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Original article

Postpartum haemorrhage management, risks, and maternal outcomes: findings from the World Health Organization Multicountry Survey on Maternal and Newborn Health

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Objective To explore the clinical practices, risks, and maternal outcomes associated with postpartum haemorrhage (PPH).

Design Secondary analysis of cross-sectional data.

Setting A total of 352 health facilities in 28 countries.

Sample A total of 274 985 women giving birth between 1 May 2010 and 31 December 2011.

Methods We used multivariate logistic regression to examine factors associated with PPH among all births, and the Pearson chi-square test to examine correlates of severe maternal outcomes (SMOs) among women with PPH. All analyses adjust for facility- and country-level clustering.

Main outcome measures PPH, SMOs, and clinical practices for the management of PPH.

Results Of all the women included in the analysis, 95.3% received uterotonic prophylaxis and the reported rate of PPH was 1.2%. Factors significantly associated with PPH diagnosis included age, parity, gestational age, induction of labour, caesarean section, and geographic region. Among those with PPH, 92.7% received uterotonics for treatment, and 17.2% had an SMO. There were significant differences in the incidence of SMOs by age, parity, gestational age, anaemia, education, receipt of uterotonics for prophylaxis or treatment, referral from another facility, and Human Development Index (HDI) group. The rates of death were highest in countries with low or medium HDIs.

Conclusions Among women with PPH, disparities in the incidence of severe maternal outcomes persist, even among facilities that report capacity to provide all essential emergency obstetric interventions. This highlights the need for better information about the role of institutional capacity, including quality of care, in PPH-related morbidity and mortality.

Keywords Maternal death, maternal near miss, postpartum haemorrhage, quality of care, uterotonics.

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Introduction

Postpartum haemorrhage (PPH) is a major cause of maternal morbidity and mortality, accounting for about one-third of all pregnancy-related deaths in Africa and Asia.[1] Primary PPH is typically defined as bleeding from the genital tract of 500 ml or more in the first 24 hours following delivery of the baby.[2] The incidence of PPH in observational studies is believed to be around 6%, although this can vary somewhat by geographic region and delivery setting.[3] Severe morbidities associated with PPH include anaemia, disseminated intravascular coagulation, blood transfusion, hysterectomy, and renal or liver failure.[4,5]

Only about one-third of PPH cases have identifiable risk factors. These are believed to include: a history of prior PPH;[6,7] nulliparity;[6,8,9] overdistended uterus (e.g. caused by multiple gestations or a large baby);[6,7,10–13] placental abnormalities, such as placenta praevia or placenta accreta;[11]

coagulation abnormalities;[7,13] anaemia;[8,13] induction of labour, augmentation of labour, or use of an epidural;[6,7,9–12] and prolonged labour.[6,7,9,10] In spite of speculation to the contrary, high multiparity does not appear to be a risk factor.[8,11,14] There are also no known risk factors to help predict which women will fail to respond to treatment with conventional uterotonics.[15]

Uterine atony, or failure of the uterus to contract after delivery, is the most common cause of PPH.[3,5,16] The prophylactic administration of a uterotonic has been shown to reduce the incidence of PPH through inducing uterine contractions.[17–19] Oxytocin is considered the gold standard for prophylaxis,[20] although ergometrine, methergyne, and misoprostol are also frequently used. When uterine atony occurs, the timely administration of a uterotonic drug is recommended.[20,21] Uterotonic treatment can help prevent the need for more sophisticated interventions, such as the administration of intravenous fluids, additional drug therapy, blood transfusion, and surgical intervention.

Although PPH occurs in all settings and all geographic regions, the majority of maternal deaths as a result of PPH take place in developing countries. This disparity has been attributed to differences in quality of care, including the availability of trained personnel attending deliveries, access to quality uterotonic drugs, and the timely receipt of needed interventions when obstetric emergencies arise.[22] Yet disparities in severe maternal outcomes (SMOs) also occur within higher level health facilities. In the recent World Health Organization (WHO) Multicountry Survey that documented the incidence of maternal morbidity and mortality at health facilities globally, PPH accounted for 27% of all deliveries with an SMO.[23] The aim of this analysis, therefore, was to explore the clinical practices, risks, and maternal outcomes associated with PPH.

Methods

Survey methodology

Data for this secondary analysis were derived from the WHO Multicountry Survey on Maternal and Newborn Health. This cross-sectional survey was implemented in 359 health facilities in 29 countries, and included 314 623 births. Health facilities were considered eligible if they recorded at least 1000 deliveries annually and had the capacity to provide caesarean section. Most of the facilities in this survey had also participated in the prior WHO Global Survey on Maternal and Perinatal Health (2004–2008).[24] Countries, provinces (or other equivalent political divisions within countries), and health facilities were randomly selected through a stratified, multistage cluster sampling strategy.

