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CLINICAL ARTICLE

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Binational confidential enquiry of maternal deaths due to postpartum hemorrhage in France and the Netherlands: Lessons learned through the perspective of a different context of care

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Abstract

Objective: To learn lessons for maternity care by scrutinizing postpartum hemorrhage management (PPH) in cases of PPH-related maternal deaths in France and the Netherlands.

Methods: In this binational Confidential Enquiry into Maternal Deaths (CEMD), 14 PPH-related maternal deaths were reviewed by six experts from the French and Dutch national maternal death review committees regarding cause and preventability of death, clinical care and healthcare organization. Improvable care factors and lessons learned were identified. CEMD practices and PPH guidelines in France and the Netherlands were compared in the process.

Results: For France, new insights were primarily related to organization of healthcare, with lessons learned focusing on medical leadership and implementation of (surgical) checklists. For the Netherlands, insights were mainly related to clinical care, emphasizing hemostatic surgery earlier in the course of PPH and reducing the third stage of labor by prompt manual removal of the placenta. Experts recommended extending PPH guidelines with specific guidance for women refusing blood products and systematic evaluation of risk factors. The quality of CEMD was presumed to benefit from enhanced case finding, also through non-obstetric sources, and electronic reporting of maternal deaths to reduce the administrative burden.

Conclusion: A binational CEMD revealed opportunities for improvement of care beyond lessons learned at the national level.

KEYWORDS

confidential enquiry into maternal deaths, France, maternal mortality, maternity care, obstetrics, postpartum hemorrhage, the Netherlands

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1 | INTRODUCTION

Although maternal deaths and severe acute morbidities have generally been reducing in high-income countries, the incidence of postpartum hemorrhage (PPH) has paradoxically been on the rise in many settings. The literature reports the importance of cross-border collaborations to study and reduce the burden of PPH, and a comparison of the incidence and management of PPH between countries might be a way of identifying shortfalls in PPH care.^{1,2}

Maternal mortality (MM) due to PPH is still largely preventable and case fatality rate of PPH can be considered an indicator of the quality of obstetric care.³ The PPH-related MM ratio in France has decreased over the last decade, but remains high compared with the UK and the Netherlands.⁴⁻⁷ However, the increasing incidence of PPH in the Netherlands indicates that continuous efforts are also needed to improve PPH-related care.⁸

Following this line of thought, we designed a binational confidential enquiry into maternal deaths (CEMD) for France and the Netherlands, which have conducted national CEMDs since 1995 and 1981, respectively.^{9,10} As obstetric care differs to some extent between these two countries, we hypothesized that additional lessons learned, beyond those already identified by the French and the Dutch committees, might emerge from a binational review of PPH-related maternal deaths. Reviewing cases through a different “contextualist” framework by experts from two different care contexts could give rise to new perspectives.

Our primary objective was to learn lessons for maternity care in both countries by scrutinizing management of PPH in individual cases of PPH-related deaths. Secondary objectives were to (a) compare conclusions on cause and preventability of death of our binational CEMD with those from the French/Dutch national expert committee on maternal mortality; (b) compare national PPH-guidelines while reviewing such cases; and (c) compare CEMD practices between both countries in the process.

2 | MATERIALS AND METHODS

We organized a binational review of PPH-related maternal deaths reported to the Dutch Audit Committee Maternal Mortality and Morbidity (Auditcommissie Maternale Sterfte en Morbiditeit, AMSM) and the French National Confidential Enquiry on Maternal Mortality (ENCMM).

The French national expert committee on maternal mortality (CNEMM) and the AMSM were each represented by three experts: the French committee by two obstetrician-gynecologists and one anesthesiologist from the CNEMM and the Dutch by three obstetrician-gynecologists from the AMSM, two from tertiary academic centers and one from a secondary-level teaching institution.

PLMdV was present during one meeting of both the AMSM and the CNEMM in order to (a) be trained in performing CEMD, (b)

observe differences in CEMD practices, and (c) have the appropriate background knowledge to be able to organize this binational CEMD.

