Paper 1: Lancet Series on postpartum haemorrhage

Postpartum haemorrhage: epidemiology, consequences and missed opportunities

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Summary

Excessive bleeding after childbirth, known as postpartum haemorrhage (PPH), can turn an uncomplicated birth into a catastrophe. Each year, an estimated 27 million women experience PPH worldwide – 17 million after vaginal birth and 10 million during or after caesarean birth. An estimated 43,000 women die from PPH annually, translating to a death every 12 minutes. The pooled prevalence of PPH at vaginal birth is 12·6% (95% Confidence Interval (CI) 10·1–15·2) and at caesarean birth 30·9% [95% Credible Interval (CrI) 24·9–37·6], based on the conventional definition of PPH. Common causes of PPH are uterine atony, genital tract trauma, retained placenta, abnormal placentation, and coagulopathy. Risk factors include caesarean birth, multiple pregnancy, anaemia, high maternal body mass index, previous PPH, female genital mutilation, sepsis, pre-eclampsia, macrosomia, and lack of antenatal care. In addition to being the leading cause of maternal mortality worldwide, the consequences of PPH include serious morbidities such as severe anaemia, hysterectomy, organ failure, and long-term psychological trauma. The global economic burden of PPH is estimated at US$ 10·4 billion ($9·8–13·2 billion) annually, consisting of US$ 3·6 billion ($3·2–6·2 billion) to health systems and US$ 6·8 billion ($6·2–7·5 billion) to societies. The World Health Organization (WHO), based on a rigorous review of the evidence, has recently redefined PPH as objectively measured blood loss of ≥300 mL *plus* an abnormal haemodynamic sign, or objectively measured blood loss of ≥500 mL, whichever occurs first. This new definition prioritises early PPH diagnosis and treatment to avert life-threatening maternal outcomes. Comprehensive efforts to address the missed opportunities in the prevention, diagnosis and treatment of PPH will be necessary to improve outcomes. The priorities include addressing the unmet need for contraception, mitigating modifiable risks such as anaemia, avoiding unnecessary caesarean sections, using effective single uterotonic prophylaxis for all births and combination prophylaxis for women at high risk of PPH, ensuring accurate and objective

measurement of blood loss for early PPH diagnosis, and promptly implementing treatment with an evidence-based bundle. The PPH Roadmap (2023-2030) provides a global framework for action.

Keywords

Postpartum haemorrhage, definition, diagnosis, prevalence, causes, risk factors, consequences, economic burden

Introduction

Some blood loss is expected after childbirth, but for some women the bleeding becomes excessive. Excessive bleeding after birth, called postpartum haemorrhage (PPH), can abruptly turn an uncomplicated birth into a life-threatening emergency. If PPH is not recognised and treated early, a woman can deteriorate very quickly and die from exsanguination. Each maternal death extinguishes the life and aspirations of a woman, denying her the fundamental right to survive childbirth and thrive. PPH-related maternal deaths also leave behind newborn orphans and the prospects of survival for these children are poor. A 25-year longitudinal study in Ethiopia found that infants whose mothers died within 42 days of their birth were 57 times more likely to die within the first month of life when compared with those whose mothers survived.[1] Similarly, a survival analysis in rural Tanzania found children orphaned by early maternal deaths had only a 50% chance of reaching their first birthday, compared to a >90% chance among peers with living mothers.[2]

A particular tragedy of PPH deaths is that most are assessed to be preventable. Confidential enquiries into maternal deaths from multiple countries consistently show that poor access to care and substandard quality of care underlie most of these deaths.[3-5] Sound knowledge about the causes, risk factors, prevention, diagnosis, treatment, and consequences of PPH are pre-requisites to improve outcomes. This three-part Lancet Series on PPH presents the evidence and recommendations to improve the standard of care to reduce PPH morbidity and mortality. We call for urgent action on specific clinical and policy priorities and highlight important research gaps. In this first paper of the Series, we examine the epidemiology of PPH, including its definition, prevalence, causes, risk factors, consequences, and costs, and consider the missed opportunities to reduce its burden (Table 1). The second and third papers of the Series focus on prevention and management of PPH, respectively.

Table 1: The 2026 *Lancet* postpartum haemorrhage series outline

Paper one	Paper two	Paper three
 **Epidemiology, consequences and missed opportunities**	 **Prevention of PPH: from evidence to implementation at scale**	 **Diagnosis and treatment of PPH: a race against time**
PPH definitions and terminology: ▪ Definition of PPH and severe PPH ▪ Definition of refractory, life-threatening, primary and secondary PPH PPH prevalence and numbers: ▪ Subjective and objective blood loss measurement ▪ Prevalence of PPH at vaginal and caesarean births ▪ Global and regional PPH numbers by mode of birth Causes of PPH: ▪ Tone, tissue, trauma, thrombin Risk factors for PPH: ▪ Demographic or lifestyle-related ▪ Medical ▪ Past pregnancy-related ▪ Current pregnancy-related ▪ Childbirth-related Consequences of PPH: ▪ Physical, psychological, and neonatal ▪ PPH deaths by region and mode of birth Who dies from PPH? Economic burden of PPH Challenges and missed opportunities Policy recommendations and implications Research gaps	Prevention strategies: ▪ The unmet need for contraception ▪ Mitigating risk factors for PPH o Demographic, lifestyle-related, medical, and pregnancy-related risk factors for PPH o Anaemia o Medically unnecessary caesarean operations o Other risk factors ▪ Prophylaxis o Routine single uterotonic prophylaxis o Combination uterotonic prophylaxis for high-risk women ▪ Preventing placenta accreta spectrum Implementation at scale for the prevention of PPH Policy recommendations and implications	Diagnosis of PPH: ▪ Definition of PPH at vaginal and caesarean birth ▪ Quantification of blood loss: o Measurement of PPH at vaginal birth o Calibrated blood collection drape o Measurement of PPH at caesarean birth First-response treatment of PPH: ▪ E-MOTIVE treatment bundle for vaginal births ▪ Treatment bundle for caesarean births Treatment of refractory and life-threatening PPH Transfusion of blood and blood products Time-critical steps in the management of PPH: ▪ The three-delays model ▪ The six-delays in health facilities Supportive care for women after PPH Policy recommendations and implications

PPH: Postpartum haemorrhage; WHO: The World Health Organization

Search strategy and consensus-building consultations

We published systematic reviews of postpartum haemorrhage (PPH) prevalence[6] (last search 11 August 2025), and causes and risk factors (last search 30 November 2024) in the lead-up to this Series.[7] For consequences of PPH, we conducted a comprehensive literature search on MEDLINE, Web of Science, Embase, Google Scholar, Cochrane, and ClinicalTrials.gov using relevant free text search terms and Medical Subject Headings (last search 13 July 2025). We also reviewed the latest international guidelines on the diagnosis, prevention, and treatment of PPH, and updated several systematic reviews on diagnosis, prevention, and treatment of PPH.[6-12]

An international consensus meeting on PPH was 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. The conference was funded by the Gates Foundation, with no involvement or sponsorship from commercial organisations. Key questions and evidence on policies and recommendations on PPH diagnosis, prevention, treatment, and organisation of care were presented for discussion, and the scope of work for this Series was defined.

