# IMPROVING THE RECOGNITION AND MANAGEMENT OF HEMORRHAGE: A SCOPING REVIEW OF NURSING AND MIDWIFERY EDUCATION

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## ABSTRACT

**Background:** Hemorrhage is a frequent complication that nurses and midwives must recognize and manage to avoid life-threatening consequences for patients. There is currently no synthesis of evidence on educational interventions in nursing and midwifery regarding hemorrhage, thus limiting the definition of best practices.

**Objective**: To map the literature on nursing and midwifery education regarding the recognition and management of hemorrhage.

**Design**: Scoping review based on the Joanna Briggs Institute guidelines.

**Data sources**: Quantitative studies evaluating the effect of educational interventions with students, nurses, or midwives published in English or French, with no time limit.

**Review methods**: Study selection, data extraction, and quality assessment were conducted by two independent reviewers. We characterized educational interventions based on the Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching. We categorized learning outcomes using the New World Kirkpatrick Model. Methodological quality appraisal was performed with tools from the Joanna Briggs Institute. Findings were synthesized using descriptive statistics and graphical methods.

**Result:** Most of the 38 studies used a single-group design (n=26, 68%) and were conducted with professionals (n=28, 74%) in hospital settings (n=20, 53%). Most were of low (n=14; 37%) or moderate (n=18, 47%) methodological quality. Most interventions focused on postpartum hemorrhage (n=34, 89%) and combined two or more teaching strategies (n=25, 66%), often pairing an informational segment (e.g., lecture, readings) with a practical session (e.g., workshop, simulation). Learning outcomes related to the management (n=27; 71%) and recognition of hemorrhage (n=19, 50%), as well as results for patients and organizations (n=9, 24%).

**Conclusion**: Considerable heterogeneity in interventions and learning outcomes precluded conducting a systematic review of effectiveness. High-quality, controlled studies are needed, particularly in surgery and trauma. Reflection on the contribution of nurses and midwives to the detection, monitoring, and management of hemorrhage could enrich the content and expected outcomes of hemorrhage education.



## KEYWORDS

Clinical Decision-Making; Clinical Reasoning; Education, Midwifery; Education, Nursing; Hemorrhage; Interprofessional Education; Postpartum Hemorrhage; Scoping Review; Systematic Review

## Background

Hemorrhage is a significant blood loss that exceeds what is typically expected for a particular clinical circumstance. Although it is always due to a damaged blood vessel, hemorrhage manifests itself differently depending on the anatomic location and mechanism of injury. In cardiology, hemorrhage is defined as bleeding that calls for evaluation, intervention to stop or treat blood loss, and hospitalization or increased level of care (Mehran et al., 2011). In obstetrics, definitions of postpartum hemorrhage are based on the amount of blood loss after birth and the resulting hemodynamic instability (Borovac-Pinheiro et al., 2018).

Estimated hemorrhage rates in obstetrics, cardiology, and surgery range from 2% to 8% (Al-Attar et al., 2019; Bienstock et al., 2021a; Chhatriwalla et al., 2013; Nami Saber & Klug, 2020; Ranucci et al., 2013). When severe, hemorrhage can result in inadequate cellular oxygen supply and cause hemorrhagic shock (Cannon, 2018), which manifests as a clinical syndrome of hypotension, tachycardia, cold and clammy skin, acidosis, decreased pulse pressure, and altered mental status (Schiller et al., 2017). Hemorrhage from trauma, childbirth, surgery and various other causes is estimated to be responsible for 1.9 million annual deaths across the globe (Cannon, 2018). Postpartum hemorrhage remains the leading preventable cause of maternal death (Bienstock et al., 2021a). In trauma, hemorrhage results in shock in 7% of patients and is responsible for more than one-third of deaths (Eastridge et al., 2019; Michetti et al., 2019). Across specialties, hemorrhage leads to increased hospital and intensive care unit length of stay, reoperations, and hospitalization costs (Al-Attar et al., 2019; Chhatriwalla et al., 2013; Christensen et al., 2012; Shander, 2007; Stokes et al., 2011a).