Data were collected on individuals and institutions between 1 May 2010 and 31 December 2011. Information on individuals was obtained from analysis of hospital records for all women giving birth and all women with SMOs who received services at participating health facilities during the data collection period. The data collected included: demographic and reproductive characteristics for all eligible women; information about their pregnancy and childbirth status, complications, and receipt of related interventions; and the health outcomes of the women and, if applicable, their newborn babies. Institutional data were provided by participating facilities through the completion of institutional data forms that provided information about available obstetric and newborn care services. The study protocol and other details of the data collection, entry, and cleaning procedures for this survey have been reported elsewhere.[23,25]

Statistical analysis

A total of 274 985 women attending 352 health facilities in 28 countries were included in this analysis. We excluded all 2987 participants from Japan, as it was one of only two participating countries that was categorised as 'developed', and it had an atypically high incidence of PPH. We also excluded 39 141 women who had caesarean sections before labour, and 1421 others whose mode of delivery was either unknown or who had induced terminations of pregnancy or laparotomy for ectopic pregnancy.

We used frequencies to examine PPH among all births, SMOs among women with PPH, and clinical practices for the management of PPH. We used multivariate logistic regression to examine factors associated with PPH among all births and Pearson's chi-square test to examine correlates of SMOs among women with PPH. We adjusted all analyses using the 'svy' procedure in STATA 11.2 to account for clustering at the levels of the health facility (primary sampling unit) and country (strata). Severe maternal outcomes were defined as the occurrence of either a maternal death or a maternal near miss within 7 days of giving birth or having an abortion. Maternal near miss was defined as the survival of a life-threatening condition based on standard markers of organ dysfunction.[26] P values < 0.05 were considered significant.

Results

Figure 1 summarises the PPH-related outcomes of survey participants. Overall, 1.2% of all women giving birth were

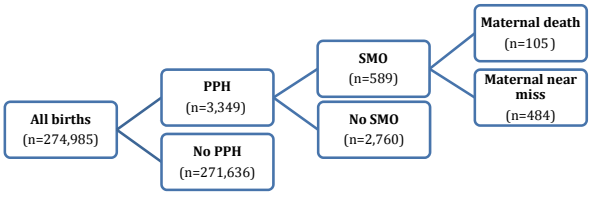

Figure 1. Flow chart of survey participants and PPH outcomes.

Table 1. Maternal, delivery, and institutional characteristics by incidence of postpartum haemorrhage

	PPH (n = 3349)	No PPH (n = 271,636)
Maternal		
Age		
Data available	3346	267,952
<20 years	340 (10.2)	29,788 (11.1)
20–34 years	2458 (73.5)	209,265 (78.1)
≥35 years	548 (16.4)	28,899 (10.8)
Marital status		
Data available	3286	265,473
With partner	2975 (90.5)	237,433 (89.4)
Without partner	311 (9.5)	28,040 (10.6)
Education		
Data available	3349	271,636
<5 years	670 (20.0)	53,213 (19.6)
5–8 years	638 (19.1)	58,914 (21.7)
9–11 years	818 (24.4)	62,266 (22.9)
>11 years	1223 (36.5)	97,243 (35.8)
Number of previous births		
Data available	3348	268,263
0	1379 (41.2)	113,185 (42.2)
1 or 2	1212 (36.2)	109,431 (40.8)
3+	757 (22.6)	45,647 (17.0)
Gestational age at delivery		
Data available	3232	265,637
<37 weeks	552 (17.1)	19,018 (7.2)
37–41 weeks	2604 (80.6)	242,369 (91.2)
>41	76 (2.4)	4250 (1.6)
Delivery		
Onset of labour		
Data available	3290	270,968
Spontaneous	2727 (82.9)	239,073 (88.2)
Induced	563 (17.1)	31,895 (11.8)
Mode of delivery		
Data available	3312	268,664
Vaginal	2477 (74.8)	218,061 (81.2)
caesarean Section	835 (25.2)	50,603 (18.8)
Institutional		
Self-reported facility location		
Data available	3135	251,338
Urban	2662 (84.9)	211,602 (84.2)
Peri-urban	338 (10.8)	26,336 (10.5)
Rural	135 (4.3)	13,400 (5.3)
Referred from another facility		
Data available	3349	271,636
Yes	248 (7.4)	1228 (0.5)
No	3101 (92.6)	270,408 (99.6)
HDI group		
Data available	3349	268,809
Very high	164 (4.9)	11,124 (4.1)
High	687 (20.5)	54,811 (20.4)
Medium	1060 (31.7)	89,334 (33.2)
Low	1438 (42.9)	113,540 (42.1)
Geographic region		
Data available	3349	268,809
Africa	970 (29.0)	69,240 (25.8)
Asia	1571 (46.9)	137,716 (51.2)
Latin America and the Caribbean	602 (18.0)	53,822 (20.0)
Middle East	206 (6.2)	8031 (3.0)

Data are n (%). Percentages have been rounded.

diagnosed with PPH. The maternal, delivery, and institutional characteristics of survey participants by incidence of PPH is shown in Table 1. In general, women with PPH tended to be slightly older, of higher parity, and with pregnancies of lower gestational age than women without PPH. They were also more likely to receive labour induction and caesarean section, and to have been referred from another health facility. There were few notable institutional differences in PPH incidence, with the exception of geographic region, for which Africa and the Middle East were slightly over-represented, as compared with non-PPH cases, whereas Asia, Latin America and the Caribbean were slightly under-represented.

