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Citation

Kallianidis, A. F., Rijntjes, D., Brobbel, C., Dekkers, O. M., Bloemenkamp, K. W. M., & Akker, T. van den. (2023). Incidence, indications, risk factors, and outcomes of emergency peripartum hysterectomy worldwide: a systematic review and meta-analysis. *Obstetrics & Gynecology*, 141(1), 35-48. doi:10.1097/AOG.0000000000005022

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Note: To cite this publication please use the final published version (if applicable).

Incidence, Indications, Risk Factors, and Outcomes of Emergency Peripartum Hysterectomy Worldwide

A Systematic Review and Meta-analysis

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OBJECTIVE: To describe the incidence, indications, risk factors, outcomes, and management of emergency peripartum hysterectomy globally and to compare outcomes among different income settings.

DATA SOURCES: PubMed, MEDLINE, EMBASE, ClinicalTrials.gov, Cochrane Library, Web of Science, and Emcare databases up to December 10, 2021.

METHODS OF STUDY SELECTION: Update of a systematic review and meta-analysis (2016). Studies were eligible if they reported the incidence of *emergency peripartum hysterectomy*, defined as surgical removal of the uterus for severe obstetric complications up to 6 weeks postpartum. Title and abstract screening and full-text review were performed using Endnote data-management software. Of 8,775 articles screened, 26 were included that were published after 2015, making the total number of included studies 154. A subanalysis

was performed for the outcomes of interest per income setting.

TABULATION, INTEGRATION, AND RESULTS: The meta-analysis included 154 studies: 14,409 emergency peripartum hysterectomies were performed in 17,127,499 births in 42 countries. Overall pooled incidence of hysterectomy was 1.1 per 1,000 births (95% CI 1.0–1.3). The highest incidence was observed in lower middle-income settings (3/1,000 births, 95% CI 2.5–3.5), and the lowest incidence was observed in high-income settings (0.7/1,000 births, 95% CI 0.5–0.8). The most common indications were placental pathology (38.0%, 95% CI 33.9–42.4), uterine atony (27.0%, 95% CI 24.6–29.5), and uterine rupture (21.2%, 95% CI 17.8–25.0). In lower middle-income countries, uterine rupture (44.5%, 95% CI 36.6–52.7) was the most common indication; placental pathology (48.4%, 95% CI 43.5–53.4) was most frequent in high-income settings. To prevent hysterectomy, uterotonic medication was used in 2,706 women (17%): 53.2% received oxytocin, 44.6% prostaglandins, and 17.3% ergometrine. Surgical measures to prevent hysterectomy were taken in 80.5% of women, the most common being compressive techniques performed in 62.6% (95% CI 38.3–81.9). The most common complications were febrile (29.7%, 95% CI 25.4–34.3) and hematologic (27.5%, 95% CI 20.4–35.9). The overall maternal case fatality rate was 3.2 per 100 emergency peripartum hysterectomies (95% CI 2.5–4.2) and was higher in lower middle-income settings (11.2/100 emergency peripartum hysterectomies 95% CI 8.9–14.1) and lower in high-income settings (1.0/100 emergency peripartum hysterectomies 95% CI 0.6–1.6).

CONCLUSION: Substantial differences across income settings exist in the incidence of emergency peripartum hysterectomy. Women in lower-income settings have a higher risk of undergoing emergency peripartum hysterectomy and suffer more procedure-related morbidity

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The authors thank J.W. Schoones for helping with the search strategy and process.

Each author has confirmed compliance with the journal's requirements for authorship.

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Financial Disclosure

The authors did not report any potential conflicts of interest.

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ISSN: 0029-7844/23

and mortality. The frequency of emergency peripartum hysterectomy is likely to increase in light of increasing cesarean delivery rates.

(*Obstet Gynecol* 2023;141:35–48)

DOI: 10.1097/AOG.0000000000005022

Emergency peripartum hysterectomy is the surgical removal of the uterus due to severe complications during pregnancy, birth, or postpartum. When all conservative measures have failed to control massive obstetric hemorrhage or life-threatening sepsis, emergency peripartum hysterectomy is used as an intervention of last resort. Although emergency peripartum hysterectomy can be a life-saving operation, it is uncommon in modern obstetrics.¹ However, because rates of cesarean delivery and, consequently, placenta accreta spectrum in pregnancies after a previous cesarean delivery are increasing, the global incidence of emergency peripartum hysterectomy is likely to rise as a result.^{1–3} The risks and benefits of the procedure must be weighed, but undue delays in performance of hysterectomy may contribute to increased morbidity and mortality.

We previously identified differences in incidence, indications, risk factors, and outcomes of emergency peripartum hysterectomy between high-income and low-income countries.¹ The incidence of emergency peripartum hysterectomy tends to be higher in low- and lower middle-income countries. The main indications for emergency peripartum hysterectomy are massive obstetric hemorrhage due to placental pathology, uterine atony, or uterine rupture, followed by puerperal sepsis.^{4,5}

Since the previous version of this review, new studies about emergency peripartum hysterectomy have been published, including several population-based studies, which were infrequent at the time of the previous review. Therefore, we performed an update of our previous systematic review and meta-analysis. The aim of this study was, first, to estimate the overall incidence of emergency peripartum hysterectomy and compare the incidence across different income settings and, second, to describe indications, risk factors, outcomes, and management of emergency peripartum hysterectomy and compare these among income settings.

SOURCES

This is an update of the systematic review and meta-analysis previously published by van den Akker et al.¹ A systematic search of PubMed, MEDLINE, EMBASE, ClinicalTrials.gov, Cochrane Library, Web of Science, and Emcare was performed up to December

10, 2021 (for search strategy, see Appendix 1, available online at <http://links.lww.com/AOG/C968>).

STUDY SELECTION

Study selection was performed independently by two of the authors (D.R. and A.F.K.). Studies published before 2015 were previously selected and included.¹ First, articles were assessed based on title and abstract. Selected studies were further assessed for eligibility based on the full text.

We used the same inclusion criteria as before; in brief, studies were included if they reported the incidence, management, or outcomes of emergency peripartum hysterectomy up to 6 weeks postpartum in a hospital, region, or country. *Emergency peripartum hysterectomy* was defined as partial or total surgical removal of the uterus for severe obstetric complications. Case-control, cohort, and cross-sectional study designs were eligible.

Excluded study designs were case reports, case series (sample size less than 10), comments, and personal communications. Other exclusion criteria were studies not reported in English and those published in journals with an impact factor less than 1. Studies were also excluded if they did not indicate the absolute number of births and emergency peripartum hysterectomies. Where possible, hysterectomies for malignancies or other nonobstetric indications were excluded from the calculation of incidence, indications, and outcomes. So-called “elective” or “planned” hysterectomies were not excluded, because most often these were performed for placenta accreta spectrum pathology.

Data extraction was performed by two authors (D.R. and A.F.K.). Data on incidence, indications, complications, maternal characteristics, and preventive measures were extracted and combined with data from the previous systematic review.¹ If studies reported on the same study population, only the most recent study was included.

The main outcome was overall pooled incidence. Incidence was calculated per income setting as well as for all countries separately. The income setting of a country was based on the gross national income per capita. Countries were classified as low-income (\$1,045 or less), lower middle-income (\$1,046–4,095), upper middle-income (\$4,096–12,695), or high-income (\$12,696 or more).⁶

Secondary outcomes were indications, risk factors, outcomes, and management characteristics of emergency peripartum hysterectomy. Indications for emergency peripartum hysterectomy were subdivided into placental pathology (placenta accreta spectrum,

placenta previa, combined placental pathology, or placental abruption), uterine atony, uterine rupture, unspecified hemorrhage, infection, cervical tear or laceration, leiomyomas with major obstetric hemorrhage, disseminated intravascular coagulation, hematoma, abnormal location of pregnancy, other, and unknown. Outcomes included transfusion of any type, intensive care unit admission, complications, and maternal morbidity and mortality. Characteristics of emergency peripartum hysterectomy described were hysterectomy type (total or subtotal), preventive measures used before emergency peripartum hysterectomy (medical or surgical), duration of surgery, blood loss, and additional procedures performed. Indications, outcomes, and management characteristics were stratified based on income setting, and the highest and lowest proportions were described. Maternal characteristics were antenatal care registration, age, and parity.

Risk-of-bias assessment was performed for all included articles. The COSMOS-E (Conducting Systematic Reviews and Meta-Analyses of Observational Studies of Etiology) methodology was followed to create study-specific guidelines for describing the risk of bias of included articles.⁷ These guidelines assisted in describing selection, information, and confounding biases (Appendix 2, available online at <http://links.lww.com/AOG/C968>). Sources of selection bias con-

sidered were extent of the catchment area, length of postpartum inclusion period, definition of emergency peripartum hysterectomy, definition of study time period, and gestational age limits. For case-control studies, the selection process and comparability by design were also taken into account. Potential causes of information bias were duration of the follow-up period and the source of data extraction. Possible confounders included age and parity, because they are commonly accepted to influence a woman's risk of emergency peripartum hysterectomy.

Overall weighted pooled incidence was calculated using a random-effects analysis with 95% CI. Proportions of indications, outcomes, maternal, and procedure characteristics were pooled using a random-effects analysis. Continuous variables were examined with pooled mean difference and 95% CI (inverse variance weighting). We used R software for statistical computing.