Considering their high incidence and associated risks, nurses and midwives must be highly skilled at recognizing and managing hemorrhage to reduce consequences and mitigate poor outcomes. In undergraduate nursing education, it is no surprise that the recognition and management of postoperative hemorrhage is one of the most popular simulation scenarios (Canadian Association of Schools of Nursing, (2019)). However, researchers have reported low proficiency levels in nurses' and midwives' ability to recognize and manage hemorrhage, leading to delays in care and increased risks of death (Ameh et al., 2016; Angelina et al., 2019; Schroll et al., 2020). In obstetrics, students, nurses, and midwives tend to underestimate postpartum blood loss, which can pose a serious threat to patient safety (Association of Women’s Health, 2021; Leduc et al., 2018; Parayre et al., 2015). In trauma, researchers have purported that nurses and other healthcare professionals could benefit from additional training in bleeding management, given the accrued interest in bleeding control techniques due to the increasing occurrence of mass casualty incidents in the United States and beyond (Schroll et al., 2020).

The recognition and management of hemorrhage require a high level of clinical decision-making for nurses and midwives, as these situations are marked by urgency, uncertainty, and high risk to patients' lives. Adequate educational preparation in this regard should promote the acquisition of domain-specific knowledge and allow learners to experience authentic clinical situations repeatedly, challenge their assumptions, receive feedback, and engage in reflection (Bélisle et al., 2021; Richmond et al., 2020a). Nevertheless, evidence regarding best practices for hemorrhage education remains limited, as research often focuses on general clinical decision-making education (Brown Tyo & McCurry, 2019; Nibbelink & Brewer, 2018), without considering the content specificity of these situations.

To our knowledge, there is currently no synthesis of the evidence regarding educational interventions aimed at nurses' and midwives' recognition and management of hemorrhage. Mapping the literature on this topic could help identify the nature and breadth of the evidence

and guide future knowledge synthesis efforts, as well as determine the potential for a systematic review to assess the effectiveness of these educational interventions (Pollock et al., 2021). Such work is critical to identifying and defining best practices to guide the design, implementation, and evaluation of effective education to prepare nurses and midwives to recognize and manage hemorrhage.

## Objective

This scoping review aimed to map the literature on nursing and midwifery education regarding the recognition and management of hemorrhage. Considering studies of educational interventions with students, nurses, or midwives, the research questions were: 1) What are the characteristics of these studies? 2) What are the characteristics of the educational interventions (i.e., content and format)? 3) What learning outcomes related to recognizing and managing hemorrhage were assessed following these educational interventions?

# METHODS

This review relied on the Joanna Briggs Institute guidelines for scoping reviews (Peters, 2020) and is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (Tricco et al., 2018). Scoping reviews are used to determine the nature and extent of research on a concept or in an area of study. They are a first step leading to a systematic review of effectiveness by clarifying what types of evidence are available and whether there is sufficient evidence to conduct a systematic review (Munn et al., 2018; Peters et al., 2020).

## Eligibility criteria

In terms of population, we considered studies with nurses and midwives at all levels of practice (i.e., undergraduate, graduate, postgraduate), in all specialties (e.g., anesthesia, obstetrics, trauma), and in all settings (e.g., clinical, community, or academic settings). Studies with interprofessional samples were included if they presented outcomes specific to nurses or midwives.

In terms of context, we included studies related to the recognition or management of hemorrhage that could lead to hemorrhagic or hypovolemic shock. We defined recognition as the ability to gather clinical data and identify cues indicating the presence of hemorrhage, and management as the actions to stop or treat blood loss. Bleeding related to chronic conditions (e.g., hemophilia, von Willebrand's disease), strokes (e.g., subarachnoid hemorrhage), or viral infections (e.g., Crimean-Congo hemorrhagic fever) were excluded because we deemed that their recognition and management was too specific.

In terms of concept, we included studies evaluating the effect of an educational intervention, that is, an intervention or program designed to improve learning outcomes (Kirkpatrick & Kirkpatrick, 2015). To be considered, educational interventions had to have a primary goal of improving nurses' or midwives' recognition or management of hemorrhage, as evidenced by a clear statement of this purpose or measurement of learning outcomes directly related to it. In addition, studies that did not include at least one learning outcome specifically related to hemorrhage—i.e., a change in knowledge, skills, attitude, confidence, practice behaviors, or patient outcome related to the intervention—were excluded. These outcomes compose levels 2, 3, and 4 of the New World Kirkpatrick model (Kirkpatrick & Kirkpatrick, 2015). It should be noted that the

interventions could include other topics and outcomes, but we did not extract data unrelated to hemorrhage.

We included peer-reviewed studies with experimental, quasi-experimental, or pre-experimental designs (i.e., randomized controlled trials, non-randomized controlled trials, before and after studies, interrupted time-series studies, posttest-only studies) to identify learning outcomes for a future systematic review of effectiveness. Grey literature, research protocols, conference abstracts, knowledge syntheses, qualitative studies, and opinion pieces were excluded because they usually are not sufficiently detailed and do not present empirical data with sufficient depth to characterize an intervention, its outcomes, and produce a meaningful synthesis. The eligibility of studies using mixed-methods designs was assessed based on their quantitative component.