Table 2 presents the characteristics of study participants according to receipt of uterotonic prophylaxis. Overall, 95.3% of women received uterotonics for the prevention of PPH. There were some differences in prophylactic coverage by age, marital status, and parity. Those who did not receive uterotonic prophylaxis tended to be younger, of higher parity, and were more likely to be single than those who received prophylaxis. Figure 2 summarises prophylaxis practices by type of uterotonic for women with and without PPH. About 5% of all women did not receive prophylaxis; among those who did, oxytocin was the most common uterotonic provided. The provision of oxytocin alone, however, was significantly more common among those with no PPH (72 versus 56%), whereas those diagnosed with PPH were nearly twice as likely to have received more than one uterotonic for prophylaxis (35 versus 19%).

Table 3 presents results from a logistic regression analysis of the predictors of PPH diagnosis. Factors associated with increased adjusted odds of PPH diagnosis included: age ≥35 years (OR 1.42; 95% CI 1.26–1.60); nulliparity (OR 1.12; 95% CI 1.01–1.25); parity of three or more (OR 1.32; 95% CI 1.09–1.59); gestational age at delivery of <37 weeks or >41 weeks, as compared with 37–41 weeks

Table 2. Maternal, delivery, and institutional characteristics by receipt of uterotonic prophylaxis

	Any uterotonic for prophylaxis (*n* = 259,145)	No uterotonic for prophylaxis (*n* = 12,653)	*P*
Maternal			
Age			
Data available	258,388	12,557	0.0060
<20 years	28,217 (10.9)	1850 (14.7)	
20–34 years	202,115 (78.2)	9351 (74.5)	
≥35 years	28,056 (10.9)	1356 (10.8)	
Marital status			
Data available	256,023	12,446	0.0213
With partner	229,762 (89.7)	10,381 (83.4)	
Without partner	26,261 (10.3)	2065 (16.6)	
Education			
Data available	259,145	12,653	0.0828
<5 years	50,907 (19.6)	2923 (23.1)	
5–8 years	56,093 (21.7)	3412 (27.0)	
9–11 years	60,398 (23.3)	2647 (20.9)	
>11 years	91,747 (35.4)	3671 (29.0)	
Number of previous births			
Data available	258,730	12,578	0.0183
0	109,665 (42.4)	4787 (38.1)	
1–2	105,555 (40.8)	4981 (39.6)	
3+	43,510 (16.8)	2810 (22.3)	
Delivery			
Onset of labour			
Data available	258,686	12,454	0.8094
Spontaneous	227,998 (88.1)	11,060 (88.8)	
Induced	30,688 (11.9)	1394 (11.2)	
Mode of delivery			
Data available	259,119	12,526	0.0875
Vaginal	211,121 (81.5)	9133 (72.9)	
Caesarean section	47,998 (18.5)	3393 (27.1)	
Institutional			
Self-reported facility location			
Data available	240,366	11,132	0.9032
Urban	202,202 (84.1)	9544 (85.7)	
Peri-urban	25,366 (10.6)	1026 (9.2)	
Rural	12,798 (5.3)	562 (5.1)	
Referred in from other facility			
Data available	259,145	12,653	0.0610
Yes	1297 (0.5)	133 (1.1)	
No	257,848 (99.5)	12,520 (99.0)	
Human development index group			
Data available	259,145	12,653	0.0631
Very high	10,945 (4.2)	329 (2.6)	
High	51,569 (19.9)	3894 (30.8)	
Medium	87,928 (33.9)	2445 (19.3)	
Low	108,703 (42.0)	5985 (47.3)	
Geographic region			
Data available	259,145	12,653	0.0993
Africa	65,629 (25.3)	4306 (34.0)	
Asia	134,143 (51.8)	5112 (40.4)	
Latin America and the Caribbean	51,188 (19.8)	3183 (25.2)	
Middle East	8185 (3.2)	52 (0.4)	

Data are *n* (%). Percentages have been rounded. We used Pearson's chi-square test to test for differences between groups. All tests were adjusted for clustering at the levels of the health facility and country.

