (3·2–3·8), but 9·3% (8·0–10·6) in south Asia and 18·0% (17·6–18·4) in sub-Saharan Africa.[8]

The unmet need for contraception worldwide has substantially reduced since 1990. However, the use of modern contraceptive methods differs between high-income and low-income countries.[9] Analysis of the best-performing countries (ie, the positive outliers or the exemplars) in each region is likely to give important and contextually relevant insights on how to reduce the unmet need for contraception. Strategies to address unmet need should be based on a sound understanding of the needs and preferences of women and their communities. Social and behavioural change interventions for improving contraceptive provision and uptake, targeting adolescents, postpartum women, geographically remote communities, families on low income, people with disabilities, and people living in fragile settings, are a priority.[10] Immediate postpartum contraception (within 24 h) should be promoted to meet contraceptive need and achieve a desirable interpregnancy interval. Potentially useful strategies for meeting the unmet need for contraception include community engagement, free or subsidised contraceptives, increasing girls' and boys' access to reproductive and sexual health education, task sharing or shifting to expand the range of front-line health providers who can offer contraceptive services,[11] leveraging immunisation services to offer contraceptive options, behaviour change strategies for health providers to promote contraception, mass media campaigns, and mobile services.[10] Continued global and national investment in contraceptive coverage will bring many benefits, including a reduction in PPH occurrences and deaths.

## Mitigating risk factors for postpartum haemorrhage

There are several sociodemographic, medical, and pregnancy-related risk factors for PPH (panel 2),[1] many of which are modifiable. Many risk factors also contribute to other complications in pregnancy or general ill health in women, and therefore need attention. Examples of such risk factors include anaemia, high BMI, gestational diabetes, and hypertensive disorders of pregnancy.[1,4] Two strong risk factors that require urgent global action are anaemia and caesarean sections that are not medically indicated.

### Anaemia

Anaemia in pregnancy is defined as a haemoglobin concentration (Hb) of less than 110 g/L in the first and third trimesters, or less than 105 g/L in the second trimester.[4] The global prevalence of anaemia in pregnancy is 37%; however, regions vary considerably, with Africa and Asia having the highest prevalance.[16,17] The main cause of anaemia is iron deficiency, which is often secondary to dietary deficiency or heavy menstrual bleeding.[16] Other important causes of anaemia, such as haemoglobinopathies, malaria, and hookworm infestation, should also be considered depending on the geographical setting and clinical context.

Anaemia is strongly associated with PPH (adjusted odds ratio [OR] 2·36, 95% CI 1·29–4·32).[2] This association could be due to compensatory increases in cardiac output;

placental size and vascularity;[18] reductions in the oxygen carrying capacity of blood, compromising myometrial contractility;[19] and impaired blood clotting. Anaemia is also strongly associated with the risk of maternal death. An analysis of more than 310 000 women with severe anaemia (defined as Hb <70 g/L) from 359 health facilities in 29 countries found that the odds of death in women with severe anaemia were more than two-fold higher compared with women without severe anaemia (adjusted OR 2·36, 1·60–3·48).[20] Other important implications of anaemia include infection, sepsis, low birthweight, preterm birth,[21] and social and economic impacts, including a reduced ability to engage in paid work, increased gender wage gaps, and greater risk of household poverty.[5,22]

A full blood count is the optimal test for diagnosing anaemia.[4] However, in settings where this is not available, on-site haemoglobin testing with a haemoglobinometer is recommended.[4] Development of scalable, low-cost, on-site, and accurate haemoglobin testing technology is a research priority.

Effective interventions to tackle anaemia include the management of heavy menstrual bleeding, dietary adjustments, oral or intravenous iron treatment, and, on rare occasions, blood transfusion. Dietary improvements should focus on a balanced diet enriched with foods high in iron, such as leafy vegetables, pulses, eggs, dairy, fish, and meat, as well as minimising the intake of iron chelators (eg, tea). Heavy menstrual bleeding can be treated with the combined oral contraceptive pill, non-steroidal anti-inflammatory drugs, tranexamic acid, or an intrauterine hormone-releasing system.[23] Prevention and treatment of hookworm infection in endemic areas and malaria treatment in pregnancy are also important strategies to reduce the risk of anaemia.[5]

WHO recommends routine daily iron and folic acid supplementation for all pregnant women, with 30–60 mg of elemental iron and 400 µg of folic acid.[4] However, if a woman is diagnosed with anaemia during pregnancy, the elemental iron dose should be increased to 120 mg per day until her Hb reaches at least 110 g/L.[4] Intravenous iron infusion can be considered when oral iron is not tolerated or ineffective in treating the anaemia, or when anaemia needs to be corrected rapidly (eg, when severe anaemia is diagnosed close to the time of birth).[4] However, as there is a small risk of anaphylaxis with iron infusion (estimated to be <1 in 1000),[24] this treatment should only be offered in facilities that can monitor for and manage anaphylaxis.