2.1 | Study population

In total, 14 cases of PPH-related maternal deaths were selected (by PLMdV, Tvda, CD-T). For each country, five cases of PPH by atony and two cases of PPH by cesarean surgical trauma were selected consecutively as these etiologies are among the main causes of severe PPH.¹¹ The number of cases was pragmatically determined by PLMdV, Tvda and CD-T based on the number of cases available for each country. French cases were selected among maternal deaths that happened in 2013–2019. As the absolute number of Dutch cases was lower, these were selected over 2008–2019. The different methods for the identification of maternal deaths by the AMSM and the ENCMM are described in Table S1.

2.2 | Data collection

Each case file was fully translated from French to Dutch or inversely by PLMdV, who is fluent in both languages. Medical records included antenatal charts, medical charts on management of PPH, laboratory and microbiology results, operation reports, and autopsy reports. In France, information is extracted by two clinical assessors designated to collect on-site information by completing an elaborate standardized questionnaire. This information was translated on site at the Obstetrical, Perinatal and Pediatric Epidemiology Research Team (Epopé) unit of INSERM in Paris, France, where fully anonymized medical records are stored, only accessible by the ENCMM coordination team. In the Netherlands, all charts are uploaded by the local maternity care worker reporting the maternal death. Since 2016, secure electronic reporting has been made possible through the “Netherlands Obstetric Surveillance System” (NethOSS), which is in line with the General Data Protection Regulation (GDPR). The Dutch cases were consulted on a secured online network only accessible by AMSM members.

The translated and anonymized medical records were accessible electronically on a protected server 1 month prior to a physical gathering for all six participating experts. The experts received an extensive informative document about organization of maternity care in both countries.

In January 2022, both teams met in Paris for a 2-day meeting consisting of three parts: (1) presentation of the French/Dutch PPH-guidelines followed by a discussion between the experts; (2) presentation of the cases by the experts followed by a systematic discussion in English led by a moderator highly trained in CEMD, fluent in French and English (CD-T); the discussion was observed and documented by an epidemiologist from INSERM involved in the confidential enquiries in France for several years (MS) and PLMdV; and (3) presentation of the identified improvable care factors and formulation of lessons learned by the experts. Differences emerging

from the discussion on national PPH guidelines and CEMD practices resulted in recommendations.

2.3 | Analysis

Patient and hospital characteristics were analyzed for each case (PLMdV). Cause of death was classified according to the *International Classification of Diseases and Related Health Problems* (ICD-10), followed by preventability of death, defined as any action or inaction that could have prevented fatal outcome.¹² Results were compared with previous conclusions by the CNEMM/AMSM. Improvable care factors were classified per topic. Qualitative data were expressed as number (percentage) and quantitative variables as median (range). Statistical significance testing was deemed not necessary as data were purely descriptive.

Each woman's care was systematically assessed by the French/Dutch experts on appropriateness of clinical care (preconceptional care, pregnancy follow-up, obstetric care, anesthesiologic care, intensive care), organization of healthcare (equipment and materials, communication, quality of documentation, transportation) and interaction of the patient with the healthcare system (failure of follow-up of the patient, social vulnerability, mental vulnerability), number of preventable deaths according to level of care of delivery hospital. Most relevant and redundant improvable factors resulted in lessons learned accompanied by case histories to illustrate the subtleties of culture and context brought to light by our binational meeting.

Statistical analysis was performed using Stata version 16 (StataCorp LLC, College Station, TX, USA).

2.4 | Ethical considerations

For the Dutch data, ethical approval was waived because this is not required for CEMD, as it is considered an essential element to improve birth care. In France, ENCMM is approved by the National Data Protection Authority (CNIL) and thus ethical approval was not required either. Collected data are fully anonymized and publications following analysis of these data cannot be traced back to individual patients or to health workers. Informed consent was therefore not required.

3 | RESULTS

Maternal, pregnancy, and hospital characteristics are presented in [Table 1](#). Differences were mainly related to hospital facilities such as an adult intensive care unit (ICU), blood bank, and access to an interventional radiology unit. In France, 5/7 (71%) women who died gave birth in a hospital without an ICU, whereas the figure was zero for the Netherlands where acute obstetric care is generally only provided in hospitals with an ICU. Hospital facilities were more limited

TABLE 1 Patient characteristics, hospital characteristics, cause of death, and preventability of death of individual postpartum hemorrhage management (PPH)-related maternal deaths from France and the Netherlands.