## Search strategy and information sources

On April 14, 2021, six electronic databases— Cumulative Index of Nursing and Allied Health Literature (CINAHL; EBSCOhost), Education Resources Information Center (ERIC, ProQuest Dissertations & Thesis Global), EMBASE (Ovid), MEDLINE (Ovid), Web of Science (Social Sciences Citation Index, Citation Index Expanded), and PsycINFO (APA PsychNet),—were searched using a combination of controlled descriptors and keywords related to the following concepts: education, nursing or midwifery, and hemorrhage (see supplementary material Table 1). The search was restricted to papers published in English or French, with no time limit. We also performed a hand search in the reference lists of eligible studies and Google Scholar.

## Study selection

Titles and abstracts of citations were screened independently by two reviewers using the Covidence platform (Systematic Review Software, Veritas Health Innovation, Melbourne, Australia). Two reviewers independently retrieved and assessed full texts of eligible citations based on the eligibility criteria mentioned above. Disagreements at any stage of the selection process were resolved through discussion.

## Assessment of methodological quality

Two reviewers independently assessed the methodological quality of included studies using the Joanna Briggs Institute quality appraisal tools for experimental, quasi-experimental, and pre-experimental studies (Tufanaru et al., 2017). These tools allow identifying methodological elements that pose a risk to internal validity. Thirteen items were assessed for experimental studies. Nine items were assessed for quasi-experimental and pre-experimental studies. The following scale was used: yes (1 point), no or unclear (0 point), and not applicable. Disagreements were resolved through discussion or by involving a third reviewer. Based on previous reviews (Lapierre et al., 2021; Roberts & Cooper, 2019), we prospectively determined the following cut-off scores to qualify the methodological quality of included studies. For experimental studies, scores of 0 to 6 were considered low, 7 to 9 moderate, and 10 to 13 (maximum) high. For quasi-experimental and pre-experimental studies, scores of 0 to 5 were considered low, 6 to 7 moderate, and 8 to 9 (maximum) high. When there were non-applicable items, the total study score was weighted based on a maximum possible score excluding the non-applicable items.

## Data extraction

The following data were extracted independently by two reviewers using an ad hoc extraction form in the Covidence platform (Veritas Health Innovation, Melbourne, Victoria, Australia): study information (e.g., location), methods (i.e., aim, design, participants), characteristics of the educational intervention based on the Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching (i.e., theory, learning objectives, content/subject, context and setting, schedule, materials, educational strategies, incentives, instructors/teachers, delivery, environment) (Meinema et al., 2019), and learning outcomes (i.e., name, definition, time points, instruments, level, results). For studies with a control group, we only extracted data regarding the educational intervention for the intervention group as designated by study authors.

Outcomes were categorized according to their level per the New World Kirkpatrick Model (Kirkpatrick & Kirkpatrick, 2015): level 2—learning: acquisition of knowledge, skills, attitude, confidence, and commitment; level 3—behavior change: application of what participants learned as a result of the educational intervention in clinical practice; and level 4—results: achievement of targeted outcomes as a result of the educational intervention, such as changes in organizational practice or benefits to patients. A third reviewer resolved disagreements.

**Data synthesis**

Based on the extracted data, we developed descriptive tables using frequencies and percentages to synthesize study characteristics, characteristics of the educational interventions, and outcome results. In addition, two reviewers independently coded the content of the interventions in MAXQDA 2020 (VERBI Software GmbH, Berlin, Germany) using a categorization of clinical decision-making outcomes in health professions education: data gathering, cue recognition, consideration of options, risk assessment, diagnoses, prioritization, management actions, communication of a plan, and calling for help (Lavoie et al., 2021)—new codes were added if necessary. After that, we created a code map to graphically illustrate the most frequent content combinations in the educational interventions under review (Kuckartz & Rädiker, 2019). To do so, we analyzed the relationships between codes based on their co-occurrence in the same educational intervention.