### Caesarean sections that are not medically indicated

A caesarean section can be a life-saving intervention for women and their newborns when conducted at the right time and for the right indication, by skilled health-care providers. However, many caesarean sections are done without a clear medical indication, and many are not done despite being needed, or done late.[25] The overuse and underuse of caesarean sections vary hugely in regions, and between and within countries.[25] The caesarean section rate in many sub-Saharan countries is less than 5%, whereas in many Latin American countries, this rate exceeds 50%.[26] A strict benchmark for an appropriate caesarean birth rate for a country is difficult to define as it is dependent on various factors, including population and health service characteristics, but a

***Panel 2:*** **Risk factors for postpartum haemorrhage**

**Risk factors with strong association (OR >2)**

- Anaemia
- Female genital mutilation
- Sepsis
- Previous PPH
- Grand multiparity
- No antenatal care
- Placenta praevia
- Resolved placenta praevia
- Stillbirth
- Multiple pregnancy
- Assisted conception
- Caesarean birth
- General anaesthesia[12]
- Magnesium infusion[13]
- Prolonged second stage of labour[14]
- Shoulder dystocia
- Birthweight ≥4500 g

**Risk factors with moderate association (OR >1·5 to 2)**

- BMI ≥30 kg/m²
- Liver disease
- Family history of PPH
- Hypertensive disorders of pregnancy[13]
- Pre-eclampsia
- Gestational diabetes
- Polyhydramnios
- Birthweight 4000 g to <4500 g
- Episiotomy[13]
- COVID-19

**Risk factors with weak association (OR >1 to 1·5)**

- BMI 25–29·9 kg/m²
- Black ethnicity
- Asian ethnicity
- Uterine fibroids
- Antidepressant use
- Asthma
- Epilepsy[15]
- Premature rupture of membranes
- Induction of labour
- Augmentation of labour
- Instrumental birth

Information sourced from Yunas et al,[7] or from other cited sources. PPH=postpartum haemorrhage. OR=pooled odds ratio (adjusted pooled ORs are reported, where available; otherwise, pooled crude ORs are reported).

caesarean rate that exceeds 20% is unlikely to be associated with benefits.[27] A *Lancet* Series on caesarean section, published in 2018, estimated that 6·2 million caesarean sections that were not medically indicated were conducted per year worldwide.[28]

Caesarean section is a strong risk factor for PPH (adjusted OR 5·18, 95% CI 3·42–7·85)[2] and also increases the future risk of further caesarean sections, uterine rupture, and placenta accreta spectrum, therefore increasing the risk of obstetric haemorrhage in future pregnancies. A systematic review found a quarter of all women who died in low-income and middle-income countries had undergone a caesarean section. Of these maternal deaths, a third were due to PPH.[29]

WHO has published evidence-based recommendations on reducing caesarean sections that are not medically indicated.[30] These recommendations include addressing women's fears and misperceptions about vaginal birth, mandatory second opinions for caesarean section indication, financial strategies to remunerate health professionals and facilities equally for vaginal births and caesarean sections, audits and feedback loops for facilities, and promotion of collaborative care models for midwives and obstetricians, in which intrapartum care is primarily provided by midwives.[30] Assisted vaginal birth and external cephalic version for breech pregnancies also have a role in reducing caesarean section rates. Although robust guidance is available, widespread implementation has not yet materialised. Urgent implementation research, including learning from positive outliers, is a priority.

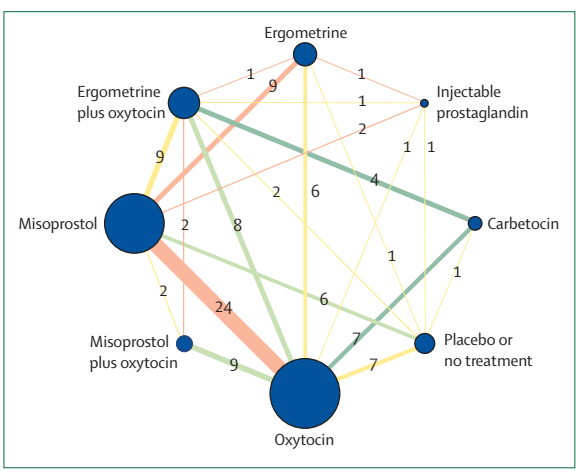


***Figure 1:*** **Network diagram of uterotonic drugs for the prevention of postpartum haemorrhage (blood loss ≥500 mL)**
Figure adapted from Gallos et al.[3] The nodes represent an intervention, and their size is proportional to the number of trials comparing this intervention to any other in the network. The lines connecting each pair of interventions represent a direct comparison; their width is proportional to the number of trials contributing to each direct comparison. Numbers on the lines represent the number of trials for each comparison. Dark green lines represent high-certainty evidence, light green lines are for moderate-certainty evidence, yellow lines are for low-certainty evidence, and red lines are for very low-certainty evidence.