	Dutch cases (N = 7)	French cases (N = 7)
Patient characteristics (n [%])		
Age (year)		
20–29	1 (14)	0
30–39	6 (86)	5 (71)
>40	0	2 (29)
Ethnicity		
Caucasian	5 (71)	4 (67)
African	1 (14)	1 (14)
Caribbean	1 (14)	0
Asian	0	2 (29)
Obesity	0	0
Parity		
Nulliparous	2 (29)	3 (43)
Multiparous	5 (71)	4 (57)
Scarred uterus	1 (14)	3 (43)
Mode of birth		
Vaginal spontaneous	3 (43)	2 (29)
Instrumental	2 (29)	0
Cesarean section	2 (29)	5 (71)
Planned	0	0
Emergency	2 (29)	5 (71)
PPH risk factors		
Uterine scar	1 (14)	3 (43)
History of PPH	0	1 (14)
Pre-eclampsia	1 (14)	1 (14)
Multiple gestation	0	0
Macrosomia	2 (29)	1 (14)
Labor augmentation	2 (29)	2 (29)
Placenta previa	1 (14)	0
Place of birth ^a		
Home	0	0
Outpatient in-hospital	1 (14)	0
In-patient in-hospital	6 (86)	7 (100)
Characteristics of delivery hospital		
No. of births		
<500 births/year	0	1 (14)
>500 and <1500 births/year	2 (29)	2 (29)
>1500 and <3000 births/year	4 (57)	1 (14)
>3000 births/year	1 (14)	3 (43)
Level of care ^b		
Primary care hospital	0	3 (43)
Secondary care hospital	4 (57)	2 (29)

(Continues)

TABLE 1 (Continued)

	Dutch cases (N = 7)		French cases (N = 7)	
Tertiary care hospital	3 (43)		2 (29)	
Facilities				
Obstetrician present				
On site 24h/24 h	3 (43)		5 (71)	
On call at night	4 (67)		2 (29)	
Anesthesiologist present				
24h/24 h on site	5 (71)		5 (71)	
On call at night	2 (29)		2 (29)	
Adult intensive care unit	7 (100)		2 (29)	
Embolization unit	4 (57)		2 (29)	
Blood bank	7 (100)		2 (29)	
Laboratory	7 (100)		2 (29)	
	Binational review	AMSM	Binational review	CNEMM
Cause of death				
Atony	4 (67)	5 (71)	5 (71)	5 (71)
Surgical lesion	2 (29)	2 (29)	2 (29)	2 (29)
Other	1 (14)	0	0	0
Preventability of death				
No conclusion	0	0	1 (14)	1 (14)
Not preventable	1 (14)	0	0	0
Perhaps preventable	0	1 (14)	0	2 (29)
Probably preventable	6 (86)	6 (86)	6 (86)	4 (67)
Preventable deaths according to level of care				
Primary care	0		3 (43)	
Secondary care	4 (57)		2 (29)	
Tertiary care	2 (29)		1 (14)	

Abbreviation: AMSM, Auditcomissie Maternale Sterfte en Morbiditeit.

^aPlace of birth could be at home or at the hospital as outpatient or in patient. This distinction was made following the maternity care system in the Netherlands where low-risk parturients can have a home birth with their own midwife. If a parturient wishes to give birth at a hospital without a medical indication, she can have an outpatient in-hospital birth, which means her own midwife and not the hospital oversees the birth. Women with a medical indication give birth under the responsibility of the hospital (inpatient).

^bPrimary care hospital: local, general hospital/secondary care hospital: regional, general hospital/tertiary care hospital: central, academic hospital.

in France, necessitating frequent patient transfer to better adapted organizational structures.

Cause and preventability of death are presented in Table 2. One Dutch case (14%) from 2008, classified as a maternal death from uterine atony by the AMSM, was classified as maternal death from amniotic fluid embolism by the binational experts. It was noted that, at that time, this

TABLE 2 Improvable care factors identified by the experts of the binational review categorized per topic.