RESULTS

In total, 154 studies were included (Fig. 1); 128 had been included in the previous meta-analysis.¹ This update includes 26 additional studies and presents data for an additional 7,741 women in 22 nations⁸⁻³³ (Appendix 3, available online at <http://links.lww.com/AOG/C968>). Eight of the new studies were from

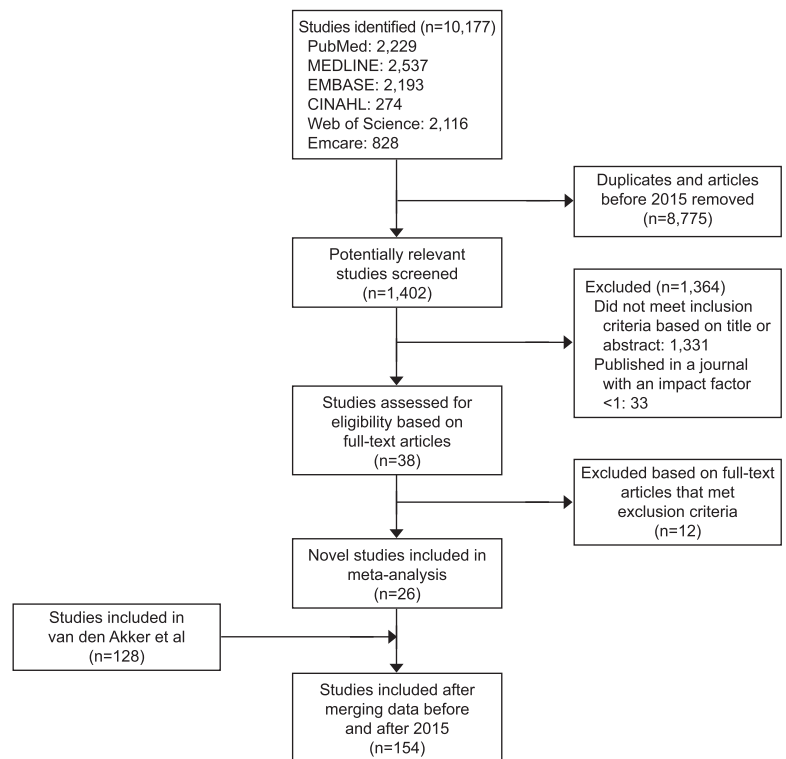


Fig. 1. Flowchart showing selection of studies included in the meta-analysis. Kallianidis. *Emergency Peripartum Hysterectomy Worldwide*. *Obstet Gynecol* 2023.

countries from which we previously did not have data: Belgium, France, Germany, Romania, Slovakia, Sweden, Iceland, and Papua New Guinea. All studies combined included a total of 15,599 women who underwent emergency peripartum hysterectomy—193 (1.2%) from low-income settings, 2,403 (15.4%) from lower middle-income settings, 1,975 (12.7%) from upper middle-income settings, and 11,028 (70.7%) from high-income settings.

Overall, risk of bias was considered low in 25 studies (16.2%), moderate in 66 studies (42.8%), and high in 63 studies (40.5%) (Appendix 2, <http://links.lww.com/AOG/C968>). Risk of selection bias was considered high in 55 of the studies (35.7%). Risk of information bias was low in 106 studies (68.8%), moderate in 35 studies (22.7%), and high in 13 studies (8.4%). Fifteen of 24 case-control studies did not account for confounding by age or parity. Risk of confounding bias was thus assessed as high in these 15 studies, moderate in two studies, and low in seven studies.

Seventeen of the included studies were population-based.^{17–19,22,23,27,34–45} The other 137 were hospital-based, of which six were multicenter studies. Two population-based studies reported data from more than one country.^{18,19} Information on these countries was subdivided and analyzed separately.

In 89 studies, case definitions of emergency peripartum hysterectomy were described. Definitions varied widely among studies. In 13 studies, women undergoing hysterectomy up to 6 weeks postpartum were included,^{11,17,30,31,41,44–51} 54 studies included women up to 24 hours postpartum,^{9,12,14–16,25,28,29,33,34,38,39,52–94} and 22 studies included women within another time range (but within 6 weeks).^{18,19,21,27,32,35,36,40,42,89,95–106} In 31 studies, only emergency peripartum hysterectomies beyond 24 weeks of gestation were included.^{11,12,31–33,40,47,50,53,58,71–73,76–78,83,86,90,97,98,100,107–117} Another 20 studies excluded women based on limits other than 24 weeks of gestation.^{9,18,19,23,24,27,34,41,46,48,51,57,59,64,67,69,85,87,118,119} Nine studies included peripartum hysterectomies regardless of gestational age.^{37,44,45,91,102,117,120–123} All other

studies (n=91) lacked specific exclusion criteria for gestational age. There were no new case-control studies since 2015. Information on indications, complications, and preventive measures for hysterectomy was extracted from medical records in 130 studies.

The incidence of emergency peripartum hysterectomy was reported in 147 studies; seven studies were not included because they reported only cesarean^{64,70,106} or postpartum hysterectomies⁸⁷ or did not report an incidence at all.^{42,89,124} Altogether, 14,409 emergency peripartum hysterectomies were performed over 17,127,499 births in 42 countries. The overall weighted incidence was 1.1 cases per 1,000 births (95% CI 1.0–1.3).

The reported incidence differed considerably across income settings (Table 1). The highest incidence was observed in lower middle-income settings (3.0, 95% CI 2.5–3.5), and the lowest incidence was observed in high-income settings (0.7, 95% CI 0.5–0.8). Incidence varied from 0.2 per 1,000 births in Denmark,³⁵ Ireland,¹⁰³ Norway,⁷⁸ and Turkey⁶⁷ to 10.1 per 1,000 births in India.¹²³ Figures 2 and 3 show incidence of emergency peripartum hysterectomy worldwide and in Europe, respectively.

Maternal age ranged from 11⁹⁶ to 54^{22,47} years, with an overall mean age of 32.1 years (95% CI 31.9–32.8). The overall mean gestational age was 36 5/7 weeks (95% CI 35 3/7–37 1/7 weeks). Parity was reported in 105 studies, representing 7,555 women: 6,324 (83.7%) women were multiparous.

Prior uterine surgery was described in 101 studies, representing 6,841 women. A total of 3,319 (49.8%, 95% CI 45.1–54.6) women had previously undergone cesarean delivery. The total number of cesarean deliveries was provided for 1,362 women; 671 (51.0%, 95% CI 44.4–57.7) of these women had had two or more cesarean deliveries. Other uterine surgery (eg, myomectomy, curettage, hysteroscopic septum resection, cornual resection) had previously been performed in 556 women (0.4%, 95% CI 0.1–1.2). In 44 studies, registration status was mentioned: 877 of 2,251 women (37.4%, 95% CI 28.5–47.4) had been registered for

Table 1. Incidence Per Income Setting*

Income Setting	No. of Studies	No. of Emergency Peripartum Hysterectomies	No. of Women	Incidence (95% CI)
Low	2	193	93,355	1.5 (0.6–4.0)
Lower middle	43	2,257	849,772	3.0 (2.5–3.5)
Upper middle	34	1,924	2,573,707	0.9 (0.7–1.1)
High	75	10,035	13,610,665	0.7 (0.5–0.8)
Total	154	14,409	17,127,499	1.1 (1.0–1.3)

* Weighted incidence per 1,000 births using random-effects model.

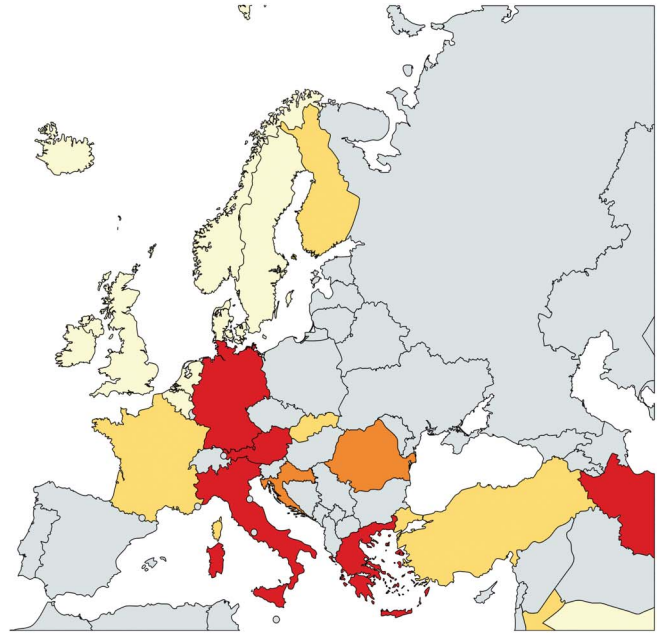
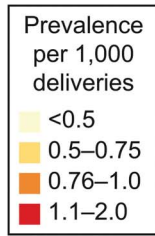


Fig. 2. Map of Europe showing the incidence of emergency peripartum hysterectomy per country. Image created with mapchart.net ©.

Kallianidis. *Emergency Peripartum Hysterectomy Worldwide. Obstet Gynecol* 2023.

antenatal care. The lowest proportion of women registered in the first trimester was in lower middle-income settings (490/1,461, 29.4%, 95% CI 22.31–37.6), followed by 76 of 165 (46.1%) women in low-income settings, based on one study only.