In March 2023, the World Health Organization (WHO) convened 136 stakeholders at the Global Summit on Postpartum Haemorrhage to identify persistent challenges in reducing the global burden of PPH and chart a course of action. Stakeholders included researchers, policymakers, guideline developers, programme implementers, women's advocates, funders, UN agencies, industry representatives, and innovators from over 50 countries.[13] Key challenges identified included: differences across guidelines, difficulties in implementing evidence-based recommendations in the field, lack of clarity on research priorities, and fragmented advocacy efforts resulting in diluted messages and slower-than-

Definitions and terminology

There is a wide array of PPH definitions and terminology[16] used across guidelines, health systems, and research. The definitions often differ by both the variables used to constitute the definition (e.g., blood loss alone, or blood loss plus vital signs) and the thresholds used for defining abnormality (e.g. 500 mL, 750 mL or 1000 mL for blood loss).[16,17] Such variations have hampered progress in improving PPH outcomes.

The WHO responded to this challenge by reappraising the PPH definition through an evidence-based framework that included the systematic exploration of the prognostic implications[15,18], therapeutic effects[9], and cost-effectiveness of using various clinical markers[19] or definitions for identifying women at risk of death or severe morbidity from PPH. The clinical markers explored included measured blood loss, pulse, systolic and diastolic blood pressure, and shock index, individually and in combination, using an individual participant data meta-analysis (IPD-MA) of 12 datasets from 23 countries, comprising 312,151 women.[18] The analysis found that diagnostic criteria that included measured blood loss of 300 mL or more, in combination with any abnormal vital sign (pulse >100/minute, systolic blood pressure <100 mmHg, diastolic blood pressure <60 mmHg, or shock index >1·0), or ≥500 mL blood loss even in the absence of an abnormal vital sign, had a prognostic sensitivity of 87– 88% and prognostic specificity of 67–76% for predicting maternal death or severe morbidity.[18]

A Cochrane network meta-analysis evaluating the effectiveness of various combinations of diagnostic and treatment strategies for PPH found a diagnostic strategy that triggered

124 treatment based on a ‘3-option trigger’ (1. clinical concern, or 2. blood loss ≥ 300 mL to <
125 500 mL plus abnormal vital sign(s), or 3. blood loss ≥ 500 mL), compared with a diagnostic
126 strategy that triggered treatment based on a ‘2-option trigger’ (1. clinical concern, or 2. blood
127 loss ≥ 500 mL) resulted in lower PPH (≥ 500 mL) rate (RR 0·65, 95% CI 0·49–0·86; high
128 certainty), lower severe PPH (≥ 1000 mL) rate (RR 0·38, 95% CI 0·27–0·55; high certainty),
129 and reduced need for additional uterotonics (RR 0·34, 95% CI 0·20–0·55; high certainty).[9]
130 There was also a trend towards a reduced need for blood transfusion (RR 0·78, 95% CI 0·38–
131 1·59; moderate certainty), and maternal death (RR 0·72, 95% CI 0·00–$2·9\times10^{7}$; low
132 certainty) with the ‘3-option trigger’ strategy that included the 300 mL threshold in addition
133 to the 500 mL threshold when compared with the ‘2-option trigger’.[9]
134
135 An international panel of experts, convened by the WHO, considered the evidence on
136 prognostic accuracy along with the evidence on the importance of outcomes to women and
137 health workers, resource implications and cost-effectiveness, acceptability, feasibility, and
138 impact on equity of an expanded diagnostic criteria for PPH, and formulated a new
139 recommendation for PPH diagnosis. *The Consolidated Guidelines for the Prevention,*
140 *Diagnosis and Treatment of Postpartum Haemorrhage*, therefore, recommends the diagnosis
141 of PPH and initiation of first-response treatment (see Paper 3 in the Lancet Series on
142 postpartum haemorrhage), with the following criteria: objectively measured blood loss of
143 ≥300 mL with any abnormal haemodynamic sign, or objectively measured blood loss of ≥500
144 mL, whichever occurs first within 24 hours after childbirth, and with particular vigilance in
145 the first two hours.[15] The PPH definition based on these criteria prioritises prognostic
146 sensitivity (i.e., capturing women with predicted poor outcomes) and optimises early
147 diagnosis and first-response treatment of PPH. Definitions of PPH terms used in this Series
148 are presented in the Panel and reflect commonly used classifications based on severity of

bleeding, timing of onset of bleeding, and response to treatment or need for escalation of care. There is a need to review the prognostic data underpinning these terms, and if necessary, further refine the severity spectrum so that the terms have a clear link to prognostic outcomes and treatment decisions.

Panel

Postpartum haemorrhage (PPH) terminology

By severity of bleeding

PPH

Objectively measured blood loss of ≥300 mL with any abnormal haemodynamic sign, or objectively measured blood loss of ≥500 mL, whichever happens first

Severe PPH

Objectively measured blood loss of ≥1,000 mL

Life-threatening PPH

Bleeding that has compromised a woman's condition through haemodynamic shock, collapse, or acute organ failure, necessitating immediate life-saving interventions from healthcare professionals. This is likely when objectively measured blood loss is ≥1,500 mL, but can also occur at lower levels of blood loss; for example, in a woman with severe anaemia.

By response to treatment

Refractory PPH

PPH that has not responded to the first-line treatment bundle.

By timing of onset

Primary PPH

PPH that occurs within the first 24 hours of childbirth

Secondary PPH

PPH that occurs after the first 24 hours of childbirth

Postpartum haemorrhage prevalence and numbers

Studies investigating the prevalence of PPH have shown highly variable results.[6] A key reason for the variation relates to the methods used for assessing blood loss. Subjective visual assessment of blood loss is currently the most common practice to diagnose PPH, but it misses 52% of women with PPH (pooled sensitivity 48%, 95% CI 44–53, 4 studies, 196 305 participants, moderate certainty).[8] On the other hand, objective blood loss measurement with blood collection devices, such as a calibrated blood collection drape, is far more accurate, missing only 7% of women with PPH (pooled sensitivity 93%, 95% CI 92–94, two studies, 53 762 participants, high certainty).[8]