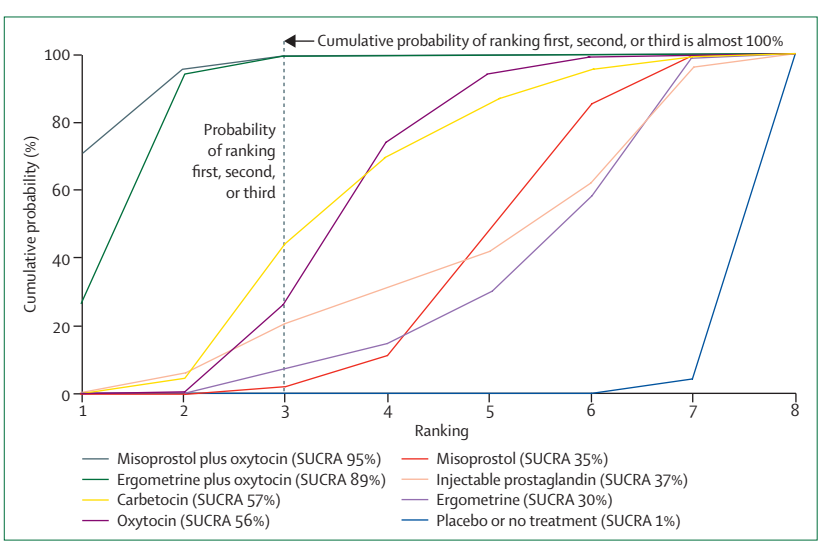


***Figure 2:*** **Cumulative rankograms comparing each of the uterotonic agents for prevention of postpartum haemorrhage (blood loss ≥500 mL)**
Figure adapted from Gallos et al.[3] Ranking indicates the cumulative probability of being the best agent, the second best, the third best (and so on). The x-axis shows the relative ranking and the y-axis the cumulative probability of each ranking. We estimate the surface underneath this cumulative ranking line (SUCRA); the larger the SUCRA, the higher its rank among all available agents.

## Routine uterotonic prophylaxis for all women

Uterine atony is reported in 70·6% of women diagnosed with a PPH (95% CI 63·9–77·3; n=834707 women; 14 studies).[2] Although several risk factors for PPH are known, no accurate prediction models exist to foretell who will have a PPH, or, more specifically, atonic PPH.[31,32] Therefore, effective prevention of PPH with uterotonic drugs is advocated for all women after childbirth.[4] However, opinions differ over which uterotonic drug or drug combination is best for preventing PPH. A Cochrane network meta-analysis was conducted to explore the relative effects of various uterotonics and combinations thereof. The review included 122 trials (n=121931 women) conducted across 48 high-income, middle-income, and low-income countries, involving seven uterotonic drugs or drug combinations (figure 1). Most studies were in hospital settings (115/122; 94%), with women having a vaginal birth (87/122; 71%).[3]

The network meta-analysis found that all drugs or drug combinations—except injectable prostaglandins, for which data were scarce—were effective in preventing PPH of at least 500 mL compared with placebo or no treatment. The two highest-ranked agents of all seven options were combinations of two uterotonic drugs: oxytocin plus misoprostol, and oxytocin plus ergometrine (figure 2). Oxytocin plus misoprostol reduced PPH (≥500 mL) by 30% when compared with oxytocin alone (risk ratio [RR] 0·70, 95% CI 0·57–0·87; moderate-certainty evidence), and oxytocin plus ergometrine reduced PPH (≥500 mL) by 24% when compared with oxytocin alone (RR 0·76, 0·64–0·90;

high-certainty evidence). The highest-ranked single agents were oxytocin and carbetocin, which were similar in their effectiveness in preventing PPH of at least 500 mL. Oxytocin reduced PPH by 42% when compared with placebo or no treatment (RR 0·58, 0·48–0·69) and carbetocin by 43%, again when compared with placebo or no treatment (RR 0·57, 0·43–0·74).[3] Misoprostol reduced PPH by 36% compared with placebo or no treatment (RR 0·64, 0·53–0·77), although evidence for this comparison was scarce.