Indications for emergency peripartum hysterectomy were described in 157 studies for 9,258 women (Table 2). The most common indications were placental pathology (38.0%, 95% CI 33.9–42.4), uterine atony (27.0%, 95% CI 24.6–29.5), and uterine rupture

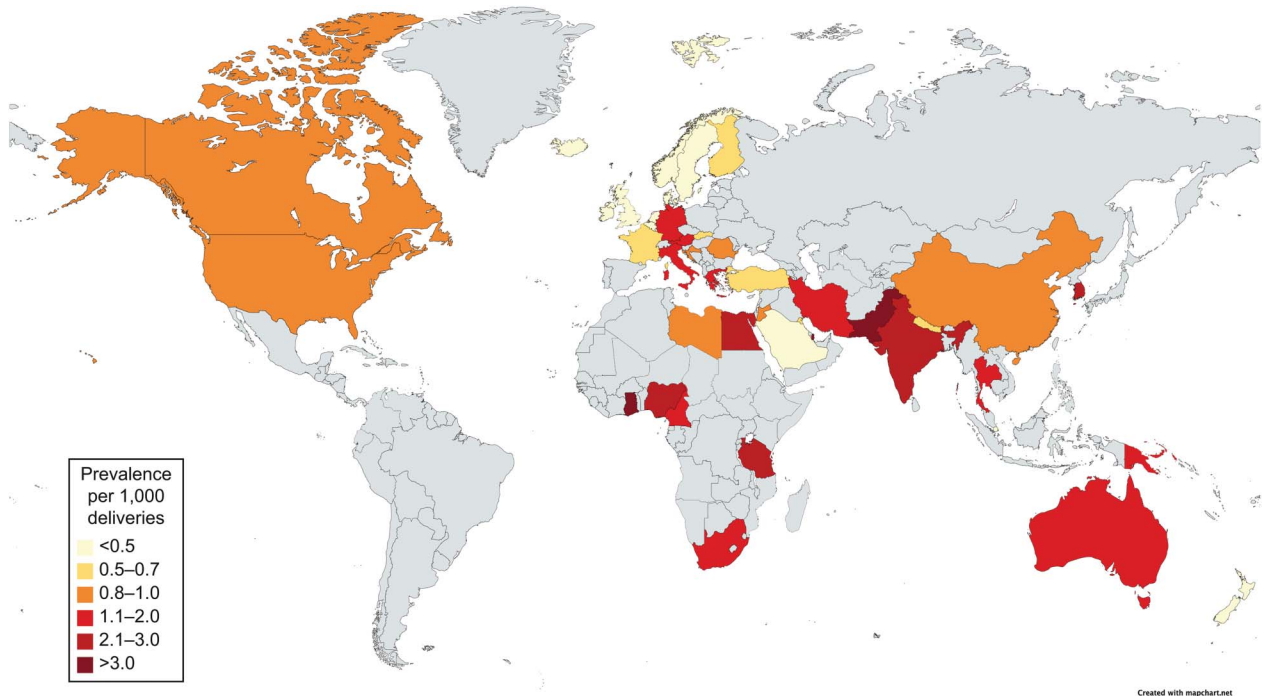


Fig. 3. World map showing the incidence of emergency peripartum hysterectomy per country. Image created with mapchart.net ©.

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Table 2. Indications for Emergency Peripartum Hysterectomy

Indication	No. of Studies	No. of Women (n/N)	Proportion (95% CI)*
Placental pathology	157	3,791/9,213	38.0 (33.9–42.4)
Placenta accreta spectrum	130	2,293/8,115	23.9 (20.5–27.7)
Placenta previa	71	809/4,822	13.9 (11.8–17.1)
Combined or unspecified placental pathology	32	416/1,606	26.1 (20.5–32.5)
Placental abruption	42	147/2,913	5.2 (4.0–6.9)
Uterine atony	143	2,638/8,157	27.0 (24.6–29.5)
Uterine rupture [†]	140	2,019/8,421	21.2 (17.8–25.0)
Unspecified hemorrhage	48	397/2,549	13.3 (9.8–17.9)
Infection [‡]	41	170/3,083	4.4 (3.9–6.0)
Cervical tear or laceration	25	99/2,250	4.0 (2.7–5.9)
DIC	15	104/1,551	4.0 (1.8–8.8)
Hematoma [§]	18	41/1,117	4.3 (3.2–5.8)
Abnormal location of pregnancy	8	14/465	3.0 (1.8–5.0)
Leiomyomas with major obstetric hemorrhage	30	65/2,970	2.3 (1.6–3.1)
Other [¶]	22	55/1,590	3.8 (2.7–5.4)
Unknown	14	149/2,313	3.7 (2.0–6.8)

DIC, disseminated intravascular coagulation.

* Proportions calculated using random-effects model and exceed 100% because more than one indication was possible.

[†] Includes both uterine rupture and extension of uterine incision.

[‡] Includes endometritis, pelviperitonitis, chorioamnionitis, gangrenous uterus, puerperal sepsis, pelvic abscess, and hemorrhage due to these infections.

[§] Includes broad ligament, retroperitoneal, and unspecified hematoma.

^{||} Includes abdominal, cervical, molar, and ruptured cornual pregnancy.

[¶] Includes avulsion of uterine artery, uterine inversion, septic abortion, medical termination of pregnancy perforation, malignancy with hemorrhage, sterilization, arteriovenous malformation, uterine anomaly, and retained tissue.

(21.2%, 95% CI 17.8–25.0). The distribution of these indications varied considerably across income settings. The most common indication in lower middle-income settings was uterine rupture (44.5%, 95% CI 36.5–52.7); in high-income countries it was placental pathology (48.4%, 95% CI 43.5–53.4) (Table 3).

Measures that were taken to prevent hysterectomy were described for 3,401 women in 46 studies (including one multinational study¹⁸). Uterotonic medication was given to 2,706 women: oxytocin in 1,439 (53.2%), prostaglandins in 1,207 (44.6%), and ergometrine in 467 (17.3%). Five hundred seventy-five women (21.2%) received uterotonics without further specification. Surgical measures to prevent emergency peripartum hysterectomy were described

in 2,740 women (80.5%) (Table 4). Compressive surgical measures were the most commonly performed interventions before emergency peripartum hysterectomy (62.6%, 95% CI 38.3–81.9) and included bimanual compression in 235 women (98.9%, 95% CI 6.6–100.0), vaginal or uterine packing in 266 (20.5%, 95% CI 14.3–28.5), uterine balloon tamponade in 382 (16.3%, 95% CI 11.9–22.0), and uterine compression sutures in 383 (14.3%, 95% CI 9.3–21.4).

The type of hysterectomy was known for 6,240 women; total abdominal hysterectomy was performed in 3,128 (50.1%) and subtotal hysterectomy in 3,112 (49.8%). Type of hysterectomy varied among income settings; total abdominal hysterectomy was performed in 175 of 193 (90.6%) of the surgeries in low-income countries, 783 of 2,154 (36.3%) in lower middle-

Table 3. Indications Per Income Setting*

Income Setting	Placental Pathology		Uterine Atony		Uterine Rupture	
	Proportion (95% CI)	No. of Studies	Proportion (95% CI)	No. of Studies	Proportion (95% CI)	No. of Studies
Low	25 (—)	1	36 (—)	1	25 (—)	1
Lower middle	20.7 (15.8–26.8)	44	20.9 (17.6–24.7)	38	44.5 (36.6–52.7)	44
Upper middle	41.8 (33.3–50.9)	35	31.0 (25.0–37.6)	33	13.8 (9.8–19.2)	34
High	48.4 (43.4–53.4)	77	28.9 (25.7–32.3)	71	9.3 (7.0–12.1)	77

* Proportion of indications per 100 emergency peripartum hysterectomies, calculated using random-effects model.

Table 4. Mechanical Measures to Prevent Emergency Peripartum Hysterectomy

Measure	No. of Studies	No. of Patients (n/N)	Proportion (95% CI)*
Fundal massage	6	210/319	83.8 (33.7–98.1)
Compression [†]	36	1,274/2,700	62.6 (38.3–81.9)
Bimanual compression	7	235/686	98.9 (6.6–100)
Vaginal or uterine packing	21	266/1,195	20.5 (14.3–28.5)
Uterine balloon tamponade	20	382/1,870	16.3 (11.9–22.0)
Uterine compression sutures [‡]	26	383/2,367	14.3 (9.3–21.4)
Artery ligation [§]	38	603/2,407	22.4 (16.4–29.8)
Oversewing of placental bed	17	190/985	19.1 (13.4–26.5)
Manual removal of placenta [¶]	8	68/493	10.8 (6.1–18.4)
Uterine artery embolization	14	136/1,569	7.9 (5.5–11.2)
Curettage	10	116/583	2.2 (8.0–48.1)
Other [‡]	9	143/787	15.9 (10.7–23.0)

* Weighted proportions per 100 emergency peripartum hysterectomies using random-effects model.

[†] Including eight cases in which compression was unspecified.

[‡] Includes B-Lynch procedure and other or unspecified procedures.

[§] Includes ligation of the uterine, ovarian, internal iliac, and hypogastric arteries.

^{||} Includes suturing of bleeding points and cervical lacerations.

[¶] Includes examination under anesthesia.

[‡] Includes placenta left in utero, intra-abdominal packing, internal iliac artery balloon placement, hot saline packs, lower segment belt, securing of uterine angles, and unspecified measures.

income countries, 752 of 1,463 (51.4%) in upper middle-income countries, and 1,418 of 2,492 (56.9%) in high-income countries.

Additional surgery performed during or after hysterectomy was detailed for 5,248 women. Repeat laparotomy was required in 434 patients (8.9%, 95% CI 6.9–11.6) (Table 5). Relaparotomy was performed most often in high-income countries (265/2,813, 10.9%, 95% CI 8.2–14.9), followed by upper middle-income (139/1,492, 9.7%, 95% CI 6.2–16.1), lower middle-income (28/750, 7.4%, 95% CI 3.5–11.1), and low-income (2/193, 1.0%, 95% CI 0.2–4.2).