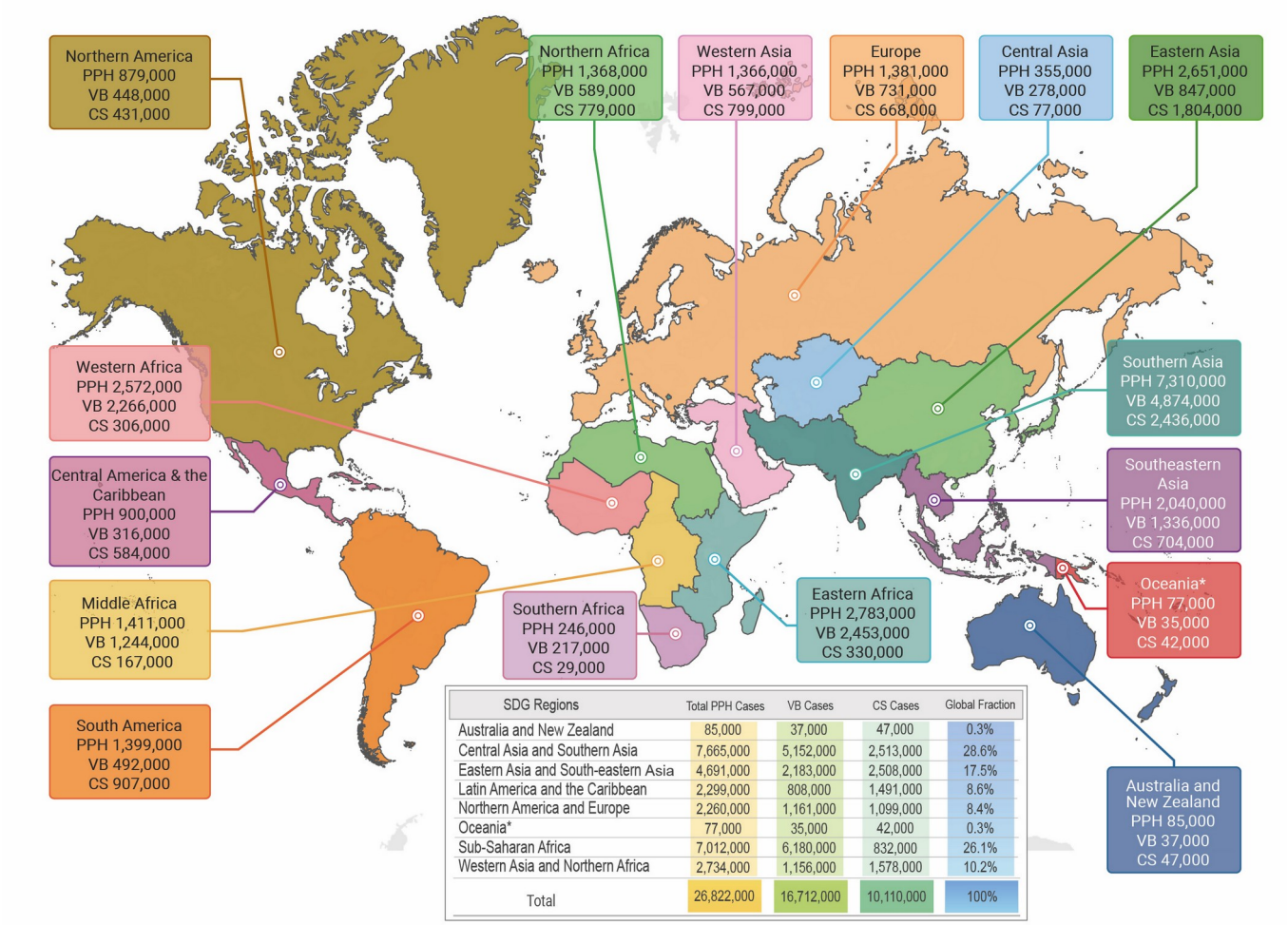
We carried out a systematic review and meta-analysis to synthesise the prevalence of PPH (defined as blood loss ≥500 mL) and severe PPH (≥1000 mL), stratified by the method of blood loss assessment, as well as mode of birth.[6] The synthesis included 81 studies, with a total of 42,709,185 women from 40 countries. The pooled prevalence of objectively diagnosed PPH (≥500 mL) at vaginal birth was 12·6% (95% CI 10·1–15·2). This was more than three-fold higher than the pooled prevalence of subjectively diagnosed PPH at vaginal birth (3·9%, 95% CI 3·0–4·9). The pooled prevalence of objectively diagnosed severe PPH (≥1,000 mL) at vaginal birth was 3·3% (95% CI 2·6–4·1), whilst the subjectively diagnosed severe PPH prevalence at vaginal birth was lower at 2·3% (95% CI 1·3–3·6).

There were limited data on objectively diagnosed PPH (≥500 mL) prevalence at caesarean birth, but modelled estimates suggested a prevalence of 30·9% (95% CrI 24·9–37·6) (supplementary appendix). The pooled prevalence of subjectively diagnosed PPH (≥500 mL) at caesarean birth was 8·2% (95% CI 3·7–14·3). The pooled prevalence of objectively diagnosed severe PPH (≥1,000 mL) at caesarean birth was 8·5% (95% CI 5·8–11·6). This was more than two-fold higher than the pooled prevalence of subjectively diagnosed severe

PPH at caesarean birth (3·7%, 95% CI 2·7–4·9). We found the prevalence of PPH and severe PPH was substantially higher with objective blood loss assessment methods for diagnosis, suggesting underestimation of blood loss and missed diagnosis of PPH with subjective assessment methods.

We used Bayesian hierarchical models to estimate global and regional numbers of PPH (supplementary appendix). The models used country-specific birth counts, country or region-specific caesarean birth rates, and global rates of objectively diagnosed PPH at vaginal and caesarean births (supplementary appendix). An estimated 27 million women experience a PPH (≥500 mL) globally every year, with 17 million (62%) at vaginal birth and 10 million (38%) at caesarean birth. The annual total of women who have PPH in each Sustainable Development Goal (SDG) region and sub-region is shown in Figure 1. Over 80% of the estimated global burden of PPH is in Asia and Africa.

Figure 1: Estimated annual postpartum haemorrhage (≥500 mL) numbers by Sustainable Development Goal regions and subregions, and mode of birth



SDG Regions	Total PPH Cases	VB Cases	CS Cases	Global Fraction
Australia and New Zealand	85,000	37,000	47,000	0.3%
Central Asia and Southern Asia	7,665,000	5,152,000	2,513,000	28.6%
Eastern Asia and South-eastern Asia	4,691,000	2,183,000	2,508,000	17.5%
Latin America and the Caribbean	2,299,000	808,000	1,491,000	8.6%
Northern America and Europe	2,260,000	1,161,000	1,099,000	8.4%
Oceania*	77,000	35,000	42,000	0.3%
Sub-Saharan Africa	7,012,000	6,180,000	832,000	26.1%
Western Asia and Northern Africa	2,734,000	1,156,000	1,578,000	10.2%
Total	26,822,000	16,712,000	10,110,000	100%

*Oceania, excluding Australia and New Zealand
SDG: sustainable development goal; PPH: postpartum haemorrhage; VB: vaginal birth; CS: caesarean section
Estimates from modelled data for 2023 (the total PPH cases in the figure slightly vary from the modelled estimates due to rounding of numbers for representation in the map).
Data derived from Bayesian hierarchical modelling (supplementary appendix, section 3.1-3.3)

Postpartum haemorrhage causes and risk factors

The causes and risk factors for PPH are subjects of debate in both the lay and scientific communities. A systematic review of qualitative literature found that in many communities, bleeding after childbirth is considered "normal" and may even be viewed as necessary to expel "impurities" and “cleanse the woman's body”.[20] Misconceptions about the causes of PPH persist, with some communities believing that PPH is caused by supernatural powers or

evil spirits that are punishing the woman for past mistakes.[20] There are also uncertainties within the scientific community about the causes and risk factors for PPH.