The greater effectiveness of combination uterotonic prophylaxis, however, comes at a cost. Both oxytocin plus ergometrine and oxytocin plus misoprostol were associated with more side-effects compared with oxytocin alone. Oxytocin plus ergometrine was associated with vomiting, abdominal pain and diarrhoea, and hypertensive episodes;[3] oxytocin plus misoprostol was associated with fever, shivering, and diarrhoea.[3] Oxytocin and carbetocin had minimal side-effects.[3]

Health providers should consider the effectiveness and side-effects of uterotonic drugs for routine prophylaxis, as well as their cost, availability, feasibility of administration, acceptability, and impact on equity.[4] On the basis of these factors, oxytocin or carbetocin can be used as first-line agents for routine PPH prophylaxis at vaginal and caesarean births. However, because oxytocin degrades in heat, if cold-chain storage (2–8°C) cannot be guaranteed, heat-stable carbetocin would be the preferred option. If heat-stable carbetocin is unavailable or unaffordable, or injectable uterotonics are not feasible, oral misoprostol, which is heat-stable, is an alternative.[4] Prophylactic uterotonic drugs should be given immediately (preferably within 1 min) after birth.

The recommended dose of oxytocin for PPH prophylaxis is 10 international units, given intramuscularly or intravenously.[4] Intravenous administration can be more effective and is therefore recommended if the woman already has an intravenous line; however, rapid bolus infusion of oxytocin should be avoided due to the risk of hypotension. The recommended dose of carbetocin for PPH prophylaxis is 100 µg, given intramuscularly or intravenously.[4] The recommended dose for misoprostol is 400 µg, given orally.[4]

### Combination uterotonic prophylaxis for women at high risk of postpartum haemorrhage

The Cochrane network meta-analysis of uterotonics found that, when compared with oxytocin alone, the combination of oxytocin plus misoprostol is more effective in preventing PPH of at least 500 mL (35 fewer PPHs per 1000 women), and in reducing blood transfusion (13 fewer per 1000), the need for additional uterotonics for PPH treatment (55 fewer per 1000), and blood loss (60 mL less on average).[3] The combination of oxytocin plus ergometrine is more effective in preventing PPH of at least 500 mL (28 fewer PPHs per 1000 women), and in reducing blood transfusion (six fewer per 1000) and the need for additional uterotonics (40 fewer per 1000), when compared with oxytocin alone. Although these combination regimens are not routinely recommended due to the risk of side-effects and potential complications, the risk–benefit balance should be considered for women at high risk of PPH, for whom combination uterotonic prophylaxis might carry more benefit than harm. WHO therefore suggests that the combination of oxytocin and misoprostol be considered for prophylaxis in women at high risk of PPH.[4] The combination of oxytocin and ergometrine is not recommended due to the risks this regimen poses to women with known or unknown hypertension. We suggest that the combination regimen of oxytocin and misoprostol be considered for those with risk factors, particularly if the association with such risk factors is strong, or if they have multiple risk factors[1]—situations where the potential benefits could outweigh the potential risks (panel 3).

Tranexamic acid is an important drug in the treatment of PPH (see the third paper in this Series[33]). However, two recent Cochrane reviews have shown that tranexamic acid does not have a preventive role.[34,35] The risk of thromboembolic events is potentially increased with tranexamic acid use, and this risk probably outweighs the theoretical benefit of tranexamic acid in PPH prevention, particularly for caesarean birth, for which the baseline risk of thromboembolism is increased.[4] Furthermore, the likelihood of serious medication errors with inadvertent intrathecal injection of tranexamic acid (mistaken for spinal anaesthetic drugs) can increase with widespread, but medically unindicated, use of this drug.[36,37]

### Preventing placenta accreta spectrum

Placenta accreta occurs when the placenta invades deeply into the uterine wall, making it difficult for the placenta to detach from the uterus after childbirth. Attempts to separate the adherent placenta can result in catastrophic bleeding. Although its cause is not fully understood, a

***Panel* 3: Priority interventions at scale for postpartum haemorrhage prevention**

- Address the unmet need for contraception
- Improve antenatal care coverage
- Mitigate modifiable risk factors for PPH (eg, high BMI and hypertensive disorders)
- Diagnose and address anaemia
- Ensure women at high risk of PPH give birth at appropriate facilities
- Reduce caesarean sections that are not medically indicated
- Take steps to reduce the prevalence of placenta accreta
- Offer single uterotonic prophylaxis for all births
- Consider combination uterotonic prophylaxis for women at high risk of PPH

PPH=postpartum haemorrhage.

commonly accepted mechanism postulates the destruction of the endometrium (eg, during a previous caesarean section, uterine curettage, or myomectomy), predisposing women to deeper invasion of the placenta into the uterine muscle.[38] Rates of placenta accreta are rising rapidly worldwide, in parallel with the global rise in caesarean section rates.