Weighted mean operating time was 137 minutes (95% CI 132–153). The weighted mean volume of blood loss during surgery was 3.9 L (95% CI 3.3–4.2).

Most women undergoing hysterectomy (4,930/5,420, 91.4%) received transfusion of red blood cells, with a weighted mean of 8 units per person (95% CI 7.1–8.9). Two studies mentioned salvage of blood

cells, accounting for 12 of 143 women included (8.4%).^{23,38} Fresh frozen plasma was administered to 847 of 1,431 women (59.1%). Other transfusions given to treat coagulopathy were platelets in 213 of 407 women (52.3%), tranexamic acid in 154 of 486 (31.7%), fibrinogen in 135 of 707 (19.1%), cryoprecipitate in 30 of 204 (14.7%), recombinant factor VIIa in 90 of 1,125 (8.0%), and prothrombin complex in 3 of 126 (2.4%).

The proportion of women receiving transfusion of packed red blood cells differed among income settings: 79 of 165 in low-income settings (47.8%), 1,248 of 1,285 (97.1%) in lower middle-income settings, 783 of 816 (95.6%) in upper middle-income settings, and 2,816 of 3,154 (89.2%) in high-income settings. The mean number of units of red blood cells given per person increased with income setting; 2.4 in low-income settings, 4.4 in lower middle-income settings, 7.3 in upper middle-income settings, and 9.7 in high-income settings.

Table 5. Procedures in Addition to Hysterectomy

Procedure	No. of Studies	No. of Patients (n/N)	Proportion (95% CI)*
Salpingo-oophorectomy	33	234/2,244	10.1 (8.2–12.5)
Relaparotomy	63	434/4,014	9.0 (6.9–11.6)
Bladder or ureteral repair	23	115/1,156	8.6 (6.1–12.0)
Artery ligation or embolization	7	35/406	8.2 (3.9–16.5)
Other [†]	5	20/308	6.8 (2.8–15.4)

* Weighted proportions per 100 emergency peripartum hysterectomies using random-effects model.

[†] Includes abdominal packing, bowel repair, appendectomy, uterine curettage, and unspecified procedures.

The duration of hospital stay ranged from 6 hours¹¹ to 240 days¹²⁵; the pooled average time of admission was 9.2 days (95% CI 8.4–10.1). A total of 1,588 of 3,438 (46.2%) women were admitted into the intensive care unit, with a mean stay of 2.4 days (95% CI 2.0–3.2).

Information on complications was given in all but 24 studies,^{19,21,22,25,26,28,34,41,42,57} representing^{63,66,68,69,82,89,93,104,111,126–129} a total of 7,469 women (Table 6). The most common complications described were febrile morbidity in 1,175 women (29.7%, 95% CI 25.4–34.3), hematologic in 1,787 women (27.5%, 95% CI 20.4–35.9), and infection in 713 women (12.7%, 95% CI 10.0–15.9).

Maternal case fatality rates were given in all but seven studies.^{19,22,46,79,96,113,128} Overall, maternal death occurred in 453 of 9,814 hysterectomies, resulting in a case fatality rate of 3.2% (95% CI 2.5–4.2). Maternal case fatality rates differed among income settings; low- and lower middle-income countries had mean case fatality rates of 9.3% (95% CI 5.9–14.3) and 11.2% (95% CI 9.0–14.0), respectively, whereas, in upper middle- and high-income countries, case fatality rates were 3.9% (95% CI 2.8–5.7) and 1.0% (95% CI 0.5–1.6), respectively. The highest maternal

case fatality rate was reported in Nigeria: 13 of 22 women (59.1%) undergoing hysterectomy died.

Data on perinatal death were provided in 94 studies. The overall perinatal case fatality rate was 19% (14.4–24.9). The perinatal case fatality rate was 14.3% (95% CI 4–32.7) in low-income settings, 54.7% (95% CI 46.7–62.6) in lower middle-income settings, 18% (95% CI 13.9–24.8) in upper middle-income settings, and 5.6% (95% CI 4.1–7.5) in high-income settings.

No new case-control studies were included. Appendix 4 (available online at <http://links.lww.com/AOG/C968>) describes risk factors.

DISCUSSION

Marked differences in incidence, indications, management, and outcomes of emergency peripartum hysterectomy that were previously identified remain among countries with different income levels. Of the 26 newly included studies, a substantial proportion were population-based studies, which contributed to the validity of the present review. Overall, the incidence of emergent peripartum hysterectomy was 1.1 per 1,000 births, with the highest incidence

Table 6. Complications After Emergency Peripartum Hysterectomy

Complication	No. of Studies	No. of Patients (n/N)	Proportion (95% CI) ¹
Febrile morbidity	81	1,175/4,252	29.7 (25.4–34.3)
Hematologic ²	115	1,787/4,058	27.5 (20.4–35.9)
Infection ³	77	647/4,372	12.7 (10.0–15.9)
Wound ⁴	88	643/4,643	11.8 (9.8–14.3)
Genitourinary ⁵	109	713/6,531	9.9 (8.5–11.5)
Pulmonary ⁶	38	179/2,229	6.1 (4.1–8.9)
Psychological disturbance	16	60/990	5.9 (3.7–9.3)
Gastrointestinal ⁷	55	170/2,827	5.5 (4.2–7.2)
Renal ⁸	45	181/3,428	4.2 (3.0–6.4)
Cardiovascular ⁹	31	69/2,504	3.2 (2.4–4.4)
Thromboembolic ¹⁰	35	67/2,137	3.2 (2.5–4.3)
Neurologic ¹¹	6	8/295	3.0 (1.5–5.9)
Endocrinologic ¹²	5	8/243	3.3 (1.7–6.4)
Other ¹³	19	93/1,728	4.6 (2.6–7.9)

¹ Weighted proportions per 100 emergency peripartum hysterectomies using random-effects model.

² Includes bleeding, anemia, hypovolemic shock, hematomas, and coagulopathy.

³ Includes septicemia; pelvic, subphrenic, or vaginal cuff abscess; thrombophlebitis; respiratory infection; urinary infection; urinary tract infection; and peritonitis.

⁴ Includes dehiscence, hematoma, infection or sepsis, and incisional hernia.

⁵ Includes bladder or ureteric injury, fistula, incontinence, and urine retention.

⁶ Includes atelectasis, pneumothorax, pulmonary edema, pleural effusion, acute respiratory distress syndrome, and ventilation requirement.

⁷ Includes paralytic ileus, jaundice, liver dysfunction, ascites, bowel injury, and intestinal obstruction.

⁸ Includes acute renal failure, hydronephrosis, and oliguria.

⁹ Includes cardiac arrest, myocardial infarction, heart failure, and cardiomyopathy.

¹⁰ Includes deep vein thrombosis, pulmonary embolism, air embolism, and amniotic fluid embolism.

¹¹ Includes stroke, seizure, and coma.

¹² Includes Sheehan's syndrome and premature ovarian failure.

¹³ Includes prolonged pain, reactive splenomegaly, multiorgan failure, compartment syndrome, bed sores, anaphylactic shock, and cortical blindness.

observed in lower middle-income settings (3.0/1,000 births). The most common indication in low-income settings was uterine rupture; in high-income settings, it was placental pathology. Half of all women undergoing emergency peripartum hysterectomy previously underwent cesarean delivery.

There was a considerable difference in incidence of emergency peripartum hysterectomy among income settings. International differences in the incidence of emergency peripartum hysterectomy may be caused by variations in maternal age and health status, cesarean delivery rates, clinical management of major obstetric hemorrhage, study setting, and definition and availability of other surgical or radiologic interventions.^{1,130,131} Data suggest that the incidence also varies among high-income countries. This may be attributed to large geographic distances within countries; countries with spread out populations (eg, Canada, Australia) seem to have a higher incidence of emergency peripartum hysterectomy. Transport to health care facilities may result in longer delay, with women presenting already in shock in case of hemorrhage necessitating prompt intervention, or transport to a referral hospital with options for uterus-sparing interventions being logistically impossible.

For low-income countries, the incidence of emergency peripartum hysterectomy should be interpreted with caution because it was based on only two hospital-based studies from Tanzania (low-income during the study period) and Nepal. Low-income countries face multiple challenges, including difficulties for women to access health care facilities, limited availability of conservative management options, and low numbers of skilled birth attendants. Moreover, research output is limited compared with higher-income countries and might be published in lower-impact journals, thereby making it harder to identify. This makes the representativity of our findings for these countries limited.

Worldwide, placental pathology was the most common indication for emergency peripartum hysterectomy. This is likely a result of the increasing rates of cesarean delivery.¹³² Indications varied among income settings. Uterine rupture was most common indication in lower middle-income settings, and placental pathology was most frequently observed in high-income settings. This difference may be attributable to higher rates of obstructed labor, lack of monitoring of labor progress, and reduced accessibility and availability of maternity care in lower-income settings.¹³³

Previous studies have demonstrated that registration for antenatal care is a protective factor for

emergency peripartum hysterectomy.¹³⁴ Although many women were registered as not having received antenatal care, the association between antenatal care and emergency peripartum hysterectomy remains unclear because of possible lack of documentation. First, it was not possible to distinguish truly unregistered women from women referred who received antenatal care outside the facility where emergency peripartum hysterectomy was performed. Also, antenatal care registration was mentioned almost exclusively for low- and lower middle-income countries, where women may have a higher chance of not accessing antenatal care.