	French cases	Dutch cases
Number of cases (n)	7	7
Total number of improvable care factors (n)	30	34
Median number of improvable care factors per patient	3	4
Clinical care (n) ^a		
Preconceptional care		
In vitro fertilization despite advanced maternal age	1 (14)	0
Pregnancy follow-up		
Insufficient diagnostic testing when indicated	1 (14)	1 (14)
Failure to consider timely birth	0	1 (14)
Obstetric care		
Delay in PPH ^b diagnosis	3 (43)	2 (29)
Delay in PPH treatment	3 (43)	6 (86)
Inadequate PPH treatment (no hemostatic surgery)	0	4 (57)
Lack of recognition of PPH risk factors	2 (29)	0
Absence of senior staff for PPH management	0	2 (29)
Anesthesiologic care		
Delayed coagulation testing	0	3 (43)
Delayed transfusion treatment	5 (71)	4 (57)
Inadequate transfusion treatment	2 (29)	2 (29)
ICU care		
Delayed treatment	0	1 (14)
Inadequate treatment	0	1 (14)
Organization of the healthcare system (n)		
Equipment and materials		
Lack of blood products	1 (14)	0
Communication		
Lack of leadership	3 (43)	1 (14)
Surgical safety checklist not used	4 (57)	0
Quality of documentation of the case files		
Lacking documentation	1 (14)	5 (71)
Inadequate documentation	2 (29)	2 (29)
Transportation		
Inadequate indication for transfer	0	1 (14)
Poorly organized transfer	2 (29)	0
Interaction of the patient and the healthcare system (n)		
Failure of follow-up of the patient	0	0
Mental vulnerability	0	0
Social vulnerability	0	1 (14)

Abbreviation: PPH, postpartum hemorrhage.

^aNumber of cases in which the improvable care factor was identified.

diagnosis was less frequently considered by national experts and that today the AMSM might have classified it similarly to the binational panel. One case was considered 'non preventable' by the binational experts where it had been classified as 'perhaps preventable' by the AMSM initially. Two French cases (29%) were considered as perhaps preventable by the CNEMM but as probably preventable by the binational experts, emphasizing a lack of anticipation regarding PPH riskfactors.

Improvable care factors were identified for all maternal deaths and classified per topic (Table 2). For France, most new perspectives were related to organization of healthcare. For the Netherlands, new insights were related especially to clinical care (Figure 1). Lessons learned with regard to improving maternity care are presented along with case histories (Table 3).

Improvable clinical care focused mainly on manual placenta removal (MPR) and on performing hemostatic surgery (vascular ligation/uterine compression sutures). In some Dutch cases, a significant time delay was noticed between PPH diagnosis and MPR at the operating theater. The French experts suggested this delay could be reduced by MPR at the labor ward in the presence of an epidural, which is not standard practice in the Netherlands. There was a difference between the binational experts with regard to the use of hemostatic surgery. The Dutch preferred arterial embolization earlier in the chain of events, whereas the French had a lower threshold to perform hemostatic surgery. Although this finding could be partly

explained by differences in national recommendations, the experts also hypothesized that the more restricted use of hemostatic surgery in the Netherlands might have resulted in a more important barrier to perform this type of surgery among Dutch obstetricians.

Organization of the healthcare system could mainly be improved through better communication between maternity care workers and optimization of hospital facilities. It was clear from the French cases that sign-outs at the end of surgery were not common practice. In the Netherlands this would include sponge and instrument counts, the recap of any surgical or anesthesiologic problems, and special notices for the postoperative management, and such a sign-out is performed before leaving the operating theater after any procedure in the presence of all the maternity workers concerned. Furthermore, in the French cases, several reports disclosed the absence of someone having a 'helicopter' view engendering situational unawareness. There was no direction of the team and responsibilities were sometimes unclear, resulting in delays in the appropriate management.

The differences between the French and Dutch PPH guidelines resulted in topics for future research and matters to keep in mind when updating national PPH guidelines (Table 4). The importance of the national context of these recommendations was stressed for the prevention and management of PPH in women refusing blood products; indeed, whereas in France the law allows doctors to transfuse Jehovah's Witnesses in the case of vital risk, in the Netherlands this is not possible without the woman's consent.

Recommendations on the conduct and organization of CEMD are presented in Table 5. The finding that Dutch cases were more often lacking documentation on pregnancy follow-up (4/7, 67%) and anesthesiologic care (2/7, 29%) could well be explained by the method of information extraction, the French committee members collecting data on the spot after the maternal death.