A systematic review to understand the various causes of and risk factors for PPH included 327 studies, consisting of 847, 413, 451 women.[7] The pooled rates of the five most common known causes of PPH were uterine atony (70·6% [95% CI 63·9–77·3]; n=834,707 women, 14 studies), genital tract trauma (16·9% [9·3–24·6]; n=18,449 women, six studies), retained placenta (16·4% [12·3–20·5]; n=235,021 women, nine studies), abnormal placentation (3·9% [0·1–7·6]; n=29,638 women, two studies), and coagulopathy (2·7% [0·8–4·5]; n=236,261, nine studies). Uterine atony may be associated with a distended uterus (e.g. multiple pregnancy, macrosomia or polyhydramnios), intrauterine infection, or prolonged labour.[21] Genital tract trauma includes lacerations to the perineum, vagina or cervix at vaginal birth, as well as uterine or cervical tears at caesarean section. Uterine rupture is a particularly serious genital tract trauma that may be linked to obstructed labour and previous uterine surgery such as a caesarean section or myomectomy. Abnormal placentation includes placenta praevia and placenta accreta spectrum. Coagulopathy may result from pre-existing medical conditions (e.g. haemophilia A, idiopathic thrombocytopenic purpura, or von Willebrand's disease) or conditions acquired in pregnancy (e.g. complicated pre-eclampsia, disseminated intravascular coagulation, or anticoagulation treatment).[21] An uncommon but serious cause of PPH is uterine inversion which is associated with fundal placentation, uterine atony, and forceful umbilical cord traction.[21]

Risk factors for PPH were organised into socio-demographic, medical, past pregnancy-related, current pregnancy-related, and childbirth-related categories (Table 2). Based on the pooled odds ratios (ORs), the risk factors were classified as having weak (OR >1 to 1·5),

moderate (OR >1·5 to 2), or strong (OR >2) association with PPH. Potentially modifiable strong or moderate risk factors include obesity, anaemia, lack of antenatal care, and unnecessary caesarean sections. Risk factors for which expert clinical care can mitigate the risk include gestational diabetes, female genital mutilation, placenta praevia, multiple pregnancy, stillbirth, and various medical conditions associated with PPH (such as hypertensive disorders and liver disease). General anaesthesia has a strong association with PPH[22] and other complications, so regional anaesthesia is generally preferable.

Table 2 Risk factors for postpartum haemorrhage

Risk factor category	Strength of association	Risk factor	OR (95% CI)
Socio-demographic	Weak (OR >1 to 1·5)	Black versus white ethnicity	1·44 (1·03 – 2·01)
		Asian versus white ethnicity	1·15 (1·04 – 1·27)
Medical	Strong (OR >2)	Anaemia	2·36 (1·29 – 4·32)
		Female genital mutilation	2·14 (1·43 – 3·20)
		Sepsis	2·31 (1·55 – 3·46)
	Moderate (OR >1·5 to 2)	BMI 30 – 34·9 vs 18·5 – 24·9 kg/m^2	1·51 (1·32 – 1·72)
		Liver disease	1·64 (1·12 – 2·42)
		COVID-19	1·85 (1·56 – 2·18)
	Weak (OR >1 to 1·5)	BMI 25 – 29·9 vs 18·5 – 24·9 kg/m^2	1·21 (1·13 – 1·30)
		Uterine fibroids	1·20 (1·06 – 1·35)
		Antidepressant use	1·47 (1·28 – 1·70)
		Asthma	1·24 (1·13 – 1·36)
		Epilepsy[23]	1·21 (1·17 – 1·25)
Past pregnancy-related	Strong (OR >2)	Previous PPH	3·17 (2·42 – 4·16)
		Grand multiparity vs nulliparity	2·62 (1·24 – 5·52)
	Moderate (OR >1·5 to 2)	Family history of PPH[24]	1·63 (1·24 – 2·14)
	Weak (OR >1 to 1·5)	Grand multiparity vs multiparity	1·48 (1·14 – 1·91)
Current Pregnancy-related	Strong (OR >2)	No antenatal care vs antenatal care	2·78 (1·78 – 4·36)
		Placenta praevia	3·10 (1·61 – 5·97)
		Resolved placenta praevia	3·35 (2·43 – 4·62)
		Stillbirth	5·39 (3·32 – 8·75)
		Multiple pregnancy	2·62 (2·14 – 3·21)
		Assisted conception vs natural conception	2·40 (2·08 – 2·76)
	Moderate (OR >1·5 to 2)	Pre-eclampsia	1·54 (1·48 – 1·60)
		Gestational diabetes	1·88 (1·16 – 3·03)
		Polyhydramnios	1·73 (1·32 – 2·28)

Childbirth-related	Strong (OR >2)	Caesarean birth	5·18 (3·42 – 7·85)
		General anaesthesia[22]	2·90 (1·90 – 4·50)
		Magnesium infusion[25]	2·02 (1·15 – 3·56)
		Prolonged second stage of labour[26]	3·40 (2·40 – 4·70)
		Shoulder dystocia	2·06 (1·67 – 2·54)
		Birthweight 4500 – 5000g vs <4000g	2·08 (1·70 – 2·54)
	Moderate (OR >1·5 to 2)	Birthweight 4000 to <4500g versus <4000g	1·67 (1·54 – 1·80)
		Episiotomy[25]	1·81 (1·56 – 2·11)
	Weak (OR >1 to 1·5)	Premature rupture of membranes (PROM) vs no PROM	1·39 (1·28 – 1·51)
		Induction of labour	1·37 (1·22 – 1·54)
		Augmentation of labour	1·28 (0·85 – 1·94)
		Instrumental birth	1·44 (1·03 – 2·00)

OR: pooled Odds Ratio (adjusted pooled odds ratios are reported, where available; otherwise, pooled crude odds ratios are reported). CI: confidence interval; BMI: Body mass index; PPH: postpartum haemorrhage.

Information sourced from Yunas et al[7], or from other sources which are identified with the superscripted references.

Consequences of postpartum haemorrhage

The consequences of PPH can extend well beyond the immediate episode of bleeding, affecting the woman, her newborn, her family, and the wider society. The consequences may be physical, psychological or social (supplementary appendix). Physical consequences include haemodynamic shock, organ dysfunction, laparotomy, hysterectomy, and mortality (Table 3). Psychological consequences include increased anxiety, postnatal depression, and post-traumatic stress disorder. The consequences on the newborn include compromised bonding and breastfeeding. If a mother dies from PPH, the consequences on the baby and any siblings are even greater. The domestic and societal consequences include diminished care for children[27] and loss of productivity.[28] Approaches to mitigate these consequences are provided in the third paper of this Lancet Series.