Postoperative maternal morbidity and mortality rates were considerable. A quarter of the women had infectious or bleeding complications. This is likely due to the high volume of blood loss associated with emergency peripartum hysterectomy (average volume of blood loss 3.9 L).¹³⁵ The highest rates of blood transfusion were found in lower middle-income settings. The highest quantities of red blood cells, however, were transfused in high-income settings. This inverse relationship may be explained by fewer alternative preventive measures and a limited availability of blood transfusion in lower-income settings.¹³⁶ The ability to transfuse a woman will undoubtedly influence the decision to perform emergency peripartum hysterectomy, which may happen earlier in the course of hemorrhage in some settings as a result. The same may happen when few other conservative management options are available. Access to safe blood transfusion is likely to be an efficient and cost-effective intervention to reduce maternal mortality associated with emergency peripartum hysterectomy in lower-income settings.

There was also a remarkable difference in perinatal mortality among income settings; rates in lower-income settings were disproportionately higher compared with high-income settings. Risk of perinatal death was up to nine times higher in lower middle-income compared with high-income settings. These impressive inequities can be explained by resource limitations and delays in accessing maternity care, as well as by inadequate management compounded by a lack of skilled birth attendants.^{133,137,138}

To our knowledge, this is the largest and most comprehensive review to date on incidence, indications, and outcomes of emergency peripartum hysterectomy. It provides a robust global overview of emergency peripartum hysterectomy through reporting on data from 42 countries. Our study includes a thorough assessment of the quality of included studies. Whereas the previous article used an adaptation of the

Newcastle-Ottawa scale, we assessed all 154 studies again, this time using the COSMOS-E criteria.

Nevertheless, this study has several limitations. First, women from low-income settings were under-represented in this meta-analysis. Second, this meta-analysis includes few population-based studies. However, population-based studies have their own limitations, such as unknown data quality, data collection not usually done by the researchers, and possibly missing confounder information. Third, in the absence of individual data, multivariable analysis was not possible and multiple or sequential measures could not be described, as often occurs in practice. Fourth, risk of bias was assessed as high in 35.7% of the studies. We did not exclude studies after quality assessment, to calculate a more accurate estimate of mean values. Also, by excluding such a high number of studies, we deemed that estimations of incidence would become problematic.

These data suggest a number of considerations. First, there is a need for a universal definition for emergency peripartum hysterectomy. We suggest that future studies on emergency peripartum hysterectomy include all hysterectomies up to 6 weeks postpartum, because most infectious complications will arise later than 24 or 48 hours postpartum.¹⁷ Also, almost none of the studies included hysterectomies in the first trimester due to abortive complications, which would also be of importance. Second, literature on emergency peripartum hysterectomy in low-income countries and in South America, Asia, and Africa is scarce. Clearly more data are needed from these regions. Third, we observed an increase in the number of population-based studies that were included compared with 7 years ago. Although population-based studies provide the most accurate representation of a country's incidence, use of routinely collected data may have some degree of inaccuracy. Fourth, this review underlines the importance of reducing cesarean delivery rates, which remain the most important risk factor for placenta accreta spectrum, uterine rupture, and massive obstetric hemorrhage. Fifth, because placental pathology is the most frequent indication for emergency peripartum hysterectomy in high-income settings, we recommend that increased efforts should be undertaken to care for these complex patients.

To conclude, considerable inequity exists in incidence and associated morbidity and mortality of emergency peripartum hysterectomy across the world. This inequity can be reduced only by improving accessibility, availability, and quality of care for the vulnerable group of pregnant women globally.

REFERENCES

1. van den Akker T, Brobbel C, Dekkers OM, Bloemenkamp KW. Prevalence, indications, risk indicators, and outcomes of emergency peripartum hysterectomy worldwide: a systematic review and meta-analysis. *Obstet Gynecol* 2016;128:1281-94. doi: 10.1097/AOG.0000000000001736
2. Huque S, Roberts I, Fawole B, Chaudhri R, Arulkumaran S, Shakur-Still H. Risk factors for peripartum hysterectomy among women with postpartum haemorrhage: analysis of data from the WOMAN trial. *BMC Pregnancy Childbirth* 2018;18:186. doi: 10.1186/s12884-018-1829-7
3. Rossi AC, Lee RH, Chmait RH. Emergency postpartum hysterectomy for uncontrolled postpartum bleeding: a systematic review. *Obstet Gynecol* 2010;115:637-44. doi: 10.1097/AOG.0b013e3181cfc007
4. Geller SE, Koch AR, Garland CE, MacDonald EJ, Storey F, Lawton B. A global view of severe maternal morbidity: moving beyond maternal mortality. *Reprod Health* 2018;15(suppl 1):98. doi: 10.1186/s12978-018-0527-2
5. Say L, Pattinson RC, Gulmezoglu AM. WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). *Reprod Health* 2004;1:3. doi: 10.1186/1742-4755-1-3
6. World Bank. Classifying countries by income. Accessed Feb 3, 2021. <https://datatopics.worldbank.org/world-development-indicators/stories/the-classification-of-countries-by-income.html#:~:text=As%20of%201%20July%202019,between%20%24%2C996%20and%20%2412%2C375%3B%20high%2D>
7. Dekkers OM, Vandenbroucke JP, Cevallos M, Renehan AG, Altman DG, Egger M. COSMOS-E: guidance on conducting systematic reviews and meta-analyses of observational studies of etiology. *PLoS Med* 2019;16:e1002742. doi: 10.1371/journal.pmed.1002742
8. Sharma B, Sikka P, Jain V, Jain K, Bagga R, Suri V. Peripartum hysterectomy in a tertiary care hospital: epidemiology and outcomes. *J Anaesthesiol Clin Pharmacol* 2017;33:324-8. doi: 10.4103/joacp.JOACP_380_16
9. Akintayo AA, Olagbuji BN, Aderoba AK, Akadir O, Olofinbiyi BA, Bakare B. Emergency peripartum hysterectomy: a multicenter study of incidence, indications and outcomes in southwestern Nigeria. *Matern Child Health J* 2016;20:1230-6. doi: 10.1007/s10995-016-1924-1
10. Ul Ehsan MK, Waseem MS, Ahmad J. AN assessment of extent and associated factors of obstetric hysterectomy and its association with mortality and morbidity. *Indo Am J Pharm Sci* 2019;6:6765-9. doi: 10.5281/zenodo.2612185
11. Chawla J, Arora D, Paul M, Ajmani SN. Emergency obstetric hysterectomy: a retrospective study from a teaching hospital in north India over eight years. *Oman Med J* 2015;30:181-6. doi: 10.5001/omj.2015.39
12. Zhang Y, Yan J, Han Q, Yang T, Cai L, Fu Y, et al. Emergency obstetric hysterectomy for life-threatening postpartum hemorrhage: a 12-year review. *Medicine (Baltimore)* 2017;96:e8443. doi: 10.1097/md.00000000000008443
13. Senturk MB, Cakmak Y, Guraslan H, Dogan K. Emergency peripartum hysterectomy: 2-year experiences in non-tertiary center. *Arch Gynecol Obstet* 2015;292:1019-25. doi: 10.1007/s00404-015-3740-z
14. Tahaoglu AE, Balsak D, Togrul C, Obut M, Tosun O, Cavus Y, et al. Emergency peripartum hysterectomy: our experience. *Ir J Med Sci* 2016;185:833-8. doi: 10.1007/s11845-015-1376-4
15. Özcan H, Uğur MG, Balat Ö, Bayramoğlu Tepe N, Sucu S. Emergency peripartum hysterectomy: single center ten-year

experience. *J Matern Fetal Neonatal Med* 2017;30:2778–83. doi: 10.1080/14767058.2016.1263293