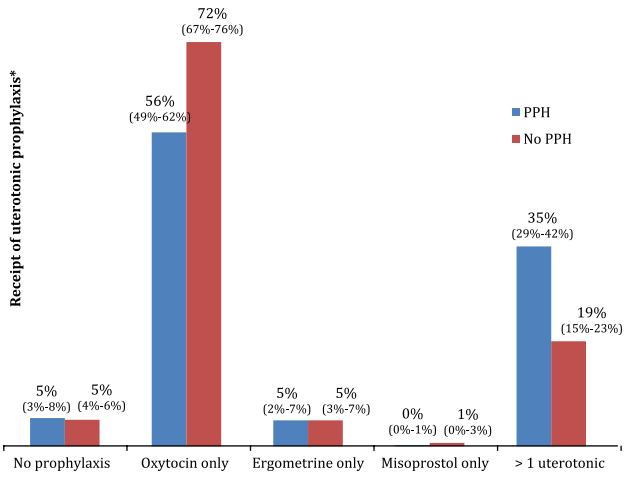

Figure 2. Receipt of uterotonic prophylaxis by incidence of postpartum haemorrhage. *95% confidence intervals are in parentheses.

(respective ORs were 2.63; 95% CI 2.28–3.04 and 1.56; 95% CI 1.02–2.38); induction of labour (OR 1.55; 95% CI 1.20–2.00); caesarean section (OR 1.46; 95% CI 1.20–1.79); and residence in the Middle East as compared with Africa (OR 1.79; 95% CI 1.20–2.67).

As shown in Figure 1, 17.6% of PPH events resulted in an SMO: 14.5% were considered near misses involving some marker of organ dysfunction, and 3.1% resulted in maternal death. Table 4 summarises PPH treatment practices by severity of maternal outcome. Close to 93% of all PPH cases received uterotonics for the treatment of PPH, 32.5% received blood products, and 23.1% received therapeutic intravenous antibiotics. Other, less frequently reported interventions included the removal of retained products of conception, manual placental removal, laparotomy, artery ligation/embolisation, and balloon/condom tamponade. As might be expected, the provision of most interventions was considerably higher among women with SMOs, about two-thirds of whom received blood products and one-quarter of whom received massive transfusion and/or hysterectomy.

Table 5 summarises the correlates of SMOs among women with PPH. There were significant differences by demographics [age, education, and Human Development Index (HDI) group] as well as clinical variables (parity, gestational age at delivery, anaemia, receipt of uterotonic prophylaxis, and receipt of uterotonics for the treatment of PPH). As might be expected, the incidence of SMOs was

Table 3. Factors associated with postpartum haemorrhage: logistic regression results

	PPH diagnosed			
	Crude OR (95% CI)	***P***	**Adjusted OR (95% CI)**	***P***
Age				
<20 years	0.97 (0.82–1.16)	0.749	0.96 (0.81–1.14)	0.664
20–34 years	Ref.	–	Ref.	–
≥35 years	1.61 (1.43–1.83)	0.000	1.42 (1.26–1.60)	0.000
Number of previous births				
0	1.10 (0.99–1.22)	0.065	1.12 (1.01–1.25)	0.038
1–2	Ref.	–	Ref.	–
3+	1.50 (1.28–1.75)	0.000	1.32 (1.09–1.59)	0.005
Gestational age				
<37 weeks	2.70 (2.33–3.13)	0.000	2.63 (2.28–3.04)	0.000
37–41 weeks	Ref.	–	Ref.	–
>41 weeks	1.66 (1.08–2.57)	0.021	1.56 (1.02–2.38)	0.039
Onset of labour				
Spontaneous	Ref.	–	Ref.	–
Induced	1.55 (1.17–2.05)	0.002	1.55 (1.20–2.00)	0.001
Caesarean section	1.45 (1.21–1.75)	0.000	1.46 (1.20–1.79)	0.000
Geographic region				
Asia	0.81 (0.61–1.09)	0.167	0.82 (0.60–1.12)	0.215
Africa	Ref.	–	Ref.	–
Latin America	0.80 (0.59–1.09)	0.151	0.75 (0.54–1.03)	0.077
Middle East	1.83 (1.24–2.69)	0.002	1.79 (1.20–2.67)	0.005

All estimates were adjusted for clustering at the levels of the health facility and country. Variables dropped from the final models because of non-significance included the provision of uterotonic prophylaxis, marital status, self-reported facility location, HDI groups, educational attainment, and the interaction of age with parity.