The primary preventive strategy for addressing PPH related to placenta accreta spectrum is to curb the increase in caesarean sections that are not medically indicated. Ultrasound placental localisation should be routine care for all women, particularly for those who have had a previous caesarean section. However, an ultrasound scan might not always detect placenta accreta spectrum, and a high index of suspicion should be maintained even when the scan is normal.

If ultrasound shows invasion of placenta into a uterine scar, several steps should be taken for PPH prevention, based on evidence-based guidance[39] and senior obstetric involvement. Preoperative planning—particularly imaging to identify any involvement of the bladder, cervix, parametrium, or bowel—and rapid escalation from a caesarean section to hysterectomy to prevent excessive blood loss are important preventive strategies for PPH from placenta accreta spectrum. Such care is best delivered at a tertiary hospital with expert multidisciplinary care, blood and blood products, and intensive care facilities. Prophylactic uterine artery embolisation, or leaving the placenta in situ for natural resolution, are steps that can be considered in specialist facilities with appropriate expertise.[6]

### Implementation at scale

Guidelines alone are insufficient to ensure implementation of PPH prevention measures at scale. Policy environments that include appropriate financing structures, reliable procurement and supply chains for essential drugs and equipment, supportive workforce models (eg, midwifery-led care), and auditing and accountability systems are necessary for effective implementation, together with commitment from political, policy, practitioner, and community stakeholders; institutional readiness with trained and motivated staff; adequate and sustained financing; and advocacy.[40] Strong national leadership to establish clear policies that can be adapted to local realities and promoted by champions at all levels is essential. Implementation approaches should be particularly focused on reducing existing health inequities and ensuring new inequities are not introduced.

Anaemia prevention, for example, is not simply a case of providing a prescription for iron tablets. Robust antenatal care, community engagement and education on the importance of dietary diversity, haemoglobin testing, patient medication reminder systems, and task-shifting of iron supplement provision to reach the most at-risk populations in community settings are all essential.[4] Effective implementation requires understanding of and action to address gendered, social, and environmental factors that exacerbate these issues, such as gender norms that influence intrahousehold food allocation (eg, women and girls eating smaller portions than men, or dietary restrictions during menstruation), gendered health access (eg, diminished autonomy or financial control over seeking health care), child marriage and early childbearing, and climate change (eg, rising temperatures increasing infectious disease spread and threatening food security).[41–44]

Heat-stable carbetocin has the advantage of not needing cold-chain transport and refrigerated storage, when compared with oxytocin. However, the unit cost of heat-stable carbetocin might be considered too high in some settings, making its pricing structure an important marketing factor that could scale up its use. Successful and ongoing international efforts are underway to procure heat-stable carbetocin at preferential pricing for low-resource countries with high PPH burden.

Misoprostol might not be as effective as oxytocin or carbetocin for PPH prevention, but it does reduce PPH (≥500 mL), severe PPH (≥1000 mL), and blood transfusion rates, when compared with placebo or no treatment.[3] Misoprostol is heat-stable and affordable, with side-effects that are self-limiting in nature, and so has minimal safety concerns. Misoprostol can therefore be used by community-based health workers to reach women giving birth at home and potentially reduce health disparities. WHO therefore recommends 400 µg oral misoprostol for PPH prevention, which can be administered by community or unskilled health workers if no skilled providers are present at childbirth.[4] An alternative approach is the advanced distribution of misoprostol directly to pregnant women to be self-administered after childbirth, but such an approach should only be considered if targeted monitoring and evaluation are in place.[4]

Research to address medically unindicated caesarean sections is an implementation research priority. Such research should address multiple clinical and non-clinical issues, including financial drivers, at the level of women, providers, facilities, health systems, and national policy. Caesarean births in many countries could soon outnumber vaginal births. Reasons for this increase include health-care provider and institutional financial incentives, health-care providers' fear of litigation, women's fear of vaginal birth, delayed childbearing, and increasing prevalence of comorbidities such as maternal obesity.[45] The consequences of this excess are mostly borne by women—not only in their current pregnancy, but also in future pregnancies.

## Discussion

Prevention of PPH is often seen as synonymous with the prophylactic use of a uterotonic drug after childbirth. However, numerous other steps can help prevent a PPH, including the use of contraception to avoid unwanted pregnancies, addressing modifiable risk factors for PPH,

reducing caesarean sections that are not medically indicated and improving the safety of those that are, and the use of combination uterotonic prophylaxis for women at high risk of PPH. PPH prevention cannot neglect broader public health measures, such as community engagement and birth preparedness, encouraging early and regular antenatal visits, avoiding nutritional deficiencies and anaemia, and addressing obesity and other risk factors. Effective PPH prevention requires a comprehensive approach in addition to the traditional focus on uterotonic prophylaxis at birth.