16. Pan XY, Wang YP, Zheng Z, Tian Y, Hu YY, Han SH. A marked increase in obstetric hysterectomy for placenta accreta. *Chin Med J (Engl)* 2015;128:2189–93. doi: 10.4103/0366-6999.162508
17. Heitkamp A, Seinstra J, van den Akker T, Vollmer L, Gebhardt S, van Roosmalen J, et al. A district-wide population-based descriptive study of emergency peripartum hysterectomy in a middle-income country. *Int J Gynaecol Obstet* 2019;146:103–9. doi: 10.1002/ijgo.12837
18. Jakobsson M, Tapper AM, Colmorn LB, Lindqvist PG, Klungsoyr K, Krebs L, et al. Emergency peripartum hysterectomy: results from the prospective Nordic Obstetric Surveillance Study (NOSS). *Acta Obstet Gynecol Scand* 2015;94:745–54. doi: 10.1111/aogs.12644
19. Kallianidis AF, Maraschini A, Danis J, Colmorn LB, Deneux-Tharoux C, Donati S, et al. Epidemiological analysis of peripartum hysterectomy across nine European countries. *Acta Obstet Gynecol Scand* 2020;99:1364–73. doi: 10.1111/aogs.13892
20. Cheng HC, Pelecanos A, Sekar R. Review of peripartum hysterectomy rates at a tertiary Australian hospital. *Aust N Z J Obstet Gynaecol* 2016;56:614–8. doi: 10.1111/ajo.12519
21. Balalau DO, Sima RM, Bacalbasa N, Ples L, Stanescu AD. Emergency peripartum hysterectomy, physical and mental consequences: a 6-year study. *J Mind Med Sci* 2016;3:65–70.
22. Govindappagari S, Wright JD, Ananth CV, Huang Y, D'Alton ME, Friedman AM. Risk of peripartum hysterectomy and center hysterectomy and delivery volume. *Obstet Gynecol* 2016;128:1215–24. doi: 10.1097/aog.0000000000001722
23. Campbell SM, Corcoran P, Manning E, Greene RA. Peripartum hysterectomy incidence, risk factors and clinical characteristics in Ireland. *Eur J Obstet Gynecol Reprod Biol* 2016;207:56–61. doi: 10.1016/j.ejogrb.2016.10.008
24. Arulpragasam K, Hyanes G, Epee-Bekima M. Emergency peripartum hysterectomy in a Western Australian population: ten-year retrospective case-note analysis. *Aust N Z J Obstet Gynaecol* 2019;59:533–7. doi: 10.1111/ajo.12922
25. Lauroy A, Verhaeghe C, Vidal F, Parant O, Legendre G, Guerby P. Perioperative outcomes using LigaSure compared with conventional technique in peripartum hysterectomy. *Arch Gynecol Obstet* 2020;301:229–34. doi: 10.1007/s00404-019-05398-0
26. de Gregorio A, Friedl TWP, Scholz C, Janni W, Ebner F, de Gregorio N. Emergency peripartum hysterectomy a single-center analysis of the last 13 years at a tertiary perinatal care unit. *J Perinat Med* 2019;47:169–75. doi: 10.1515/jpm-2018-0149
27. Maraschini A, Lega I, D'Aloja P, Buoncristiano M, Dell'Oro S, Donati S. Women undergoing peripartum hysterectomy due to obstetric hemorrhage: a prospective population-based study. *Acta Obstet Gynecol Scand* 2020;99:274–82. doi: 10.1111/aogs.13727
28. Triunfo S, Ferrazzani S, Volpe M, Scambia G, Lanzone A. Old and novel insights into emergency peripartum hysterectomy: a time-trend analysis. *Arch Gynecol Obstet* 2020;301:1159–65. doi: 10.1007/s00404-020-05504-7
29. Bolnga JW, Mola GDL, Ao P, Sapau W, Verave O, Lufele E, et al. Mortality and morbidity after emergency peripartum hysterectomy in a provincial referral hospital in Papua New Guinea: a seven-year audit. *Aust N Z J Obstet Gynaecol* 2021;61:360–5. doi: 10.1111/ajo.13286
30. Chaudhary V, Singh M, Nain S, Reena F, Aggarwal K, Biswas R, et al. Incidence, management and outcomes in women undergoing peripartum hysterectomy in a tertiary care centre in India. *Cureus* 2021;13:e14171. doi: 10.7759/cureus.14171
31. Mbakwa MR, Tendongfor N, Ngunyi YL, Ngek ESN, Alemkia F, Egbe TO. Indications and outcomes of emergency obstetric hysterectomy; a 5-year review at the Bafoussam Regional Hospital, Cameroon. *BMC Pregnancy Childbirth* 2021;21:323. doi: 10.1186/s12884-021-03797-3
32. Rawashdeh H, Obeidat R, Masaadeh L. Emergency peripartum hysterectomy in a tertiary teaching hospital in Northern Jordan: a 15-year review. *Gynecol Surg* 2021;18:1. doi: 10.1186/s10397-021-01082-x
33. Yildirim GY, Koroglu N, Akca A, Talmac M, Dikmen S, Yildirim G, et al. What is new in peripartum hysterectomy? A seventeen year experience in a tertiary hospital. *Taiwan J Obstet Gynecol* 2021;60:95–8. doi: 10.1016/j.tjog.2020.11.014
34. Wei Q, Zhang W, Chen M, Zhang L, He G, Liu X. Peripartum hysterectomy in 38 hospitals in China: a population-based study. *Arch Gynecol Obstet* 2014;289:549–53. doi: 10.1007/s00404-013-3002-x
35. Sakse A, Weber T, Nickelsen C, Secher NJ. Peripartum hysterectomy in Denmark 1995-2004. *Acta Obstet Gynecol Scand* 2007;86:1472–5. doi: 10.1080/00016340701692651
36. Kwee A, Bots ML, Visser GH, Bruinse HW. Emergency peripartum hysterectomy: a prospective study in The Netherlands. *Eur J Obstet Gynecol Reprod Biol* 2006;124:187–92. doi: 10.1016/j.ejogrb.2005.06.012
37. Knight M, Kurinczuk JJ, Spark P, Brocklehurst P; United Kingdom Obstetric Surveillance System Steering Committee. Cesarean delivery and peripartum hysterectomy. *Obstet Gynecol* 2008;111:97–105. doi: 10.1097/01.AOG.0000296658.83240.6d
38. Glaze S, Ekwalinga P, Roberts G, Lange I, Birch C, Rosengarten A, et al. Peripartum hysterectomy: 1999 to 2006. *Obstet Gynecol* 2008;111:732–8. doi: 10.1097/AOG.0b013e31816569f2
39. Gerli S, Favilli A, Bini V, Di Renzo GC. Postpartum hysterectomy: a regional multicentre analysis in Italy. *J Obstet Gynaecol* 2010;30:829–32. doi: 10.3109/01443615.2010.518258
40. Eniola OA, Bewley S, Waterstone M, Hooper R, Wolfe CD. Obstetric hysterectomy in a population of south east England. *J Obstet Gynaecol* 2006;26:104–9. doi: 10.1080/01443610500443196
41. Chen M, Zhang L, Wei Q, Fu X, Gao Q, Liu X. Peripartum hysterectomy between 2009 and 2010 in Sichuan, China. *Int J Gynaecol Obstet* 2013;120:183–6. doi: 10.1016/j.ijgo.2012.09.012
42. Bodelon C, Bernabe-Ortiz A, Schiff MA, Reed SD. Factors associated with peripartum hysterectomy. *Obstet Gynecol* 2009;114:115–23. doi: 10.1097/AOG.0b013e3181a81cdd
43. Hamsho MA, Alsakka M. Emergency obstetric hysterectomy in Qatar—a 20-year review. *Int J Fertil Womens Med* 1999;44:209–11.
44. Zwart JJ, Dijk PD, van Roosmalen J. Peripartum hysterectomy and arterial embolization for major obstetric hemorrhage: a 2-year nationwide cohort study in The Netherlands. *Am J Obstet Gynecol* 2010;202:150.e1–7. doi: 10.1016/j.ajog.2009.09.003
45. Knight M. Peripartum hysterectomy in the UK: management and outcomes of the associated haemorrhage. *BJOG* 2007;114:1380–7. doi: 10.1111/j.1471-0528.2007.01507
46. Pradhan M, Shao Y. Emergency peripartum hysterectomy as postpartum hemorrhage treatment: incidence, risk factors, and complications. *JNMA J Nepal Med Assoc* 2014;52:668–76. doi: 10.31729/jnma.2375