Table 4. Summary of postpartum haemorrhage treatment practices

	All PPH cases (n = 3349)	PPH near miss (n = 484)	PPH death (n = 105)
Uterotonics for treatment	3102 (92.7)	432 (89.3)	92 (87.6)
Blood products	1088 (32.5)	310 (64.1)	61 (58.1)
Therapeutic intravenous antibiotics	773 (23.1)	156 (32.2)	39 (37.1)
Removal of retained products of conception	519 (15.5)	100 (21.7)	11 (10.5)
Manual removal of the placenta	356 (10.6)	59 (12.2)	10 (9.5)
Massive transfusion	162 (4.9)	136 (28.1)	26 (24.8)
Hysterectomy	160 (4.8)	138 (28.5)	22 (21.0)
Laparotomy	156 (4.7)	85 (17.6)	26 (24.8)
Artery ligation/ embolisation	103 (3.1)	40 (8.3)	12 (11.5)
Balloon/condom tamponade	75 (2.2)	16 (3.3)	2 (1.9)

Data are n (%).

Table 5. Correlates of severe maternal outcomes among women with PPH

	PPH cases with SMOs (n = 589)	PPH cases with no SMOs (n = 2760)	P
Age			
<20 years	42 (7.1)	298 (10.8)	<0.0001
20–34 years	393 (66.8)	2065 (74.9)	
≥35 years	153 (26.0)	395 (14.3)	
Education in years			
<5 years	208 (35.3)	462 (16.7)	<0.0001
5–8 years	106 (18.0)	532 (19.3)	
9–11 years	116 (19.7)	702 (25.4)	
>11 years	159 (27.0)	1064 (38.6)	
Number of previous births			
0	171 (29.0)	1208 (43.8)	<0.0001
1–2	204 (34.6)	1008 (36.5)	
3+	214 (36.3)	543 (19.7)	
Gestational age at delivery in weeks			
<37 years	130 (24.1)	422 (15.7)	0.0004
37–41 years	402 (74.4)	2202 (81.8)	
>41 years	8 (1.5)	68 (2.5)	
Anaemia	228 (38.7)	405 (14.7)	<0.0001
Receipt of uterotonic prophylaxis	495 (86.4)	2669 (96.8)	<0.0001
Receipt of uterotonics for treatment	524 (89.0)	2578 (93.5)	0.0369
Referred in from another facility	177 (30.1)	71 (2.6)	<0.0001
Caesarean section	202 (36.1)	633 (23.0)	0.0001
HDI group			
Very high	14 (2.4)	150 (5.4)	0.0006
High	109 (18.5)	578 (20.9)	
Medium	128 (21.7)	932 (33.8)	
Low	338 (57.4)	1100 (39.9)	
Geographic region			
Africa	193 (32.8)	777 (28.2)	0.0765
Asia	286 (48.6)	1285 (46.6)	
Latin America and the Caribbean	99 (16.8)	503 (18.2)	
Middle East	11 (1.9)	195 (7.1)	

Data are n (%). Percentages have been rounded. We used Pearson's chi-square test to test for differences between groups. All tests were adjusted for clustering at the levels of the health facility and country. We also conducted analyses without including women referred from other facilities, and there were no notable differences in any of the results presented in this table.

also much higher among those referred from other facilities (30.1 versus 2.6%). Figure 3 summarises the incidence of SMOs among PPH cases according to HDI group. The most notable disparities were in maternal deaths, which occurred with greatest frequency in low- and medium-HDI settings.

The receipt of obstetric interventions among PPH cases with SMOs is shown in Figure 4 according to HDI group. In all HDI settings, the interventions most commonly provided were uterotonics for the treatment of PPH and the provision of blood products. Other interventions, such as various surgical manipulations, were more commonly reported in very high- and high-HDI settings.

Discussion

Main findings

In this survey of women giving birth at 352 health facilities in 28 countries, the vast majority received at least one uterotonic for prophylaxis, and 19% received more than one uterotonic. The provision of more than one uterotonic for prophylaxis was even higher (35%) among those diagnosed with PPH. The reported rate of PPH among all women was 1.2%, and factors significantly associated with PPH diagnosis included age, parity, gestational age, induction of labour, caesarean section, and geographic region. Among those diagnosed with PPH, 92.7% received uterotonics for the treatment of PPH, one-third received blood products, and about one-quarter received therapeutic intravenous antibiotics. Overall, 17.2% of PPH cases resulted in an SMO. There were significant differences in the incidence of SMOs by age, parity, gestational age, anaemia, receipt of uterotonics for prophylaxis or treatment, referral from another facility, and HDI group. Rates of death were highest in low-/medium-HDI countries.

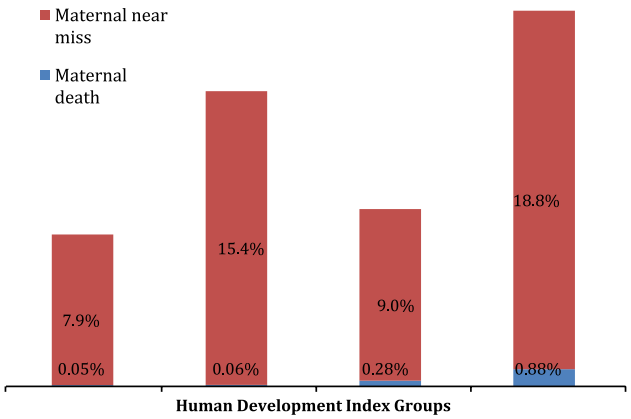

Figure 3. Incidence of severe maternal outcomes among women with PPH, by HDI group.