## RESULTS

The initial search yielded 5,168 unique records (Figure 1). After screening the titles and abstracts, the full text of 198 potentially eligible studies was screened, and 38 studies were included in this review (Al-Kadri et al., 2014; Amod & Brysiewicz, 2017; Andreatta et al., 2011; Andrighetti et al., 2012; Burns et al., 2019; Dawood et al., 2021; Evans et al., 2014; Garcia et al., 2012; Ghosh et al., 2019; Goldsworthy et al., 2019; Gray & Cavner, 2017; Jayanna et al., 2016; Joudeh et al., 2021; Komorowski et al., 2017; Kordi et al., 2015; Kordi et al., 2016; Latuska et al., 2019; Lei et al., 2019; Low et al., 2008; Low et al., 2012; Luegenbiehl, 1997; Miner, 2020; Moudi et al., 2019; Nilsson et al., 2014; Nishimwe et al., 2021; Rao et al., 2019; Siaulys et al., 2019; Sorensen et al., 2009; Stitely et al., 2011; Sukprasert et al., 2006; Varanelli et al., 2019; Weiler et al., 2018; Wong et al., 2016; Zehler & Musallam, 2021).

**[Figure 1. Flow diagram of study selection]**

Table 1 presents the characteristics of studies—all percentages are based on the 38 included studies. Most studies involved licensed professionals (n=28, 74%) in a hospital setting (n=20, 53%). There were 8 studies (21%) with interprofessional samples, primarily including physicians, medical students, or orderlies. Most studies (n=26, 68%) used a one-group quasi-experimental design; only 12 studies (32%) involved a comparison group. The median sample size was 81 (interquartile range 119). Regarding the methodological quality of experimental studies (n=7,

18%), 3 (8%), 3 (8%), and 1 (3%) were of low, moderate, and high quality, respectively. For quasi-experimental studies (n=31; 82%), 11 (29%), 15 (39%), and 5 (13%) were of low, moderate, and high quality, respectively (see supplementary material tables 2 and 3).

**[Table 1. Characteristics of included studies]**

## Characteristics of educational interventions

In most educational interventions, learning objectives focused on postpartum hemorrhage in obstetrical settings (n=34, 89%). The other interventions focused on traumatic (n=3, 8%) and postoperative hemorrhage (n=1, 3%).

Theoretical support for the educational interventions was explicit in 3 studies (8%). One study (Andrighetti et al., 2012) used principles of adult learning (Lippitt et al., 1984) and the novice to expert model (Benner, 1984) to guide the development of simulation activities but did not provide further details. Another study (Garcia et al., 2012) used the theory of popular education by Freire (2000) as a framework to plan a culturally sensitive, empowering educational intervention on postpartum hemorrhage to complement the knowledge and skills of Guatemalan traditional midwives. Based on Freire's work with oppressed populations, this theory emphasizes the participation of learners and educators as equals in a learning process based on dialogue and action and situated within a social and political context. The third study (Goldsworthy et al., 2019) used the social cognitive theory of Bandura (1986) to design a hands-on simulation program to provide a mastery experience involving opportunities for vicarious learning, modeling, and task repetition for nursing students. The theory also guided the choice of a clinical self-efficacy measure to assess the program's effect.

In terms of educational strategies, the most frequent were lectures (n=19, 50%), workshops (n=17, 45%), and simulations with a clinical scenario (n=14, 37%). Other strategies included readings (n=10, 26%), e-learning (n=8; 21%), mentoring (n=6, 16%), case discussions (n=2, 5%), games (n=2, 5%), and audits and feedback (n=1, 3%). In addition, 25 studies (66%) combined two or more strategies (up to 4). The most frequent combinations were lectures with workshops (n=15, 39%), workshops with readings (n=7, 18%), and lectures with simulations (n=6, 16%).

Figure 2 shows the 9 prevailing themes in the content of the educational interventions and the relationships among them. Most interventions addressed actions to manage bleeding (e.g., bimanual uterine compression, tourniquet, medication; n=27, 71%) and/or the recognition of cues indicating hemorrhage (e.g., estimation of blood loss, recognition of signs of deterioration; n=24, 63%). Other frequent themes included data gathering (e.g., measuring pulse or blood pressure), teamwork and communication (n=10, 26%), and pathophysiology of hemorrhage and bleeding (n=10, 26%). Call for help (n=7, 18%), diagnoses (n=7, 18%), drugs and equipment (n=6, 16%), and documentation (n=5, 13%) were addressed less frequently. Person-centered care, safety, risk assessment, prevention, prioritization, and consideration of options were addressed in 3 interventions or less (<10%) and are not portrayed in the code map. Of note, 10 (26%) studies did not provide information on their content.