Table 3: Consequences of postpartum haemorrhage

	Percentage risk of the complication or consequence (95% CI)	**Risk of the consequence in women with PPH versus no PPH (95% CI)**

Immediate physical consequences		
Acute renal complications[a]	1·0 (0·5, 1·7)	
Acute respiratory complications[b]	2·2 (0·7, 4·7)	
Blood transfusion	12·3 (9·9, 15·0)	
Cardiac complications[c]	1·7 (0·4, 3·8)	aHR: 1·02 (0·97–1·07)[29] aHR: 1·96 (1·51, 2·53)[30]
Coagulopathy	3·4 (1·4, 6·3)	
Hepatic failure	0·3 (0·2, 0·4)	
Hysterectomy	2·1 (1·3, 3·1)	
ICU admission	3·3 (1·0, 6·7)	
Maternal death	1·6 (0·8, 2·6)	cOR: 5·6 (3·75, 8·37)[31]
Near-miss	18·0 (6·6, 33·3)	
Pulmonary embolism	0·3 (0·1, 0·6)	
Prolonged hospitalisation[d]	13·1 (0·0, 51·0)	
Seizure	0·4 (0·3, 0·6)	
Shock	2·9 (0·3, 7·5)	
Cerebral complications[e]	0·5 (0·0, 2·0)	
Delayed physical consequences		
Postnatal anaemia	46·3 (30·8, 62·1)	
Postnatal sepsis	0·6 (0·1, 1·6)	
Psychological consequences		
Anxiety	28·5 (0·0, 88·3)	aHR: 0·99 (0·90, 1·09[32]
Postnatal depression	15·5 (8·5, 24·2)	aHR: 1·08 (0·99, 1·17)[33] aOR: 1·68 (1·16, 2·42)[34] aOR: 1·68 (1·16, 2·42)[35]
Post -traumatic stress disorder	10·7 (3·1, 21·7)	aHR: 1·17 (0·73, 1·89)[32]
Consequences on the newborn		
Inability to exclusively breastfeed	27·8 (19·3, 37·2)	aOR: 0·88 (0·86, 0·90)[f]
Need for NICU admission	16·1 (11·9, 20·8)	

CI: confidence interval; cOR: crude odds ratio, aHR: adjusted hazard ratio; PPH: postpartum haemorrhage, ICU: intensive care unit; NICU: neonatal intensive care unit.
[a]Four of the eight studies specified the complication as renal failure.
[b]Three of the seven studies specified the complication as respiratory failure.
[c]Four of the ten studies specified the complication as heart failure, and two studies as cardiac arrest.
[d]Includes one study from a low-income country where it was estimated that at least one additional day in hospital was expected in 51·9% of women with PPH and two studies from high-income countries where it was estimated that at least 4 additional days in hospital were expected in 2·4% of women with PPH.
[e]Two of the three studies specifically reported this as stroke.
[f]Women with PPH were less likely to be exclusively breastfeeding their babies compared to those without PPH.
Information from a systematic review conducted by the Series authors (supplementary appendix, Figure S11: A-C), or from other sources which are identified with the superscripted references.

Anaemia, one of the common complications of PPH, has many downstream consequences. These include tiredness, cognitive impairment, depression, and susceptibility to infection, as

well as complications in a future pregnancy, including PPH, low birth weight, preterm birth, pre-eclampsia, stillbirth, and neonatal death.[36,37]

Pregnancy-related acute kidney injury (PR-AKI) can be a serious consequence of obstetric haemorrhage, pre-eclampsia or sepsis.[38] The majority of women with PR-AKI will need haemodialysis and intensive care unit management, and 10 to 47% of women may not have renal recovery after PR-AKI.[38]

An estimated 43,000 women die from PPH each year, with 27,000 (63%) deaths occurring at vaginal birth and 16,000 (37%) at caesarean birth (Figure 2; supplementary appendix). This translates to one PPH death every 12 minutes. An estimated 79% of PPH deaths occur within the first 24 hours after childbirth.[39] Two SDG regions contribute to an estimated 89% of total PPH deaths: Sub-Saharan Africa 74% and Central and Southern Asia 16% (Figure 3). Two continents, Africa and Asia, contribute to an estimated 98% of total PPH deaths. The women who are at particularly high risk of dying from PPH are identified in the Panel below.

Figure 2: Estimated annual postpartum haemorrhage deaths by Sustainable Development Goal (SDG) regions and mode of birth

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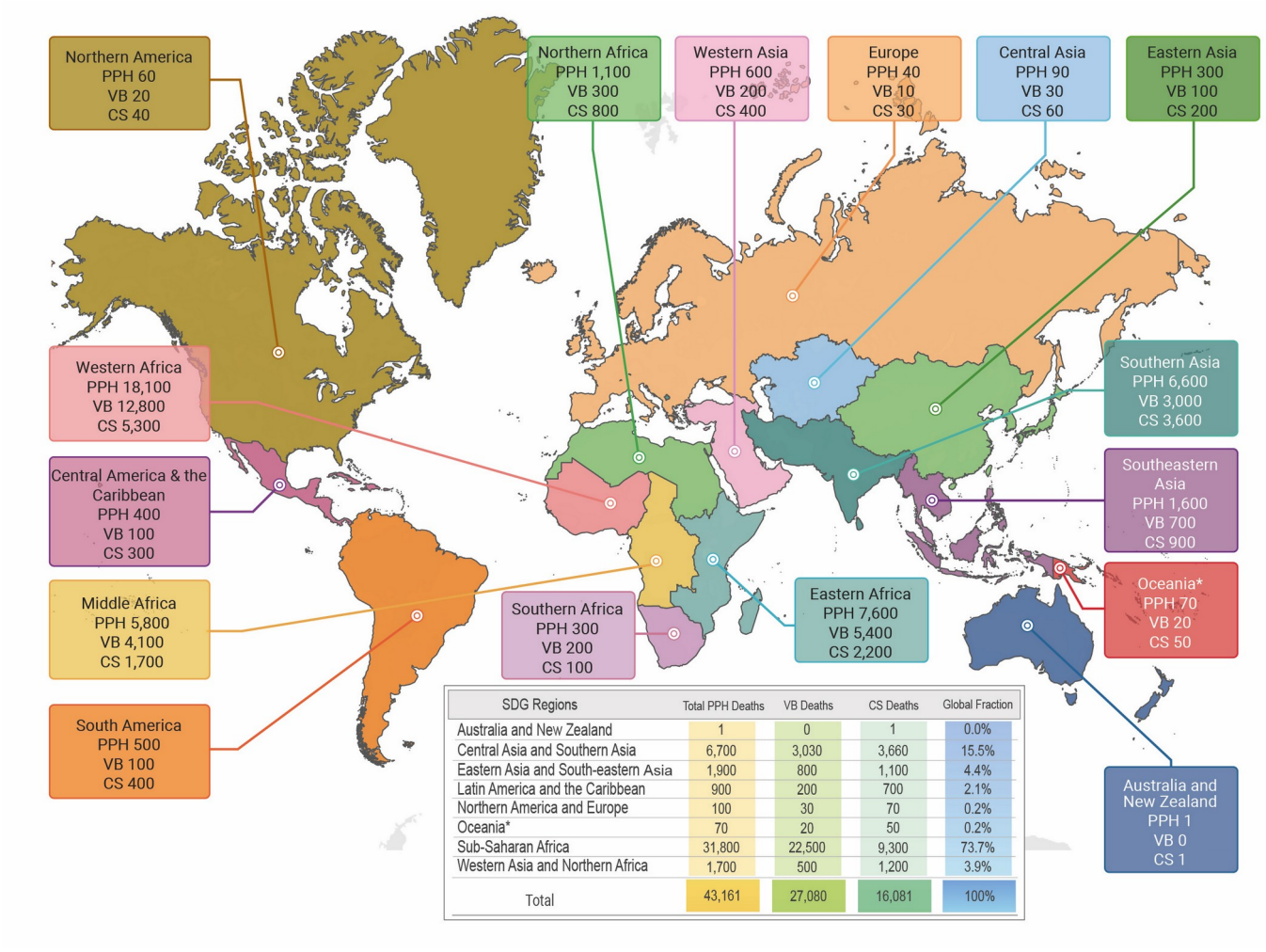