Evidence supports routine uterotonic prophylaxis for all women. Oxytocin plus misoprostol and oxytocin plus ergometrine are the most effective combinations for preventing PPH of at least 500 mL. However, these combinations are associated with substantial side-effects, and oxytocin plus ergometrine combination can be unsafe because of the risk of hypertension, particularly in those with known hypertensive disease. Therefore, single-agent prophylaxis with oxytocin or carbetocin, or with misoprostol when these are not available or feasible, remains the recommended approach (by WHO, the International Federation of Gynecology and Obstetrics, and the International Confederation of Midwives) for routine use. However, for women at high risk of PPH, combination prophylaxis with oxytocin plus misoprostol can be considered. The recommendation for combination prophylaxis in women at high risk of PPH represents a shift towards risk-stratified prevention strategies. Women with risk factors strongly associated with PPH (eg, anaemia, previous PPH, or caesarean birth), or those with multiple risk factors, could benefit from combination regimens where the potential benefit could outweigh the increased risk of side-effects.

Two modifiable risk factors for PPH demand urgent global attention. First, anaemia, which affects 37% of pregnant women globally, is associated with a 2·4-fold increased risk of PPH and substantially higher mortality rates. Effective interventions, including management of heavy menstrual bleeding, dietary adjustments, treatment of infections, and iron supplementation, are readily available but require systematic implementation.

Caesarean sections that are not medically indicated represent the second modifiable risk factor. The global disparities in caesarean section rates—which exceed 50% in many Latin American countries yet remain below 5% in many sub-Saharan African countries—highlight both overuse and underuse within and between countries. The high PPH risk associated with caesarean birth, combined with an estimated 6·2 million procedures per year that are not medically indicated, represents a substantial and preventable burden. The challenge of placenta accreta spectrum, which is directly linked to increased rates of caesarean sections, exemplifies the cascading consequences of inappropriate intervention. Prevention through judicious use of primary caesarean section is essential. Implementation at scale requires moving beyond clinical guidelines to addressing financial and health system barriers, and the root causes driving women's and providers' preferences for caesarean birth.[46]

Quality assurance of essential medicines remains an important gap. Substandard oxytocin, prevalent in many low-resource settings, undermines prevention efforts and contributes to treatment failures. Strengthening procurement systems and ensuring unbroken supply chains for quality-assured medicines are fundamental requirements for effective implementation. Heat-stable carbetocin eliminates the need for cold-chain maintenance; however, access to the drug is inequitable. Moreover, the affordability and stability of misoprostol make it suitable for community-based births, but at the expense of reduced effectiveness.

Skilled birth attendants have an important role in PPH prevention during and after childbirth. Prevention involves not only the timely use of prophylactic uterotonics, but also managing risk factors (eg, prolonged labour), reducing the risk of PPH related to perineal tearing (by using a hands-on approach to support the perineum during childbirth), avoiding unnecessary episiotomies, identifying and suturing tears early, providing safe and timely caesarean births when indicated, monitoring blood loss and vital signs objectively and frequently after childbirth, and being ready to manage PPH at all times. Where skilled birth attendants are not available, PPH prophylaxis with oral misoprostol and emergency access to appropriately equipped facilities are essential.

Innovations such as heat-stable inhaled, intranasal, or sublingual oxytocin could have a role in PPH prevention in home or community settings that have no access to skilled birth attendants. PPH prevention research priorities include developing improved, cost-effective on-site tests for anaemia diagnosis, and determining optimal dosing regimens for preventive interventions, including the most effective timing of uterotonics relative to cord clamping.

The evidence presented in this Series paper shows that various means for preventing PPH, beyond an exclusive focus on uterotonics, do exist. However, translating evidence into impact requires robust implementation approaches that engage multiple stakeholders, ensure sustained political and financial commitment, and address the broader determinants of maternal health.

#### Contributors

IDG and AC drafted the structure of this Series paper and wrote the first draft. IY and KNS were the main contributors to the Mitigating risk factors for postpartum haemorrhage section. AJD was responsible for the production of figures 1 and 2. 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

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*. ATP was the Chair of the Technical Advisory Group that developed these guidelines. 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 its 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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**References**

1 Coomarasamy A, Sindhu KN, Gallos I, et al. Postpartum haemorrhage: epidemiology, consequences, and missed opportunities. *Lancet* 2026; published online June 12. https://doi.org/10.1016/S0140-6736(26)00902-5.