In terms of content combination, content related to management actions was paired with all 8 themes, primarily with cue recognition (n=17, 45%), data gathering (n=10, 26%), teamwork and communication (n= 9, 24%), and pathophysiology of hemorrhage (n= 9, 24%). Data gathering was also associated with all 8 themes, including cue recognition (n= 9, 24%). Cue recognition was combined with 6 themes, including pathophysiology (n=8, 21%). The remaining themes

were combined with four or fewer other themes. Detailed information regarding the combination of content, including those present in less than 20% of the interventions, is available in supplementary material table 4.

**[Figure 2. Code map of the content of educational interventions]**

The median duration of one-time interventions (n=31, 82%), such as lectures or simulations, was 4 hours (range between 12 minutes to 2 days). For longer interventions (n=7, 18%) such as mentoring or multi-component programs (e.g., multiple sessions combining lectures, workshops, and written material), the median duration was 6–9 months (range between 6 months and 1 year). The schedule of these interventions varied between once a week (n=2, 5%), once a month (n=4, 11%), and every other month (n=1, 3%). The duration or schedule of interventions was not reported in 11 studies (29%).

Regarding instructors, 13 studies (34%) specified who they were, i.e., nursing or midwifery educators (n=8, 21%), researchers (n=3, 8%), a team of experts (n=1, 3%) or a surgeon (n=1, 3%). Only one study (3%) used incentives (i.e., continuing education credits and remuneration) to encourage participation, while participation was mandatory in two studies (6%). For delivery, 20 interventions (53%) used a group format, and 5 (13%) were delivered individually; 13 studies (34%) did not report this characteristic. The environment of the intervention (i.e., a description of the location where the intervention occurred) was unreported or unclear in most studies (n=22, 58%). For the other studies, interventions occurred in a simulation laboratory (n=9, 24%), directly in the clinical setting (n=5, 13%), or in a classroom or lecture theater (n=2, 5%).

## Learning outcomes

Table 2 presents a summary of learning outcomes. The four studies focusing on traumatic or postoperative hemorrhage assessed hemorrhage management with level 2 outcomes: knowledge (n=2, 5%), confidence (n=3, 8%), attitude (n=1, 3%), and skills (n=1, 3%). Only one of these studies (3%) assessed hemorrhage recognition based on participants' level of knowledge. No study assessed outcomes of level 3 (behavior) or level 4 (result).

**[Table 2. Summary of learning outcomes (n=34)]**

Regarding studies focusing on postpartum hemorrhage (n=34), most (n=27, 49%) assessed outcomes related to hemorrhage management. Specifically, studies examined level 2 outcomes—knowledge (n=1, 3%), confidence (n=8, 21%), and skills (n=9, 23%)—and/or level 3 outcomes (behavior; n=11, 29%). Fewer studies (n=19, 50%) assessed outcomes related to hemorrhage recognition. These studies focused mainly on level 2 outcomes, i.e., knowledge (n=9, 24%) and skills (n=7, 18%), while five studies (13%) assessed level 3 outcomes (behavior). Finally, 9 studies (24%) assessed level 4 outcomes (organization or patient results).

Table 3 summarizes the characteristics of the 12 studies (32%) that included a control group. Seven studies (18%) compared the effectiveness of different educational interventions or variations in a single intervention; five studies (13%) included a passive control group with no intervention. Results were diverse and would not be amenable to meta-analysis because of high heterogeneity in terms of interventions and outcomes.

**[Table 3. Characteristics and results of controlled studies (n=12)]**

## DISCUSSION

This scoping review aimed to map the literature on educational interventions to improve students, nurses, and midwives' recognition and management of hemorrhage. We found that most studies were of low or moderate quality, used quasi-experimental single-group designs, and were conducted with licensed nurses or midwives in hospital settings. The included studies suggest that educational preparation positively impacted learning outcomes related to the recognition and management of hemorrhage. However, there were very few controlled studies and considerable heterogeneity in educational interventions and learning outcomes, limiting the possibility of conducting a systematic review of effectiveness. Although this work was initially designed as a mixed-method systematic review (PROSPERO CRD 42021242295), there was virtually no qualitative evidence to synthesize either. This review highlights the need for methodologically sound studies, including controlled studies, if we hope to define best practices in the field, particularly the most appropriate content and format of educational interventions for different professionals working with specific populations.