SDG Regions	Total PPH Deaths	VB Deaths	CS Deaths	Global Fraction
Australia and New Zealand	1	0	1	0.0%
Central Asia and Southern Asia	6,700	3,030	3,660	15.5%
Eastern Asia and South-eastern Asia	1,900	800	1,100	4.4%
Latin America and the Caribbean	900	200	700	2.1%
Northern America and Europe	100	30	70	0.2%
Oceania*	70	20	50	0.2%
Sub-Saharan Africa	31,800	22,500	9,300	73.7%
Western Asia and Northern Africa	1,700	500	1,200	3.9%
Total	43,161	27,080	16,081	100%

*Oceania, excluding Australia and New Zealand
SDG: sustainable development goal; PPH: postpartum haemorrhage; VB: vaginal birth; CS: caesarean section
Estimates from modelled data for 2023 (the total PPH deaths in the figure slightly vary from the modelled estimates due to rounding of numbers for representation in the map)
Data derived from Bayesian hierarchical modelling (supplementary appendix, section 3.1-3.3)

Panel: Who dies from postpartum haemorrhage?

Maternal death reviews, of which the most comprehensive are confidential enquiries into maternal deaths, provide detailed information on maternal deaths, including cause(s), contributory factors, context and the quality of care received.[40] Several countries periodically publish their maternal death review reports, often identifying elements of substandard care and providing recommendations for improvements.[41] A systematic evidence synthesis of maternal death review reports from countries where maternal death rates are high showed several common themes on causes, contributory factors, quality of care provided, and outcomes of PPH.[42,43] Women who are most likely to die from PPH are those who have home births, those with anaemia or pre-existing medical problems, those who have a caesarean birth, particularly emergency caesarean at full cervical dilation, and those delivering in healthcare settings with staffing challenges.[7,44-46] Delayed identification of PPH and delayed initiation of PPH treatment were particular problems for women who died from PPH. Substandard care was reported in 50 - 75% of women who died from PPH.[43,47] Lessons from South Africa which has robust triennial Confidential Enquiries into Maternal Deaths show that 86% of the obstetric haemorrhage deaths are possibly or probably avoidable.[48] Patient-related avoidable factors, mostly delays in seeking care, were present for 35% of women who died. Avoidable health service factors were observed in 70% of deaths, including lack of blood for transfusion (8·5%), delays in inter-institutional transport (11·4%), delays in initiating clinical care due to overburdened services (12·2%), lack of staff (13·4%), and lack of staff with appropriate skill (18·5%). Significant problems were identified with initial assessment and PPH recognition at community healthcare centres and district hospitals. Many women were discharged from labour ward to postnatal ward with abnormal vital signs and unrecognized PPH. At all levels of care, substandard care was the most frequent problem.

Key recommendations from maternal death reviews target women, communities, healthcare providers and policy makers.[41,42] The recommendations targeting women and communities include promotion of facility births assisted by skilled birth attendants; those targeting healthcare providers include improving timely decision making in managing obstetric complications such as PPH; and those targeting policy makers include wider health system level interventions that ensure adequate numbers of competent staff, quality-assured essential medicines, effective clinical governance and risk management systems, and sustained funding.[42,49] These recommendations are further explored in the second and third papers in this Series.

Economic cost of postpartum haemorrhage

PPH has substantial economic implications for health systems and society. For health systems, women experiencing PPH may require medical procedures that have resource implications, while for society there are economic costs associated with PPH-attributable morbidity and mortality, including potentially catastrophic levels of spending required by patients.

We estimated the annual global economic burden of PPH for health systems using an ingredients-based approach, based on the different medical procedures required for PPH management, their frequency of occurrence, and associated unit costs (e.g. additional oxytocin, tranexamic acid, blood transfusion, uterine tamponade, hysterectomy, transfer to higher level facilities, or ICU admission) (supplementary appendix). Unit costs were estimated separately for low- and middle-income countries (LMIC) and high-income countries (HIC). Costs were estimated for one year (2023) in US$ (supplementary appendix).

We used a value of statistical life year approach to assess the burden of PPH on society by estimating the annual global economic burden of PPH-attributable disability-adjusted life years (DALYs). The analysis estimated total years of life lost due to a single year (2023) of PPH mortality, based on country-specific female health-adjusted life expectancy at mean age of pregnancy. For non-fatal PPH, disutility weights for either ‘PPH ≥ 1000 mL’ or ‘PPH < 1000 mL’ were assigned for a period of six weeks. DALYs were valued at average Gross Domestic Product per capita, weighted across countries according to PPH DALY burden, with 3% per annum discounting applied to future years of life lost.

In 2023, the global economic burden of PPH was estimated to be US$3·6 billion ($3·2–6·2 billion) to health systems and US$6·8 billion (6·2–7·5 billion) to society, totalling US$10·4 billion ($9·8–13·2 billion).

Challenges and missed opportunities

The PPH prevalence in low-, middle-, and high-income countries is similar[6], but the case fatality rate from PPH in low-income countries is disproportionately high (supplementary appendix, figure S12). The likelihood of death from PPH can be more than 200-fold higher in low-income countries when compared with high-income countries (supplementary appendix, figure S12). This vast health disparity, whilst unacceptable, does show reduction in PPH deaths is possible. In this Series, we identify missed opportunities, which can be pivoted to golden opportunities to create global impact (Figure 3). The missed opportunities exist along the life-course of a woman, and are rooted in the broader underlying determinants of health, i.e., social, economic, political, legal, environmental, and structural factors that affect health-seeking behaviour, access to and quality of care, and thereby, maternal health outcomes.[46] Lack of autonomy or funds may hinder a woman from seeking contraception, antenatal care or facility birth. Long distance and travel time to a health facility may worsen the outcomes for a woman bleeding after homebirth. Perverse financial incentives, rather than genuine clinical need, may drive up the caesarean birth rate. The missed opportunities we present should be understood in the context of the broader determinants of health.