4 | DISCUSSION

Our review brings to light the fact that multinational reviews of maternal deaths can identify opportunities for improvement of care that go beyond the lessons learned already identified by national enquiries, by adding the perspective from a different context of care. The main lessons learned for France focus on the organization of healthcare, in particular on the implementation of surgical checklists and assignment of leadership. The principal lessons learned for the Dutch are mainly related to clinical care, stressing the need to reduce delay of the third stage of labor by considering MPR under epidural and the performance of hemostatic surgery sooner rather than later. These lessons learned could be adapted to each national structure. Our review provides tools for the organization of CEMD, like identification of maternal deaths and electronic reporting and ideas for future updates of PPH guidelines, such as more guidance on women declining blood products.

A strength of our study is the interaction between experts of two national audit committees resulting in a complementary and critical detection of improvable care factors from a different

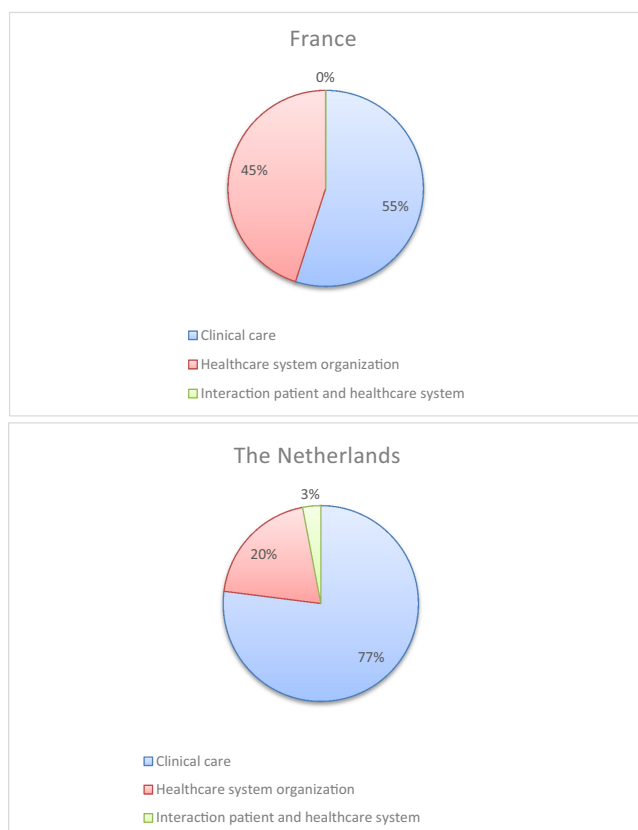


FIGURE 1 Improvable care factors for France ($n=30$) and the Netherlands ($n=34$) categorized per topic. Several improvable care factors could be categorized under more than one case.

TABLE 3 Lessons learned formulated by the experts from the binational Confidential Enquiry into Maternal Deaths (CEMD).

Lessons learned on clinical care

Obstetric care

- In case of retained placenta, regular monitoring of fundal height, volume of blood loss, and vital parameters is recommended. Maternity care workers should anticipate postpartum hemorrhage (PPH) when delay of third stage of labor exceeds 30 min.
- To reduce delay between PPH management diagnosis and manual removal of placenta, manual removal of the placenta under epidural analgesia at the labor ward can be considered.
- There seems to be a significant barrier for obstetricians to perform hemostatic surgery, such as uterine compression sutures and vascular ligation. This procedure can, however, be life-saving and should be performed sooner rather than later after failure of second-line uterotonics and intrauterine balloon tamponade, especially in women giving birth by cesarean section and in hospitals without recourse to transcatheter radiological embolization. Simulation training sessions on how to perform this type of surgery could be implemented to train these surgical skills.

A 25-year-old had an uncomplicated vaginal birth under epidural. Fifty minutes later, bleeding started while the placenta was still retained. When the obstetrician arrived 5 min afterwards, she had already lost 1200 mL of blood despite second-line uterotonics. The placenta was manually removed under general anesthesia at the operating theater 35 min after bleeding started. Blood loss was estimated at 3.5 L at that point and she had become hemodynamically unstable despite interventions. The patient died in the operating room due to cardiac arrest. The French experts concluded that the long delay between the decision to transfer the patient to the operating theater and the actual manual removal of the placenta probably contributed to this death.

Anesthesiologic care

- In case of major obstetric hemorrhage, use of ketamine instead of propofol can be considered. Due to its combination of rapid blood-cerebral transfer kinetics and sympathomimetic hemodynamic effects, ketamine is more adapted in case of hypovolemic shock.
- Timely coagulation screening seems critical in the course of PPH and we recommend that this should be monitored regularly during the course of PPH. National guidelines could detail the timing of these tests to ensure optimal transfusion.