In terms of content, almost all educational interventions were aimed to prepare obstetric nurses and midwives to recognize and manage postpartum hemorrhage. Postpartum hemorrhage remains the leading preventable cause of maternal mortality worldwide and has been the object of multiple guidelines and calls for action (Bienstock et al., 2021b). This may explain its predominance in this review. Whether mothers give birth in a hospital or non-hospital setting and considering that most postpartum hemorrhages occur within 4 hours after delivery (Leduc et al., 2018), it is widely acknowledged that nurses and midwives must be skilled to recognize and manage this complication. Nevertheless, the incidence and consequences of hemorrhage remain high in other clinical contexts and patient populations, such as surgery (e.g., cardiac, gastrointestinal, otolaryngologic) and trauma. Hemorrhage is a complication that nurses may encounter in several care settings, including medical or surgical units, intensive care units, emergency departments, among others. However, these fields were vastly underrepresented in this review, even if we used a highly sensitive search strategy. Surprisingly, the problem is not limited to methodological concerns but extends to the paucity of studies on this question. Even though hemorrhage is part of most—if not all—nursing curriculum, this review shows that this portion of nursing education is a blind spot for research. Therefore, the evidence to support education in this area remains extremely limited.

As depicted in Figure 2, most educational interventions focused on recognizing the cues of hemorrhage (mainly quantification of blood loss and alteration of vital signs) and taking actions to manage bleeding (mainly technical skills and medication administration). Although these are undeniable parts of nurses' and midwives' roles, other essential aspects of their clinical decision-making have received less attention (e.g., consideration of options, risk assessment, communication of a plan, prioritization, calling for help (Lavoie et al., 2021)). One such aspect concerns the risk factors that should raise suspicion about the possibility of hemorrhage, especially considering how nurses' expectations regarding the evolution of a particular case influence their judgment and decision-making (Tanner, 2006). For example, all mothers are at risk of postpartum hemorrhage, but educational preparation should cover specific risk factors that some mothers present (i.e., polyhydramnios, prolonged labor, infection) (Dahlke et al., 2015; Leduc et al., 2018; Postpartum Hemorrhage Clinical Practice Guideline Work Group, 2016). Other aspects include best practices regarding the many diagnostic tests that nurses may perform or transfusion of various blood products, two points that have clinical and economic consequences (Shander, 2007; Stokes et al., 2011b). Although guidelines (Kozek-Langenecker et al., 2017; Raphael et al., 2019) include recommendations regarding these issues, this review found no evidence that education exposes nurses and midwives to them. These would be

essential additions to the content of educational interventions and represent a promising avenue for defining learning outcomes relevant to the role of nurses and midwives that reflect their clinical judgment and decision-making when a patient hemorrhages.

From a pedagogical standpoint, educational interventions frequently combined informational (e.g., lectures or reading) with practical teaching strategies (e.g., workshops or simulations); very few studies relied on a single teaching strategy. Such combination appears sound, as previous studies have shown that combined teaching strategies are consistently more effective in improving learning outcomes for nurses and midwives, including satisfaction, clinical decision-making, and clinical skills (Baumberger-Henry, 2005; Huang et al., 2012; Sheikhaboumasoudi et al., 2018). It also aligns with recommendations regarding effective educational preparation, which focuses on acquiring domain-specific knowledge, experimenting with authentic clinical situations, challenging learners' assumptions, offering feedback, and fostering reflection (Richmond et al., 2020b). Furthermore, instructional design models and learning theories support structuring education with an informational phase followed by opportunities to apply, rehearse, and practice what learners have learned (McAlpine, 2004).

However, most studies did not report the theoretical underpinnings of educational interventions, a persisting problem in health professions education research (Bolander Laksov et al., 2017; Brown et al., 2019). In the absence of clear theoretical foundations, these interventions lack a rationale to support their characteristics and the mechanisms that lead to learning. Added to the incomplete description of many interventions, the interpretation of seemingly contradictory results is made even more complicated. Beyond reporting whether a given intervention has a measurable effect on learning in a specific context, research should contribute to our understanding of best practices in health professions education. Nevertheless, studies often fall prey to mistakes, such as a control group receiving no educational intervention or a truncated version of the experimental intervention. Such comparisons inevitably reveal that any educational intervention is better than none (Cook, 2012). However, their contribution to our understanding of how and why education works is limited (Freedland et al., 2019). Thus, future studies should make explicit the theoretical underpinnings of educational interventions, and their description should follow recognized guidelines such as Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching (Meinema et al., 2019). We also suggest choosing a comparison intervention according to the potential contribution to understanding how and why educational interventions work.

## Strengths and limitations

This scoping review was based on recognized methodological guidance (Peters, 2020) and reported according to current standards (Tricco et al., 2018). The literature search was conducted in several bibliographic databases using keywords and controlled descriptors to maximize sensitivity. The review was limited to studies published in English or French because we did not have the resources to consider additional languages. Two independent reviewers performed study selection, data extraction, and quality assessment to ensure relevant studies' inclusion and data and quality assessment accuracy.