47. Lone F, Sultan AH, Thakar R, Beggs A. Risk factors and management patterns for emergency obstetric hysterectomy over 2 decades. *Int J Gynaecol Obstet* 2010;109:12–5. doi: 10.1016/j.ijgo.2009.10.012
48. Lim WH, Pavlov T, Dennis AE. Analysis of emergency peripartum hysterectomy in Northern Tasmania. *Aust J Rural Health* 2014;22:235–40. doi: 10.1111/ajr.12135
49. Kwame-Aryee R, Kwakye A, Seffah J. Peripartum hysterectomies at the Korle-Bu Teaching Hospital: a review of 182 consecutive cases. *Ghana Med J* 2007;41:133–8. doi: 10.4314/gmj.v41i3.55281
50. Eltabbakh GH, Watson JD. Postpartum hysterectomy. *Int J Gynaecol Obstet* 1995;50:257–62. doi: 10.1016/0020-7292(95)02460-t
51. Awan N, Bennett MJ, Walters WA. Emergency peripartum hysterectomy: a 10-year review at the royal hospital for women, Sydney. *Aust N Z J Obstet Gynaecol* 2011;51:210–5. doi: 10.1111/j.1479-828X.2010.01278.x
52. Allam IS, Gomaa IA, Fathi HM, Sukkar GF. Incidence of emergency peripartum hysterectomy in Ain-shams University Maternity Hospital, Egypt: a retrospective study. *Arch Gynecol Obstet* 2014;290:891–6. doi: 10.1007/s00404-014-3306-5
53. Zeteroglu S, Ustun Y, Engin-Ustun Y, Sahin G, Kamaci M. Peripartum hysterectomy in a teaching hospital in the eastern region of Turkey. *Eur J Obstet Gynecol Reprod Biol* 2005;120:57–62. doi: 10.1016/j.ejogrb.2004.08.011
54. Sahin S, Guzin K, Eroglu M, Kayabasoglu F, Yasartekin MS. Emergency peripartum hysterectomy: our 12-year experience. *Arch Gynecol Obstet* 2014;289:953–8. doi: 10.1007/s00404-013-3079-2
55. Nisar N, Sohoo NA. Emergency peripartum hysterectomy: frequency, indications and maternal outcome. *J Ayub Med Coll Abbottabad* 2009;21:48–51.
56. Obiechina NJ, Eleje GU, Ezebialu IU, Okeke CA, Mbamara SU. Emergency peripartum hysterectomy in Nnewi, Nigeria: a 10-year review. *Niger J Clin Pract* 2012;15:168–71. doi: 10.4103/1119-3077.97303
57. Aboelmagd MS, Kasrawi R, Hathout H. Emergency hysterectomy in obstetric practice: five year review. *Int J Gynaecol Obstet* 1987;25:437–40. doi: 10.1016/0020-7292(87)90058-0
58. Demirci O, Tugrul AS, Yilmaz E, Tosun O, Demirci E, Eren YS. Emergency peripartum hysterectomy in a tertiary obstetric center: nine years evaluation. *J Obstet Gynaecol Res* 2011;37:1054–60. doi: 10.1111/j.1447-0756.2010.01484.x
59. Erman Akar M, Saygili Yilmaz E, Yuksel B, Yilmaz Z. Emergency peripartum hysterectomy. *Eur J Obstet Gynecol Reprod Biol* 2004;113:178–81. doi: 10.1016/j.ejogrb.2003.10.005
60. Kayabasoglu F, Guzin K, Aydogdu S, Sezginsoy S, Turkgeldi L, Gunduz G. Emergency peripartum hysterectomy in a tertiary Istanbul hospital. *Arch Gynecol Obstet* 2008;278:251–6. doi: 10.1007/s00404-007-0551-x
61. Lau WC, Fung HY, Rogers MS. Ten years experience of caesarean and postpartum hysterectomy in a teaching hospital in Hong Kong. *Eur J Obstet Gynecol Reprod Biol* 1997;74:133–7. doi: 10.1016/s0301-2115(97)00090-0
62. Omole-Ohonsi A, Taiwo Olayinka H. Emergency peripartum hysterectomy in a developing country. *J Obstet Gynaecol Can* 2012;34:954–60. doi: 10.1016/s1701-2163(16)35409-3
63. Ozden S, Yildirim G, Basaran T, Gurbuz B, Dayicioğlu V. Analysis of 59 cases of emergent peripartum hysterectomies during a 13-year period. *Arch Gynecol Obstet* 2005;271:363–7. doi: 10.1007/s00404-004-0647-5
64. Rachagan SP, Sivanesaratnam V. Caesarean hysterectomy—a review of 21 cases in the university hospital, Kuala Lumpur. *Eur J Obstet Gynecol Reprod Biol* 1984;16:321–6. doi: 10.1016/0028-2243(84)90160-6
65. Suwannarurk K, Thaweekul Y, Mairaing K, Poomtavorn Y, Bhamarapratana K. Silent abnormal placentation linkage to peripartum hysterectomy: Thammasat University Hospital 6-year study. *J Med Assoc Thai* 2014;97:473–7.
66. Tapisiz OL, Altinbas SK, Yirci B, Cenksoy P, Kaya AE, Dede S, et al. Emergency peripartum hysterectomy in a tertiary hospital in Ankara, Turkey: a 5-year review. *Arch Gynecol Obstet* 2012;286:1131–4. doi: 10.1007/s00404-012-2434-z
67. Tuncer R, Erkaya S, Sipahi T, Kara F. Emergency postpartum hysterectomy. *J Gynecol Surg* 1995;11:209–13. doi: 10.1089/gyn.1995.11.209
68. Umezurike CC, Feyi-Waboso PA, Adisa CA. Peripartum hysterectomy in Aba southeastern Nigeria. *Aust N Z J Obstet Gynaecol* 2008;48:580–2. doi: 10.1111/j.1479-828X.2008.00905.x
69. Wingprawat S, Chittacharoen A, Suthutvoravut S. Risk factors for emergency peripartum cesarean hysterectomy. *Int J Gynaecol Obstet* 2005;90:136–7. doi: 10.1016/j.ijgo.2005.04.013
70. Yamasmith W, Chaithongwongwatthana S. Risk factors for cesarean hysterectomy in tertiary center in Thailand: a case-control study. *J Obstet Gynaecol Res* 2009;35:60–5. doi: 10.1111/j.1447-0756.2008.00837.x
71. Yucel O, Ozdemir I, Yucel N, Somunkiran A. Emergency peripartum hysterectomy: a 9-year review. *Arch Gynecol Obstet* 2006;274:84–7. doi: 10.1007/s00404-006-0124-4
72. Chestnut DH, Dewan DM, Redick LF, Caton D, Spielman FJ. Anesthetic management for obstetric hysterectomy: a multi-institutional study. *Anesthesiology* 1989;70:607–10. doi: 10.1097/0000542-198904000-00009
73. Chestnut DH, Eden RD, Gall SA, Parker RT. Peripartum hysterectomy: a review of cesarean and postpartum hysterectomy. *Obstet Gynecol* 1985;65:365–70.
74. Chew S, Biswas A. Caesarean and postpartum hysterectomy. *Singapore Med J* 1998;39:9–13.
75. Clark SL, Yeh SY, Phelan JP, Bruce S, Paul RH. Emergency hysterectomy for obstetric hemorrhage. *Obstet Gynecol* 1984;64:376–80.
76. D'Arpe S, Franceschetti S, Corosu R, Palaia I, Di Donato V, Perniola G, et al. Emergency peripartum hysterectomy in a tertiary teaching hospital: a 14-year review. *Arch Gynecol Obstet* 2015;291:841–7. doi: 10.1007/s00404-014-3487-y
77. Daskalakis G, Anastasakis E, Papantoniou N, Mesogitis S, Theodora M, Antsaklis A. Emergency obstetric hysterectomy. *Acta Obstet Gynecol Scand* 2007;86:223–7. doi: 10.1080/00016340601088448
78. Engelsen IB, Albrechtsen S, Iversen OE. Peripartum hysterectomy-incidence and maternal morbidity. *Acta Obstet Gynecol Scand* 2001;80:409–12.
79. Kastner ES, Figueroa R, Garry D, Maulik D. Emergency peripartum hysterectomy: experience at a community teaching hospital. *Obstet Gynecol* 2002;99:971–5. doi: 10.1016/s0029-7844(02)01999-3
80. Lee IH, Son JH, Shin YC, Byun JH, Yoon HJ, Jee YS. Anesthetic review of emergency peripartum hysterectomy following vaginal and cesarean delivery: a retrospective study. *Korean J Anesthesiol* 2012;63:43–7. doi: 10.4097/kjae.2012.63.1.43
81. Rahman J, Al-Ali M, Qutub HO, Al-Suleiman SS, Al-Jama FE, Rahman MS. Emergency obstetric hysterectomy in a univer-

sity hospital: a 25-year review. *J Obstet Gynaecol* 2008;28:69-72. doi: 10.1080/01443610701816885