A 28-year-old patient who gave birth vaginally was transferred to the operating room for removal of placental remnant and PPH. At arrival in the operating theater, blood loss was estimated at 2 L and she had a blood pressure of 95/40 mm Hg, and a cardiac frequency of 115 beats/min. Sedation was performed by a rapid sequence induction and intubation with propofol 10 mg/mL, 300 mg IV. When the placental remnant was removed, blood loss was estimated at 4 L. Soon after, the patient had a cardiorespiratory arrest. She died 45 min later. The French experts concluded that the dose of propofol was very high in this case. Ketamine or a reduced dose of propofol in this hemodynamic unstable patient would have been more appropriate (0.5–1 mg/kg or lower) as propofol reduces system vascular resistance and has myocardial depressant effects.

ICU care

- If a patient presents signs of a septic shock after severe PPH, uterine necrosis should be in the differential diagnosis. If this suspicion is high, a hysterectomy should be performed sooner rather than later.

A 38-year-old woman gave birth in a secondary care hospital by an uncomplicated cesarean section for suspicion of cephalon pelvic disproportion. At 20 hours postpartum, she presented signs of a hemorrhagic shock. Emergency laparotomy was performed, removing 3 L of blood clots. A small bleeding artery was detected under the bladder flap and repaired, and she was transferred to the ICU where her clinical condition initially improved. Ten days after giving birth, she suddenly presented signs of a septic shock, which was thought to be caused by uterine necrosis and is treated with high doses of IV antibiotics. The patient died 24 h later. A microbiological exam showed the presence of uterine necrosis probably due to an episode of low cardiac output due to PPH resulting in a secondary infection with a streptococcus. The French experts concluded that the source of sepsis, the uterus, should have been removed as the clinical condition of the patient was good enough to perform surgery.

Lessons learned on organization of the health system

Equipment and materials

- The minimum resources needed to deal with the unexpected PPH-like presence of blood products, resuscitation skills, and surgical skills should be defined in each protocol.
- There should be discussion around the safety of having a delivery ward with a very low number of births. Also, there should be a discussion around having a delivery ward in a hospital without an adult ICU on site.

Communication

- Hospitals should consider the use of surgical safety checklists such as those proposed by the World Health Organization. Before the surgeon makes the skin incision a 'time out' should be performed. Before the patient leaves the operating room, a 'sign-out' should be performed during which the whole team should be present and during which postpartum surveillance is discussed and adapted according to the patient's risk factors. These checklists could be adapted to each national structure.
- Assignment of leadership during the course of PPH can clarify responsibilities, in particular when two medical specialists are involved. Leadership can evolve during the course of PPH and changes should be pointed out loudly so they are clear to the whole team involved. This could be trained by implementing on-site multidisciplinary simulation training on acute obstetric hemorrhage. National guidelines could recommend the implementation of this type of training on a local and national level.

A 39-year-old patient gave birth by an uncomplicated emergency cesarean section according to the surgical report of the obstetrician. Nevertheless, the anesthesiologist's report mentions a hemodynamically unstable patient during the surgery, necessitating ephedrine twice. After finishing the operation, the obstetrician leaves. The report of the operating nurse describes 2000 mL of blood in the collector system after surgery. During that night, the patient again became hemodynamically unstable and an emergency laparotomy was performed. A large retroperitoneal hematoma was found. The source of the continuous bleeding could not be detected and a hysterectomy was performed. Total amount of blood loss: 7000 mL. The woman died 3 days later due to multi-organ failure. The Dutch experts concluded that the absence of communication between the anesthesiologist and the obstetrician, and the absence of a sign-out, which could have alerted the medical team and increased vigilance during postpartum surveillance, probably contributed to a worse maternal outcome.

TABLE 3 (Continued)

Documentation

- Complete mandatory documentation of all events is recommended by using special PPH charts including vital parameters, timing and quantity of blood loss, timing of coagulation screening, timing of administration of pharmaceutical agents and blood products as well as timing of interventions and the names and functions of the staff involved. Creating such a timeline can help in obtaining insights into sub-standard care as well as excellent care.
- Clear agreements on responsibilities for postpartum surveillance, depending on where the patient is being monitored after vaginal birth or cesarean section, could improve quality of care. Agreements could include which parameters should be monitored, frequency and total duration of surveillance as well as specification regarding when the gynecologist and anesthesiologist should be notified.