Strengths and limitations

This analysis had some important limitations. As all participating facilities were required to have a high volume of births and the ability to provide caesarean section, the findings may not be generalisable to women who give birth outside of health facilities or to those who give birth in lower level facilities where many emergency obstetric interventions, such as blood transfusion or surgical services, are not offered. In addition, we were unable to assess the contribution of quality of care to SMOs using the current data.

Interpretation

The findings indicate that the provision of uterotonics for both prevention and treatment of PPH is widespread among the health facilities that participated in this survey. This suggests that there has been much progress in implementing recommendations from clinical guidelines for the prevention and management of PPH.[20,27,28] The reported rate of PPH in this survey (1.2%) was lower than expected in light of prior research, which estimated the incidence of PPH among women treated with uterotonic prophylaxis to be in the range of 3–6%.[3] We suspect that the finding from this survey may have been influenced by the use of visual assessment of postpartum bleeding, which is the clinical norm and most likely the predominant method used for PPH diagnosis among the facilities in this survey. In contrast, measured blood loss is frequently used when attempting to record PPH incidence in studies. Visual estimation has been shown to underestimate measured blood loss by an average of 100–150 ml.[29–31] It is also possible that many providers in this survey only documented events of severe PPH (clinically defined as blood loss ≥1000 ml). Previous research has documented rates of PPH in the range of 1–3% after receipt of a prophylactic uterotonic when blood loss ≥700 ml was used to trigger treatment.[32] A more recent study by Zhang and colleagues[31] reported severe PPH (≥1000 ml blood loss) among 2% of deliveries when diagnosed by visual estimation. Despite a lower than expected rate of PPH in this survey, the contribution of

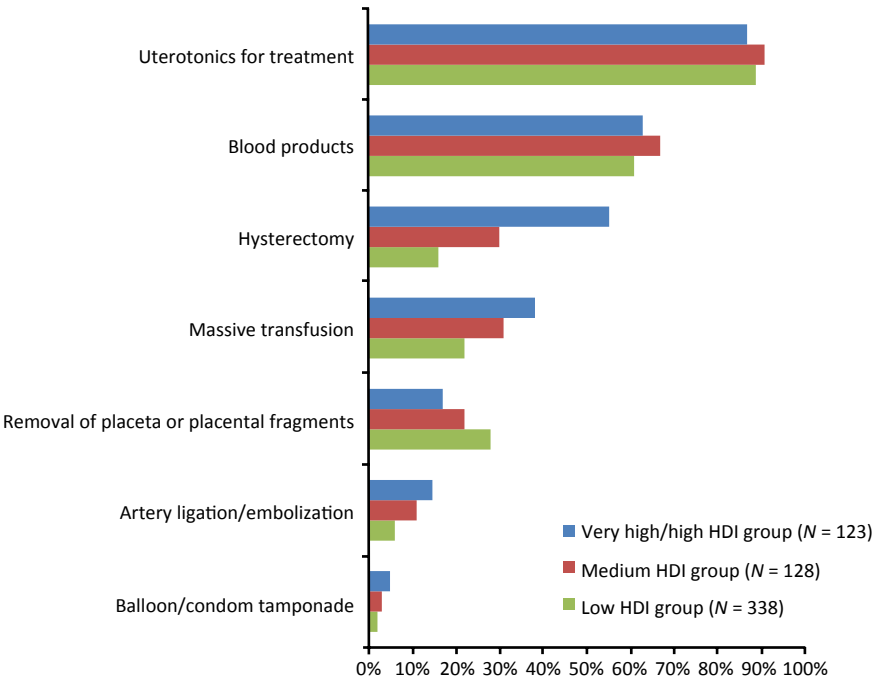

Figure 4. Receipt of obstetric interventions among PPH cases with SMOs, by HDI group.

the 1.2% of women diagnosed with PPH to SMOs was nevertheless substantial.[23]

Many of the correlates of PPH incidence in this survey were consistent with those from prior research. In particular, nulliparity, induction of labour, and caesarean section were all associated with significant increases in the odds of PPH, and the odds of PPH also varied by geographic region. In contrast with prior research, a parity of three or more was also significantly associated with increased odds of PPH. Interestingly, the provision of uterotonic prophylaxis had no significant effect on PPH risk, whereas prior research has found that receipt of prophylaxis reduces the risk of PPH by up to 60%.[19,20] As already noted, however, the data from this survey may not reflect the incidence of bleeding more than 500 ml, which would make it difficult to assess adequately the full impact of uterotonic prophylaxis. Furthermore, we cannot be entirely certain about the validity of what providers reported as either prophylaxis versus treatment of PPH.