The missed opportunities can be grouped into those that relate to menstrual health, sexual and reproductive health, pre-pregnancy, pregnancy, labour and childbirth, intra-hospital postpartum and post-discharge periods (Figure 3). Anaemia increases the risk of PPH[7] and PPH deaths.[50] Malnutrition, heavy menstrual bleeding, malaria, and parasitic infections in

endemic zones are significant causes of anaemia, and thus addressing these during adolescence, pre-pregnancy, pregnancy and postpartum periods are discussed in the second paper of the Series. Women who avoid unintended pregnancies by accessing contraception can circumvent pregnancy complications such as PPH, and thus addressing the unmet need for contraception is an important strategy to reduce PPH deaths, again discussed in the second paper. Robust PPH risk assessment and risk mitigation in the pre-pregnancy, pregnancy, labour and childbirth and postpartum periods are addressed in the second and third papers of the Series. Regular antenatal care, access to obstetric ultrasound, quality-assured essential medicines, adequate equipment and infrastructure, and well-trained and supported staff are fundamental to improving outcomes.[49] For example, the absence of an ultrasound service could mean missing the diagnosis of multiple pregnancies or placenta praevia, and thus a missed opportunity to improve PPH outcomes for women with these conditions.

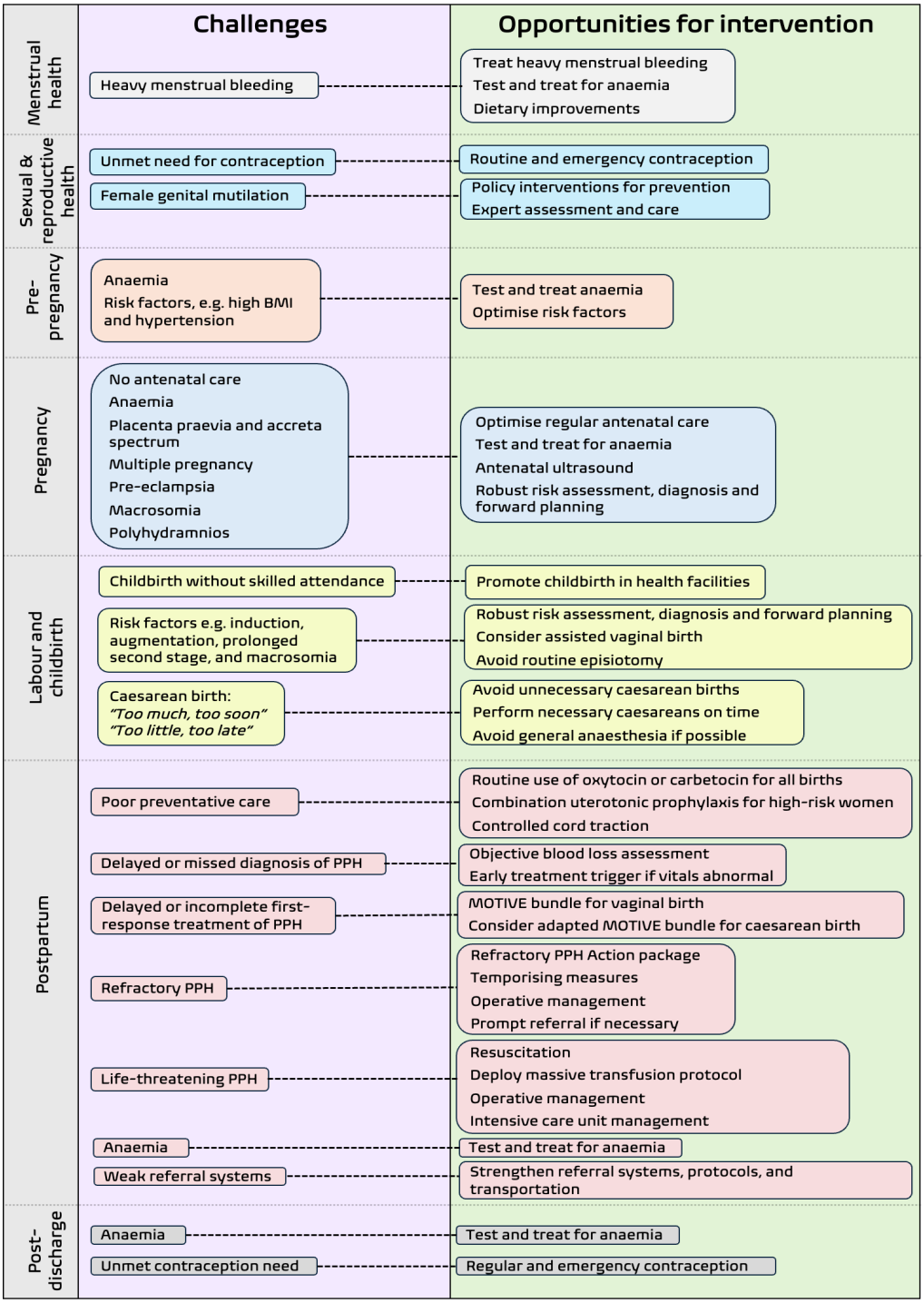
Caesarean section can be a life-saving intervention, but there is the vexing problem of inappropriate caesarean sections (both ‘too much, too soon’ and ‘too little, too late’). This is addressed in the third paper of the Series. Many countries have limited provisions for assisted vaginal birth, and this represents a missed opportunity as vacuum or forceps birth could reduce the need for caesarean section and the associated high risk of PPH, as well as future risk of placenta accreta spectrum.

The immediate postpartum period, particularly the first two hours after childbirth, presents a critical period to improve PPH outcomes. The key opportunities in the immediate postpartum period include provision of routine uterotonic prophylaxis for all births, accurate and early

diagnosis of PPH using objective blood loss assessment devices, early and prompt first-response treatment such as the use of treatment bundles, and rapid escalation for refractory and life-threatening PPH management; we discuss these in the second and third papers of the Series. Finally, the postpartum and post-discharge periods offer important touchpoints to correct anaemia, provide contraception, and advise on an appropriate inter-pregnancy interval that is essential for the health of the woman, and her current and future offspring.[51]

An important lens when we consider the missed opportunities for reducing adverse outcomes of PPH is the "three delays" model.[52] The first delay – in deciding to seek care - can be addressed through strategies such as effective antenatal care, birth preparedness and community awareness raising. The second delay – in reaching a health facility - can be mitigated through the provision of transportation for women in remote settings, maternity waiting homes, effective referral pathways and improvements in public transport infrastructure. The third delay - in receiving effective care once at as facility - is discussed in detail in paper 3 of the series.