2 Yunas I, Islam MA, Sindhu KN, et al. Causes of and risk factors for postpartum haemorrhage: a systematic review and meta-analysis. *Lancet* 2025; **405:** 1468–80.

3 Gallos ID, Yunas I, Devall AJ, et al. Uterotonic agents for preventing postpartum haemorrhage: a network meta-analysis. *Cochrane Database Syst Rev* 2025; **4:** CD011689.

4 WHO. Consolidated guidelines for the prevention, diagnosis and treatment of postpartum haemorrhage. World Health Organization. Oct 5, 2025. https://www.who.int/publications/i/item/9789240115637 (accessed June 1, 2026).

5 WHO. Accelerating anaemia reduction: a comprehensive framework for action. World Health Organization. May 12, 2023. https://www.who.int/publications/i/item/9789240074033 (accessed June 1, 2026).

6 Jauniaux E, Alfirevic Z, Bhide AG, et al, and the Royal College of Obstetricians and Gynaecologists. Placenta praevia and placenta accreta: diagnosis and management: green-top guideline no. 27a. *BJOG* 2019; **126:** e1–48.

7 Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med* 1994; **38:** 1091–110.

8 Haakenstad A, Angelino O, Irvine CMS, et al. Measuring contraceptive method mix, prevalence, and demand satisfied by age and marital status in 204 countries and territories, 1970–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2022; **400:** 295–327.

9 UN Department of Economic and Social Affairs. World family planning 2022: meeting the changing needs for family planning—contraceptive use by age and method. https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2023/Feb/undesa_pd_2022_world-family-planning.pdf (accessed June 1, 2026).

10 WHO. Social and behaviour change interventions for contraception and family planning: implementation guidance for policymakers and programme managers. World Health Organization. June 29, 2025. https://www.who.int/publications/i/item/9789240110915 (accessed June 1, 2026).

11 WHO. Scaling up family planning approaches. https://www.who.int/news/item/05-11-2025-scaling-up-family-planning-approaches (accessed June 1, 2026).

12 Combs CA, Murphy EL, Laros RK Jr. Factors associated with hemorrhage in cesarean deliveries. *Obstet Gynecol* 1991; **77:** 77–82.

13 Huang CR, Xue B, Gao Y, et al. Incidence and risk factors for postpartum hemorrhage after vaginal delivery: a systematic review and meta-analysis. *J Obstet Gynaecol Res* 2023; **49:** 1663–76.

14 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:** 290–93.

15 Kuang H, Li Y, Lu Y, Zhang L, Wei L, Wu Y. Reproductive and fetal outcomes in women with epilepsy: a systematic review and meta-analysis. *J Matern Fetal Neonatal Med* 2024; **37:** 2351196.

16 WHO. Anaemia. https://www.who.int/news-room/fact-sheets/detail/anaemia (accessed March 28, 2026).

17 Walters D, Kakietek J, Eberwein JD, Shekar M. An investment framework for meeting the global nutrition target for anemia. https://documents1.worldbank.org/curated/en/244081491391841079/pdf/114022-BRI-Anemia-rev-v5-WEB-PUBLIC.pdf (accessed June 1, 2026).

18 Lao TT, Wong LL, Hui SYA, Sahota DS. Iron deficiency anaemia and atonic postpartum haemorrhage following labour. *Reprod Sci* 2022; **29:** 1102–10.

19 Soltan MH, Ibrahim EM, Tawfek M, Hassan H, Farag F. Raised nitric oxide levels may cause atonic postpartum hemorrhage in women with anemia during pregnancy. *Int J Gynaecol Obstet* 2012; **116:** 143–47.

20 Daru J, Zamora J, Fernández-Félix BM, et al. Risk of maternal mortality in women with severe anaemia during pregnancy and post partum: a multilevel analysis. *Lancet Glob Health* 2018; **6:** e548–54.

21 Kumari S, Garg N, Kumar A, et al. Maternal and severe anaemia in delivering women is associated with risk of preterm and low birth weight: a cross sectional study from Jharkhand, India. *One Health* 2019; **8:** 100098.

22 Marcus H, Schauer C, Zlotkin S. Effect of anemia on work productivity in both labor- and non-labor-intensive occupations: a systematic narrative synthesis. *Food Nutr Bull* 2021; **42:** 289–308.

23 Bofill Rodriguez M, Lethaby A, Farquhar C. Non-steroidal anti-inflammatory drugs for heavy menstrual bleeding. *Cochrane Database Syst Rev* 2019; **9:** CD000400.