The data showing the percentage of women for whom more than one uterotonic was given and documented as 'prophylactic' may be indicative of providers using other signals (such as a gush of blood, decrease in blood pressure, or tissue trauma) in the decision to provide additional interventions to women. It is conceivable that non-blood loss indicators may lead many providers to offer women a second or additional uterotonic before diagnosing PPH. If so, this fact could account for the large differences in receipt of more than one uterotonic among the PPH and non-PPH cases documented.

The data also allude to a blurring between 'prevention' and 'treatment', suggesting that providers may not distinguish carefully between the two uses of uterotonics as they seek to manage postpartum blood loss. Such a situation raises questions about the international recommendations supporting different dosages of uterotonics for prevention and treatment, if indeed there is little difference in practice between the two indications. Given that the survey did not define PPH or require similar measurement indices for all deliveries, the confusion could also result from a lack of clear instructions for providers as to which interventions should be marked as prevention and treatment.

The findings indicate that the coverage of essential maternal interventions, including uterotonics for the management of postpartum haemorrhage and intravenous antibiotics for maternal infections, was high in the participating facilities. In spite of the availability of these interventions, maternal morbidities and mortalities persist, most notably in low- and medium-HDI settings. Although there were some differences in the interventions given across HDI groups, the survey design does not allow us to assess the contributions of the quality, timing, availability, and/or necessity of the various interventions provided to each woman.

Overall, the findings suggest that when PPH occurs, timely access to adequately equipped facilities is critical. Strengthening institutional capacity, including the quality of PPH care, at all levels of the healthcare system will contribute to efforts to reduce maternal mortality.

Conclusion

The use of essential maternal interventions, including uterotonics for the management of postpartum haemorrhage, was high in the participating facilities. Yet even among hospitals with the capacity to provide all essential interventions, disparities in the incidence of maternal death and other severe outcomes persist. This highlights the need for better information about the role of institutional capacity, including quality of care, in PPH-related morbidity and mortality. A focus on quality of care and implementing evidence-based practice in PPH management should contribute to improvements in maternal health outcomes.

Disclosure of interests

The authors declare that we have no conflicts of interest.

Contribution to authorship

All authors (WRS, JB, JPV, JPS, AMG, and BW) participated in the conception and planning of this article, and in the interpretation of the results. WRS performed the data analysis and drafted the article with JB. All authors reviewed the article and provided input to the final version. The corresponding author had access to the full data set and final responsibility for the decision to submit this article for publication.

Details of ethics approval

The HRP Specialist Panel on Epidemiological Research reviewed and approved the study protocol for technical content. This study was approved by the WHO Ethical Review Committee and the relevant ethical clearance mechanisms in all countries (protocol ID, A65661; date of approval, 27 October 2009).