Figure 3: Challenges and opportunities to reduce postpartum haemorrhage morbidity and mortality



Discussion

Postpartum haemorrhage affects a woman every 1·2 seconds; it kills a mother every 12 minutes. PPH can occur at both vaginal and caesarean births, but the prevalence of PPH at caesarean birth is approximately twice the prevalence of PPH at vaginal birth. The likelihood

of death when a woman has a PPH at caesarean birth is more than twice the likelihood of death for a woman who has a PPH at vaginal birth (supplementary appendix).

Whilst the risk of having a PPH does not vary much between low-, middle-, and high-income countries, the risk of death from PPH, i.e., the case fatality rate, varies dramatically by resource level. The PPH case fatality rate can be more than 200-fold higher in low-income countries compared with high-income countries. PPH outcomes are strong markers of health inequity, not just between regions, but also between and within countries. The reasons for inequity in PPH outcomes may be related to long-standing neglect of women's wellbeing and under-resourced health services (for example, lack of quality essential drugs and equipment; inadequate staffing, training and support; lack of blood and blood products; and inequitable access to advanced surgery and intensive care facilities).[49] Poor PPH outcomes reflect multi-level intersectional gender and sociodemographic inequalities. Women are more likely to live in poverty, have limited autonomy in health-related decision making[53], and face chronic nutritional disadvantage, contributing directly to adverse PPH outcomes through, for example, iron-deficient anaemia.[54] Moreover, chronic underinvestment[55,56] in maternal health is indicative of broader neglect of 'women's issues' in global health, reflecting longstanding disregard for women's rights.[57]

Two central approaches to mitigate the risk of PPH deaths in women are addressing key risk factors, particularly anaemia and unnecessary caesarean births, and improving early diagnosis and timely management of PPH, before complications such as haemodynamic shock or clotting derangement set in. The updated WHO definition of PPH provides a way forward for early diagnosis and intervention. Accurate measurement of blood loss using objective methods, such as a calibrated blood collection drape, and regular assessment of

haemodynamic signs in the immediate postpartum period are essential to apply the updated WHO definition in practice.

Knowledge about the causes of PPH, atony, retained tissue, abnormal placentation, trauma, and clotting abnormalities, as well as multiple causes acting concurrently, can help guide management. These causes of PPH are shared by both vaginal and caesarean births, but the likelihood of each of the causes being present in a given woman varies by the mode of birth and other clinical and contextual factors. For example, a caesarean section for prolonged labour and impacted fetal head can result in not only atonic PPH, but also PPH from tear of the uterine angles at the time of the delivery of the impacted fetal head. A woman arriving at a facility with obstructed labour may have PPH related to ruptured uterus. If treatment of atony does not resolve the PPH, other causes such as concealed trauma (e.g. cervical tear), retained tissues, and clotting abnormalities should be suspected. Finally, placenta accreta spectrum as a cause of PPH should be considered in any woman who has had a previous caesarean section. We have systematically reviewed the risk factors for PPH, and address these in detail in the second paper of the Series.

An important limitation in several existing studies is that PPH diagnosis was often based on subjective visual estimation of blood loss and with the use of traditional blood loss thresholds. In individual studies exploring risk factor associations, as the blood loss assessment method and the definition of PPH used were consistent between the exposed (e.g., women with anaemia) and the unexposed (e.g., women without anaemia) groups, the elicited associations are expected to be valid. However, we acknowledge for studies reporting the prevalence and consequences of PPH, how PPH was diagnosed (subjective vs objective) and what definition was used would have affected the reported rates. Furthermore, the rates of

consequences are also highly sensitive to case-mix, definitions of outcomes, time horizon over which outcomes were ascertained, and study design.

The physical, psychological and economic consequences of PPH are substantial. Psychological consequences have been neglected in clinical practice and research, but could have long-term impact. The short-term direct economic burden of PPH is a staggering US$ 3·6 billion per year globally. A conservative estimate for societal cost comes to US$ 6·8 billion, giving a total annual global cost of US$ 10.4 billion (supplementary appendix – economic burden of PPH). A limitation here is the absence of patient level cost data. Our estimates do not include direct out-of-pocket or indirect costs borne by women and their families, reflecting limited data availability rather than lack of importance. These costs can be substantial, and their exclusion is likely to underestimate the true economic burden of PPH. Omitting patient borne costs risks biasing economic evaluations towards services that shift costs onto patients. There is a need for more robust and standardised data on patient costs across settings. Further, long-term costs are unknown, but could add substantially to the total annual cost. However, the annual investment in research and PPH programmes remains a small fraction of the total economic cost of PPH. The Roadmap for PPH has identified research, programmatic and advocacy priorities; urgent investment is needed to achieve the goals set out in the PPH Roadmap.[14]

A health system perspective, that pays attention to workforce, supply chain, infrastructure, continuous quality improvement, financing and governance, is critical to improving PPH care and outcomes. Maintaining an effective workforce, by empowering midwives to diagnose and treat PPH, task-sharing, providing on-site inter-professional training and drills, and

ensuring adequate staffing and availability of specialists, e.g., anaesthetists and haematologists when needed, is essential to provide high-quality care. Standardization of care, for example with the MOTIVE bundle or massive transfusion protocols (MTPs) will ensure consistently effective care. Supply chain issues such as cold-chain maintenance for oxytocin, provision of essential drugs and supplies such as blood collection drapes, and an effective blood bank service need to be carefully monitored and remedied to avoid stock-outs. Infrastructure issues that need attention include emergency transport, including between facility transfers, an obstetric ultrasound service, and the availability of a well-functioning operating theatre for emergencies. Quality improvement and governance should include accountability systems, as well as regular audits, near-miss reviews, targeted problem-solving and effective healthcare management and leadership.

Gaps exist at various phases in the life-course of a woman to improve pregnancy outcomes, and specifically PPH outcomes. Identifying the specific areas of missed opportunities within these gaps in a woman's menstrual health, sexual health, pre-pregnancy, pregnancy, labour and childbirth, postpartum and post-discharge periods is essential in addressing the overall burden of PPH globally. The adoption of a standardised definition for PPH, objective measurement of blood loss enabling accurate and early detection of PPH, use of a treatment bundle, escalation in those with prolonged bleeding and working on potential areas within missed opportunities to prevent PPH remain central in reducing the burden of PPH globally.

Contributors

AC and OTO drafted the structure of the paper and the first draft of text, tables, and figures. NP and MJP were the main contributors to the 'Postpartum haemorrhage prevalence and numbers' section and were responsible for the data modelling analysis. IY was the main

contributor to the ‘Postpartum haemorrhage causes and risk factors’ section. KNS was the main contributor to the ‘Consequences of postpartum haemorrhage’ section. AA was responsible for the production of Figures 1 and 2. KNS and AJD were responsible for the production of Table 1 and Figure 3. All co-authors 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 co-authored in this Series.

Declaration of interests

IDG and OTO were members of the WHO Steering Group that oversaw the development of the WHO-FIGO-ICM *Consolidated Guidelines for the Prevention, Diagnosis and Treatment of Postpartum Haemorrhage*. The other authors declare no competing interests.

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