A 32-year-old woman gave birth by an uncomplicated emergency cesarean section for fetal indication. Two hours later, she was found in hemorrhagic shock at the recovery ward. Emergency laparotomy was performed and a uterine artery lesion was diagnosed. Despite surgical repair and massive transfusion therapy, adequate hemostasis could not be achieved. A hysterectomy was carried out during which the patient had a cardiopulmonary arrest. Although spontaneous circulation returned, she developed diffuse intravascular coagulation and she eventually died 2 days later due to multi-organ failure. As there was no documentation of the follow-up at the recovery ward, it was not clear to the experts whether postoperative surveillance had been adequate. Vital parameters, fundal height, and clinical condition of the patient were not monitored during 1 h while the medical team was undergoing a shift change. Documentation of these parameters would have given better understanding of what happened in the operating ward.

Transfer

- Transporting a hemodynamically unstable patient is a serious risk. Referral to another hospital should therefore only be considered in hemodynamically stable patients. Benefits of care available at another facility should be weighed against the potential risks of the transfer.
- A poorly organized transfer can contribute significantly to morbidity and mortality, and hospitals should aim to have protocols dedicated to transferring patients with severe PPH. There needs to be agreement between the transferring and receiving health facility about the timing of transfer and the equipment and skills of the medical staff accompanying the patient during transfer.

A 29-year-old patient gave birth at a secondary care hospital and presented massive hemorrhage due to uterine atony. She was treated and stabilized by aggressive resuscitation therapy and referred to a tertiary hospital for transcatheter radiological embolization. However, just before transport she again became hemodynamically unstable, which was why the anesthesiologist accompanied the patient in the ambulance during the transfer. Although the experts agreed that this patient should not have been transferred due to hemodynamic instability, they also noted that the transfer was extremely well organized by both the referring and the receiving facility, which underlines the importance of regional protocols for referral of patients with severe PPH.

TABLE 4 Recommendations from the experts from the binational Confidential Enquiry into Maternal Deaths (CEMD) for future updates of national postpartum hemorrhage management (PPH) guidelines.

Topic	Recommendation
Mode of birth	Guidelines could adapt management strategies for PPH to mode of birth since this could reduce the need for invasive surgery for PPH after vaginal birth and reduce delay in patients that underwent cesarean section.
Second line uterotonics	Some of the different point of views on the use of second line uterotonics arise from the absence of high-level evidence on this topic. Clear guidance is needed on which type of uterotonics should be included in the guidelines and trials should focus on timing of the administration of second line uterotonics once initial management of PPH fails.
Guidance for women refusing blood products	Each guideline should have clear guidance on multidisciplinary management of women refusing transfusion of blood products. Guidelines could include a checklist as part of their standardized protocol that would list the different blood products and alternative treatments and provide information on preconceptional counseling, pregnancy follow up and intrapartum care. An informed consent signed by the patient is recommended. Guidelines should be adapted to each national context to ensure optimal management of PPH.
Timing of management	Guidelines could provide more detailed recommendations on when to escalate management of PPH and advert senior staff. More details are needed concerning timing of interventions such as second line uterotonics, intrauterine balloon tamponade and more invasive interventions as well as on resuscitation therapy.
Risk assessment	Guidelines should provide tools for PPH risk assessment in order to identify patients at high risk of PPH before birth as well as after birth so that customized preventive measures can be taken and postpartum surveillance can be intensified.

perspective. Linguistic barriers were minimized by translation of all medical records into the experts' native language. The professional experience of PLMdV as a resident in obstetrics and gynecology in both countries facilitated the conduct of this binational enquiry. Limitations of our study included some medical records being incomplete and small study size. The longer study period for

the Netherlands (2008–2019) as compared with France (2013–2019) was not considered a limitation as the Netherlands has not seen any major adjustment in PPH recommendations since 2008, other than the introduction of tranexamic acid following the WOMAN trial.¹³ Although there was no anesthesiologist included among the Dutch experts, this was done on purpose because, contrary to France, PPH

TABLE 5 Recommendations from the experts from the binational Confidential Enquiry into Maternal Deaths (CEMD) on organization of confidential enquiries into maternal deaths.