24 Dave CV, Brittenham GM, Carson JL, Setoguchi S. Risks for anaphylaxis with intravenous iron formulations: a retrospective cohort study. *Ann Intern Med* 2022; **175:** 656–64.

25 Boatin AA, Schlotheuber A, Betran AP, et al. Within country inequalities in caesarean section rates: observational study of 72 low and middle income countries. *BMJ* 2018; **360:** k55.

26 Betran AP, Ye J, Moller AB, Souza JP, Zhang J. Trends and projections of caesarean section rates: global and regional estimates. *BMJ Glob Health* 2021; **6:** e005671.

27 Molina G, Weiser TG, Lipsitz SR, et al. Relationship between cesarean delivery rate and maternal and neonatal mortality. *JAMA* 2015; **314:** 2263–70.

28 The Lancet. Stemming the global caesarean section epidemic. *Lancet* 2018; **392:** 1279.

29 Sobhy S, Arroyo-Manzano D, Murugesu N, et al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet* 2019; **393:** 1973–82.

30 WHO. WHO recommendations non-clinical interventions to reduce unnecessary caesarean sections. World Health Organization. Oct 11, 2018. https://iris.who.int/bitstream/handle/10665/275377/9789241550338-eng.pdf (accessed June 1, 2026).

31 Ende HB. Risk assessment tools to predict postpartum hemorrhage. *Best Pract Res Clin Anaesthesiol* 2022; **36:** 341–48.

32 Movva VC, Bringman J, Young A, Gray C, Mackeen AD, Paglia MJ. Comparison of three antepartum risk assessment tools to predict significant postpartum hemorrhage in livebirths. *Transfusion* 2023; **63:** 1005–10.

33 Coomarasamy A, Devall AJ, Bell S, et al. Diagnosis and treatment of postpartum haemorrhage: a race against time. *Lancet* 2026; published online June 12. https://doi.org/10.1016/S0140-6736(26)01031-7.

34 Rohwer C, Rohwer AC, Cluver C, Ker K, Hofmeyr GJ. Tranexamic acid for preventing postpartum haemorrhage after vaginal birth. *Cochrane Database Syst Rev* 2025; **1:** CD007872.

35 Rohwer C, Rohwer A, Cluver C, Ker K, Hofmeyr GJ. Tranexamic acid for preventing postpartum haemorrhage after caesarean section. *Cochrane Database Syst Rev* 2024; **11:** CD016278.

36 Moran NF, Bishop DG, Fawcus S, et al. Tranexamic acid at cesarean delivery: drug-error deaths. *BJOG* 2023; **130:** 114–17.

37 Moran NF, Bishop DG, Fawcus S, et al. Tranexamic acid at cesarean delivery: drug-error deaths. *Am J Obstet Gynecol*. 2023; **228:** 1–4.

38 Silver RM, Branch DW. Placenta accreta spectrum. *N Engl J Med* 2018; **378:** 1529–36.

39 Royal College of Obstetricians and Gynaecologists. Placenta praevia and placenta accreta: diagnosis and management (green-top guideline no. 27a). https://www.rcog.org.uk/guidance/browse-all-guidance/green-top-guidelines/placenta-praevia-and-placenta-accreta-diagnosis-and-management-green-top-guideline-no-27a/ (accessed June 1, 2026).

40 WHO. A Roadmap to combat postpartum haemorrhage between 2023 and 2030. World Health Organization. Oct 11, 2023. https://www.who.int/publications/i/item/9789240081802 (accessed March 28, 2026).

41 The Lancet. Maternal health in the perinatal period and beyond. https://www.thelancet.com/series-do/maternal-perinatal-health (accessed March 28, 2026).

42 Sorensen C, Murray V, Lemery J, Balbus J. Climate change and women's health: impacts and policy directions. *PLoS Med* 2018; **15:** e1002603.

43 Kavle JA, Landry M. Addressing barriers to maternal nutrition in low- and middle-income countries: a review of the evidence and programme implications. *Matern Child Nutr* 2018; **14:** e12508.

44 Kalindi AM, Houle B, Smyth BM, Chisumpa VH. Gender inequities in women's access to maternal health care utilisation in Zambia: a qualitative analysis. *BMC Pregnancy Childbirth* 2023; **23:** 755.

45 Colomar M, Opiyo N, Kingdon C, et al. Do women prefer caesarean sections? A qualitative evidence synthesis of their views and experiences. *PLoS One* 2021; **16:** e0251072.

46 Betrán AP, Temmerman M, Kingdon C, et al. Interventions to reduce unnecessary caesarean sections in healthy women and babies. *Lancet* 2018; **392:** 1358–68.