82. Roethlisberger M, Womastek I, Posch M, Husslein P, Pateisky N, Lehner R. Early postpartum hysterectomy: incidence and risk factors. *Acta Obstet Gynecol Scand* 2010;89:1040-4. doi: 10.3109/00016349.2010.499445
83. Smith J, Mousa HA. Peripartum hysterectomy for primary postpartum haemorrhage: incidence and maternal morbidity. *J Obstet Gynaecol* 2007;27:44-7. doi: 10.1080/01443610601016925
84. Stanco LM, Schrimmer DB, Paul RH, Mishell DR Jr. Emergency peripartum hysterectomy and associated risk factors. *Am J Obstet Gynecol* 1993;168:879-83. doi: 10.1016/s0002-9378(12)90838-8
85. Wani RV, Abu-Hudra NM, Al-Tahir SI. Emergency peripartum hysterectomy: a 13-year review at a tertiary center in Kuwait. *J Obstet Gynaecol India* 2014;64:403-8. doi: 10.1007/s13224-014-0554-z
86. Wong TY. Emergency peripartum hysterectomy: a 10-year review in a tertiary obstetric hospital. *N Z Med J* 2011;124:34-9.
87. Yamamoto H, Sagae S, Nishikawa S, Kudo R. Emergency postpartum hysterectomy in obstetric practice. *J Obstet Gynaecol Res* 2000;26:341-5. doi: 10.1111/j.1447-0756.2000.tb01336.x
88. Yamani Zamzami TY. Indication of emergency peripartum hysterectomy: review of 17 cases. *Arch Gynecol Obstet* 2003;268:131-5. doi: 10.1007/s00404-003-0494-9
89. Castaneda S, Karrison T, Cibils LA. Peripartum hysterectomy. *J Perinat Med* 2000;28:472-81. doi: 10.1515/jpm.2000.064
90. Akinbiyi AA, Olatunbosun OA. Emergency hysterectomies (how many are potentially preventable?): a 28-year experience in Saskatoon. *J Gynecol Surg* 2004;20:81-7.
91. Singh A, Hada M, Yangzom K, GC A. Emergency peripartum hysterectomy. *Nepal J Obstet Gynaecol* 2006;1:33-6.
92. Naz SBR, Shakh MS, Perveen R, Ahmad S. Peripartum hysterectomy: a life saving procedure. *Pak J Surg* 2008;24:224-7.
93. Panagopoulos PKC, Dendris A, Economou A, Karadaglis S, Samolis S. Emergency peripartum hysterectomy: 10-year experience in a Greek public maternity unit. *Giornale Italiano di Ostetricia e Ginecologia* 2007;29:25-7.
94. Zaman BS, Sadaf J, Bhatti SZ, Shamas N. Indications and complication of emergency peripartum hysterectomy in Bahawal Victoria Hospital Bahawalpur. *Pak J Med Health Sci* 2013;7:726-9.
95. Abu-Heija AT, Jallad FF. Emergency peripartum hysterectomy at the Princess Badea Teaching Hospital in north Jordan. *J Obstet Gynaecol Res* 1999;25:193-5. doi: 10.1111/j.1447-0756.1999.tb01146.x
96. Bakshi S, Meyer BA. Indications for and outcomes of emergency peripartum hysterectomy. A five-year review. *J Reprod Med* 2000;45:733-7.
97. Forna F, Miles AM, Jamieson DJ. Emergency peripartum hysterectomy: a comparison of cesarean and postpartum hysterectomy. *Am J Obstet Gynecol* 2004;190:1440-4. doi: 10.1016/j.ajog.2004.02.021
98. Gurtani FM, Fadaei B, Akbari M. Emergency peripartum hysterectomy in Isfahan; maternal mortality and morbidity rates among the women who underwent peripartum hysterectomy. *Adv Biomed Res* 2013;2:20. doi: 10.4103/2277-9175.108004
99. Kacmar J, Bhimani L, Boyd M, Shah-Hosseini R, Peipert J. Route of delivery as a risk factor for emergent peripartum hysterectomy: a case-control study. *Obstet Gynecol* 2003;102:141-5. doi: 10.1016/s0029-7844(03)00404-6
100. Karayalcin R, Ozcan S, Ozyer S, Mollamahmutoglu L, Danisman N. Emergency peripartum hysterectomy. *Arch Gynecol Obstet* 2011;283:723-7. doi: 10.1007/s00404-010-1451-z
101. Osefo NJ. Cesarean and postpartum hysterectomy in Enugu, 1973-1986. *Int J Gynaecol Obstet* 1989;30:93-7. doi: 10.1016/0020-7292(89)90301-9
102. Sturdee DW, Rushton DI. Cesarean and post-partum hysterectomy 1968-1983. *Br J Obstet Gynaecol* 1986;93:270-4. doi: 10.1111/j.1471-0528.1986.tb07906.x
103. Tadesse W, Farah N, Hogan J, D'Arcy T, Kennelly M, Turner MJ. Peripartum hysterectomy in the first decade of the 21st century. *J Obstet Gynaecol* 2011;31:320-1. doi: 10.3109/01443615.2011.560300
104. Wenham J, Matijevic R. Post-partum hysterectomies: revisited. *J Perinat Med* 2001;29:260-5. doi: 10.1515/jpm.2001.037
105. Zelop CM, Harlow BL, Frigoletto FD Jr., Safon LE, Saltzman DH. Emergency peripartum hysterectomy. *Am J Obstet Gynecol* 1993;168:1443-8. doi: 10.1016/s0002-9378(11)90779-0
106. Ahmad S, Mir I. Emergency peripartum hysterectomy: experience at Apex Hospital of Kashmir Valley. *Int J Gynecol Obstet* 2007;8:1-4.
107. Gungorduk K, Yildirim G, Dugan N, Polat I, Sudolmus S, Ark C. Peripartum hysterectomy in Turkey: a case-control study. *J Obstet Gynaecol* 2009;29:722-8. doi: 10.3109/01443610903168358
108. Mesleh R, Ayoub H, Algwiser A, Kurdi A. Emergency peripartum hysterectomy. *J Obstet Gynaecol* 1998;18:533-7. doi: 10.1080/01443619866264
109. Chibber R, Al-Hijji J, Fouda M, Al-Saleh E, Al-Adwani AR, Mohammed AT. A 26-year review of emergency peripartum hysterectomy in a tertiary teaching hospital in Kuwait - years 1983-2011. *Med Princ Pract* 2012;21:217-22. doi: 10.1159/000334575
110. Christopoulos P, Hassiakos D, Tsitoura A, Panoulis K, Pappadias K, Vitoratos N. Obstetric hysterectomy: a review of cases over 16 years. *J Obstet Gynaecol* 2011;31:139-41. doi: 10.3109/01443615.2010.536858
111. Hernandez JS, Wendel GD Jr, Sheffield JS. Trends in emergency peripartum hysterectomy at a single institution: 1988-2009. *Am J Perinatol* 2013;30:365-70. doi: 10.1055/s-0032-1324704
112. Ossola MW, Somigliana E, Mauro M, Acaia B, Benaglia L, Fedele L. Risk factors for emergency postpartum hysterectomy: the neglected role of previous surgically induced abortions. *Acta Obstet Gynecol Scand* 2011;90:1450-3. doi: 10.1111/j.1600-0412.2011.01223.x
113. Selo-Ojeme DO, Bhattacharjee P, Izuwa-Njoku NF, Kadir RA. Emergency peripartum hysterectomy in a tertiary London hospital. *Arch Gynecol Obstet* 2005;271:154-9. doi: 10.1007/s00404-004-0715-x
114. Begum M, Alsafi F, ElFarra J, Tamim HM, Le T. Emergency peripartum hysterectomy in a tertiary care hospital in Saudi Arabia. *J Obstet Gynaecol India* 2014;64:321-7. doi: 10.1007/s13224-013-0423-1
115. Adesiyun AG, Edwin E, Ameh C. Inevitable peripartum hysterectomy in a tropical hospital: indications and maternofetal outcome. *Pak J Med Sci* 2008;24:122-6.
116. Khanum FSR, Meher UN, Zahid M. Emergency peripartum hysterectomy in a tertiary care hospital. *J Med Sci (Peshawar)* 2013;21:58-61.
117. Sahu LC, Panda S. Hysterectomy for obstetric emergencies. *J Obstet Gynaecol India* 2004;54:34-6.

118. Ogunniyi SO, Esen UI. Obstetric hysterectomy in Ile-Ife, Nigeria. *Int J Gynaecol Obstet* 1990;32:23–7. doi: 10.1016/0020-7292(90)90977-s
119. Siddiq NGA, Jabbar S, Ali T. Emergency obstetrical hysterectomy (EOH): a life saving procedure in obstetrics. *Pak J Surg* 2007;23:217–9.
120. Archana KBS. A clinical review of emergency obstetric hysterectomy. *J Obstet Gynaecol India* 2009;59:427–31.
121. Kant AWK. Emergency obstetric hysterectomy. *J Obstet Gynaecol India* 2005;55:132–4.
122. Praneswari Devi RKS, Singh D. Emergency hysterectomy: a study of 26 cases over a period of 5 years. *J Obstet Gynaecol India* 2004;54:343–5.
123. Najam RBP, Sharma R, Agarwal D. Emergency obstetric hysterectomy: a retrospective study at a tertiary care hospital. *J Clin Diagn Res* 2010;4:2864–8.
124. Lu PY, Pastorek JG II, Letellier RL, Bey MA. Elective versus emergency cesarean hysterectomy on a teaching service—1981 to 1991. *South Med J* 1997;90:50–4. doi: 10.1097/00007611-199701000-00011
125. Yalinkaya A, Guzel AI, Kangal K. Emergency peripartum hysterectomy: 16-year experience of a medical hospital. *J Chin Med Assoc* 2010;73:360–3. doi: 10.1016/S1726-4901(10)70078-2
126. Tebeu PM, Fezeu LY, Ekono MR, Kengne Fosso G, Fouelack Ymele F, Fomulu JN. Postpartum hemorrhage at Yaounde University Hospital, Cameroon. *Int J Gynaecol Obstet* 2013;121:283–4. doi: 10.1016/j.ijgo.2013.01.010
127. Sebitloane MH, Moodley J. Emergency peripartum hysterectomy. *East Afr Med J* 2001;78:70–4. doi: 10.4314/eamj.v78i2.9091
128. Katchy KC, Ziad F, Al Nashmi N, Diejomaoh MF. Emergency obstetric hysterectomy in Kuwait: a clinico pathological analysis. *Arch Gynecol Obstet* 2006;273:360–5. doi: 10.1007/s00404-005-0101-3
129. Macharey G, Ulander VM, Kostev K, Vaisanen-Tommiska M, Ziller V. Emergency peripartum hysterectomy and risk factors by mode of delivery and obstetric history: a 10-year review from Helsinki University Central Hospital. *J Perinat Med* 2015;43:721–8. doi: 10.1515/jpm-2013-0348
130. de la Cruz CZ, Thompson EL, O'Rourke K, Nembhard WN. Cesarean section and the risk of emergency peripartum hysterectomy in high-income countries: a systematic review. *Arch Gynecol Obstet* 2015;292:1201–15. doi: 10.1007/s00404-015-3790-2
131. Machado LS. Emergency peripartum hysterectomy: incidence, indications, risk factors and outcome. *N Am J Med Sci* 2011;3:358–61. doi: 10.4297/najms.2011.358
132. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol* 2006;107:1226–32. doi: 10.1097/01.AOG.0000219750.79480.84
133. Goldenberg RL, McClure EM, Saleem S. Improving pregnancy outcomes in low- and middle-income countries. *Reprod Health* 2018;15(suppl 1):88. doi: 10.1186/s12978-018-0524-5
134. Ozumba BC, Mbagwu SC. Emergency obstetric hysterectomy in eastern Nigeria. *Int Surg* 1991;76:109–11.
135. Collis R, Guasch E. Managing major obstetric haemorrhage: pharmacotherapy and transfusion. *Best Pract Res Clin Anaesthesiol* 2017;31:107–24. doi: 10.1016/j.bpa.2017.02.001
136. Kong CW, To WWK. Trends in conservative procedures and peripartum hysterectomy rates in severe postpartum haemorrhage. *J Matern Fetal Neonatal Med* 2018;31:2820–6. doi: 10.1080/14767058.2017.1357169
137. Sobhy S, Arroyo-Manzano D, Murugesu N, Karthikeyan G, Kumar V, Kaur I, 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. doi: 10.1016/S0140-6736(18)32386-9
138. Shukla VV, Carlo WA. Review of the evidence for interventions to reduce perinatal mortality in low- and middle-income countries. *Int J Pediatr Adolesc Med* 2020;7:2–8. doi: 10.1016/j.ijpam.2020.02.004

PEER REVIEW HISTORY

Received July 22, 2022. Received in revised form September 22, 2022. Accepted September 29, 2022. Peer reviews and author correspondence are available at <http://links.lww.com/AOG/C969>.