Topic	Recommendations on CEMD
Composition national committee of maternal deaths	We recommend that audit committees are represented by care providers from both primary and secondary care hospitals since this contributes to a more homogenous representation of medical care provided in a country.
Identification of deaths	In addition to direct notification of cases to the audit committee, linkage of birth registries and hospital discharge databases with death registries could improve completeness of reported maternal deaths. This is crucial to obtain a reliable identification of maternal deaths and adequate overview of incidence of maternal death in a country.
Electronic reporting	Countries should reflect on how to implement an electronic system for reporting cases of maternal death in which case files can be uploaded through a protected online server.
Information extraction	On site visiting and documenting seems to provide more complete case files which contributes to a more in-depth review of the case which could lead to better identification of improvable factors.
Safety	Safety of the confidential enquiry should be maintained. Efforts should be made to strengthen the confidence in the audit team and making maternity care workers less uncomfortable by reporting maternal deaths and providing all the available information on the case.

care in the Netherlands is generally obstetrician-led with no (obstetric) anesthesiologist present at the labor ward.

The literature does not provide clear evidence on which anesthetic technique is more effective for MPR.¹⁴ General anesthesia with intubation is recommended in case of hemodynamic instability, even if an epidural catheter is in place, to protect the airway and to control ventilation. MPR under epidural (if already in place) has been reported as a safe alternative for general anesthesia as it is faster and preventative for risks associated with general anesthesia, such as airway compromise and aspiration.^{15,16} Depending on organizational structures such as the presence of an anesthesiologist in the labor ward, spinal anesthesia could be performed in the labor ward if an epidural is not yet in place, in the absence of hemodynamic instability and coagulation disorders.¹⁷ Yet, few data exist on patient satisfaction and intraoperative discomfort regarding the different types and routes of anesthesia during this procedure.

Implementation of surgical checklists such as those proposed by the World Health Organization could improve patient outcome by better information transfer during and after surgery. This creates more awareness of PPH risk factors which can optimize postpartum surveillance.¹⁸ Leadership during PPH could be explicitly assigned to better coordinate teamwork and adhere to PPH drills. This can be trained by (multidisciplinary) simulation training.^{19,20} The lack of resources and PPH coordination contributed to preventability of death, in particular in primary care hospitals. In this context, centralization of acute obstetric care has been proposed to improve maternal outcome. However, others have suggested that this may paradoxically worsen outcome through longer travel times.²¹ Guidelines may therefore include a minimum of standards necessary to provide acute obstetric care—for both the infant and the woman—such as access to blood products and biochemistry facilities, as has been proposed by ACOG.²²

The absence of specific recommendations for patients declining blood products, such as Jehovah's Witnesses, is a recurrent problem among guidelines in high-income countries. Having a 130-fold increased PPH-related mortality risk, specific guidance on the counseling of these women could be integrated into clinical practice guidelines,

including pre-labor optimization of hemoglobin, cell salvage, and a description of the minimal resources required for a hospital to provide labor care to these women.^{23,24} The need to adapt these recommendations to each national context has been illustrated in this article.

5 | CONCLUSION

Our findings emphasize that there are still opportunities to improve maternity care among women suffering from PPH in high-income countries. We encourage the performance of multinational confidential enquiries to identify improvable care factors through a different context of care.

AUTHOR CONTRIBUTIONS

P. L. M. de Vries: conceptualization, methodology, formal analysis, writing—original draft preparation, visualization. T. van den Akker: analysis and interpretation of data, writing—review and editing. K. W. M. Bloemenkamp: analysis and interpretation of data, writing—review and editing. E. Grossetti: analysis and interpretation of data, writing—review and editing. A. Rigouzzo: analysis and interpretation of data, writing—review and editing. M. Saucedo: conceptualization, methodology, formal analysis, writing—review and editing. E. Verspyck: analysis and interpretation of data, writing—review and editing. J. Zwart: analysis and interpretation of data, writing—review and editing. C. Deneux-Tharaux: conceptualization, methodology, writing—review and editing, supervision. All authors have seen and approved the final version. All authors have agreed to be accountable for the accuracy and integrity all aspects of the work.

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The authors have no conflicts of interest.

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Research data are not shared.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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