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References

1 Khan KS, Wojdyla D, Say L, Gulmezoglu AM, Van Look P. WHO analysis of causes of maternal death: a systematic review. *Lancet* 2006;367:1066–74.
2 AbouZahr C. Global burden of maternal death and disability. *Br Med Bull* 2003;67:1–11.
3 Carroli G, Cuesta C, Abalos E, Gulmezoglu AM. Epidemiology of postpartum haemorrhage: a systematic review. *Best Pract Res Clin Obstet Gynaecol* 2008;22:999–1012.
4 McDonald S. Management of the third stage of labor. *J Midwifery Womens Health* 2007;52:254–61.
5 ACOG Practice Bulletin. Clinical management guidelines for obstetrician-gynecologists number 76, October 2006: postpartum haemorrhage. *Obstet Gynecol* 2006;108:1039–47.
6 Combs CA, Murphy EL, Laros RK. Factors associated with postpartum haemorrhage with vaginal birth. *Obstet Gynecol* 1991;77:69–76.
7 Magann EF, Evans S, Hutchinson M, Collins R, Howard BC, Morrison JC. Postpartum hemorrhage after vaginal birth: an analysis of the risk factors. *South Med J* 2005;98:419–22.
8 Tsu VD. Postpartum haemorrhage in Zimbabwe: a risk factor analysis. *Br J Obstet Gynaecol* 1993;100:327–33.
9 Gilbert L, Porter W, Brown VA. Postpartum haemorrhage—a continuing problema. *Br J Obstet Gynaecol* 1987;94:67–71.
10 Sheiner E, Sarid L, Levy A, Seidman DS, Hallak M. Obstetric risk factors and outcome of pregnancies complicated with early postpartum haemorrhage: a population-based study. *J Matern Fetal Neonatal Med* 2005;18:149–54.
11 Stones RW, Paterson CP, Saunders NJS. Risk factors for major obstetric haemorrhage. *Eur J Obstet Gynecol Reprod Biol* 1993;48:15–8.
12 Sosa CG, Althabe F, Belizán JM, Buekens P. Risk factors for postpartum hemorrhage in vaginal deliveries in a Latin-American population. *Obstet Gynecol* 2009;113:1313–9.
13 Al-Zirqi I, Vangen S, Forsen L, Stray-Pedersen B. Prevalence and risk factors of severe obstetric haemorrhage. *BJOG* 2008;115:1265–72.
14 Drife J. Management of primary postpartum haemorrhage. *Br J Obstet Gynaecol* 1997;104:275–7.
15 Mousa HA, Cording V, Alfirevic Z. Risk factors and interventions associated with major primary postpartum haemorrhage unresponsive to first-line conventional therapy. *Acta Obstet Gynecol Scan* 2008;87:652–61.
16 Mousa H, Walkinshaw S. Major postpartum haemorrhage. *Curr Opin Obstet Gynecol* 2001;13:595–603.
17 Gülmezoglu AM, Villar J, Ngoc NTN, Piaggio G, Carroli G, Adetoro L, et al. WHO multicentre randomised trial of misoprostol in the management of the third stage of labour. *Lancet* 2001;358:689–95.
18 Tunçalp Ö, Hofmeyr GJ, Gülmezoglu AM. Prostaglandins for preventing postpartum haemorrhage. *Cochrane Database Syst Rev* 2012;15:8.
19 Cotter AM, Ness A, Tolosa JE. Prophylactic oxytocin for the third stage of labor (review). *Cochrane Database Syst Rev* 2001;2001: CD000201.
20 World Health Organization. *WHO recommendations for the Prevention and Treatment of Postpartum Haemorrhage*. Geneva: WHO, 2012. Available from: http://apps.who.int/iris/bitstream/10665/75411/1/9789241548502_eng.pdf.
21 Mousa H, Alfirevic Z. Treatment for primary postpartum haemorrhage (review). *Cochrane Database Syst Rev* 2007;2007:1–25.
22 Stanton C, Koski A, Cofie P, Mirzabagi E, Grady BL, Brooke S. Uterotonic drug quality: an assessment of the potency of injectable uterotonic drugs purchased by simulated clients in three districts in Ghana. *BMJ Open* 2012;2:pii: e000431. doi: 10.1136/bmjopen-2011-000431. Print 2012.
23 Souza JP, Gülmezoglu AM, Vogel J, Carroli G, Lumbiganon P, Qureshi Z, et al. Moving beyond essential interventions for reduction of maternal mortality (the WHO Multicountry Survey on Maternal and Newborn Health): a cross-sectional study. *Lancet* 2013;381:1747–55.
24 Shah A, Faundes A, Mackoki M, et al. Methodological considerations in implementing the WHO Global Survey for Monitoring Maternal and Perinatal Health. *Bull World Health Organ* 2008;86:126–31.
25 Souza JP, Gülmezoglu AM, Carroli G, Lumbiganon P, Qureshi Z, WHOMCS Research Group. The world health organization multicountry survey on maternal and newborn health: study protocol. *BMC Health Serv Res* 2011;11:286.
26 Say L, Souza JP, Pattinson RC. WHO working group on Maternal Mortality and morbidity classifications: maternal mear miss—towards a standard tool for monitoring quality of maternal health care. *Best Pract Res Clin Obstet Gynaecol* 2009;23:287–96.
27 World Health Organzation. *WHO Guidelines for the Management of Postpartum Haemorrhage And Retained Placenta*. Geneva: WHO, 2009. Available from: http://whqlibdoc.who.int/publications/2009/9789241598514_eng.pdf
28 International Federation of Gynecology and Obstetrics (FIGO). Prevention and treatment of postpartum haemorrhage in low-resource settings offer a comprehensive overview of a combination of best practice approaches and life-saving interventions along a continuum of care from community to hospital. *Int J Gynecol Obstet* 2012;117:108–18.
29 Sloan NL, Durocher J, Aldrich T, Blum J, Winikoff B. What measured blood loss tells us about postpartum bleeding: a systematic review. *BJOG* 2010;117:788–800.
30 Stafford I, Dildy GA, Clark SL, Belfort MA. Visually estimated and calculated blood loss in vaginal and cesarean delivery. *Am J Obstet Gynecol* 2008;199:519.e1–e7.
31 Zhang WH, Deneux-Tharaux C, Brocklehurst P, Juszczak E, Joslin M, Alexander S. Effect of a collector bag for measurement of postpartum blood loss after vaginal delivery: cluster randomised trial in 13 European countries. *BMJ* 2010;340:c293.
32 Blum J, Winikoff B, Raghavan S, Dabash R, Ramadan MC, Dilbaz B, et al. Treatment of post-partum haemorrhage with sublingual misoprostol versus oxytocin in women receiving prophylactic oxytocin: a double-blind, randomised, non-inferiority trial. *Lancet* 2010;375:217–23.