Findings regarding the characteristics of interventions are subject to the quality of reporting in included studies. In addition, findings regarding learning outcomes are also subject to the inclusion of primarily quasi- and pre-experimental studies—numerous biases may affect the internal validity of these studies. Considering that this was not a systematic review of effectiveness, the current findings do not suggest the superiority of one intervention over others.

## CONCLUSIONS

Although hemorrhage is a complication that most nurses and midwives will encounter at least once in their career, this scoping review revealed a lack of evidence to support their educational preparation outside the context of postpartum. In addition, the current focus on cues of hemorrhage and care techniques invites consideration of the broader contribution that nurses and midwives could have in the detection, monitoring, and management of hemorrhage. This will require reflection and research on the role of nurses and midwives when patients hemorrhage, based on the consideration of existing guidelines and empirical observations of how this role unfolds in practice.

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Zehler, A., & Musallam, E. (2021). Game-based learning and nursing students' clinical judgment in postpartum hemorrhage: A pilot study. *J. Nurs. Educ.* , *60*(3), 159-164. https://doi.org/10.3928/01484834-20210222-07

**Figure 1. Flow diagram of study selection**

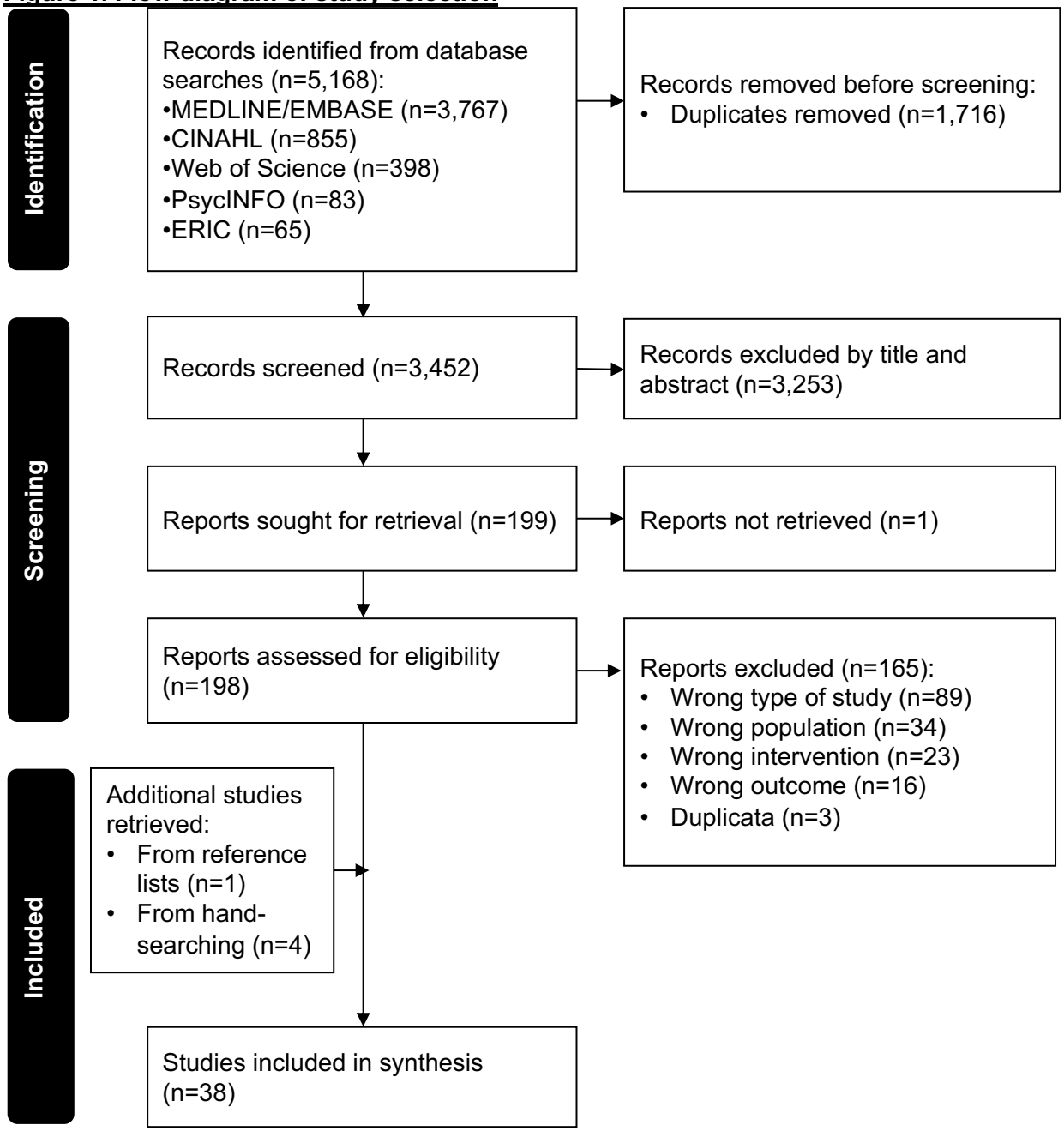
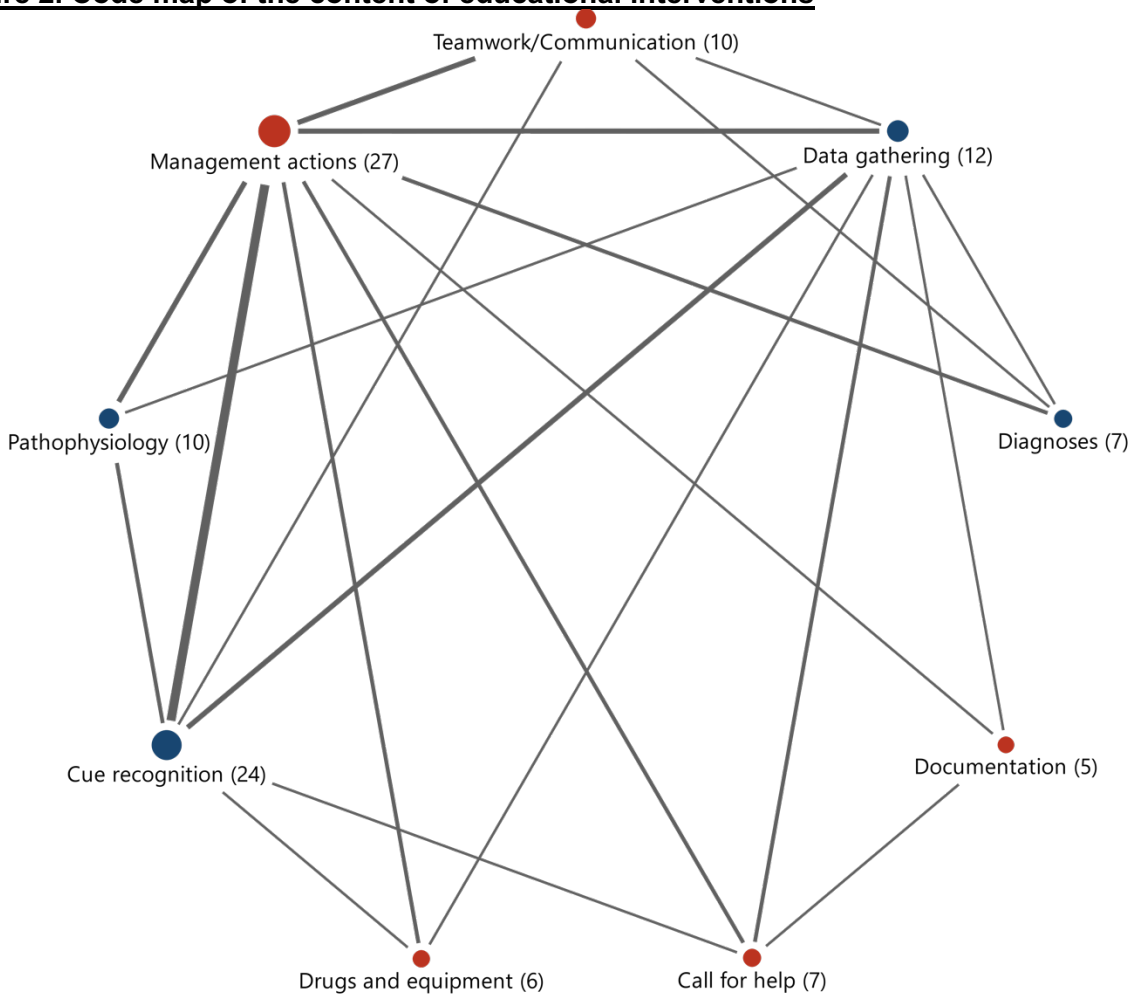


**Figure 2. Code map of the content of educational interventions**




**Legend**. The numbers in parentheses refer to the number of educational interventions (n=38) that included a content. The thickness of each line is determined by how frequently two contents were combined in the included interventions (see Supplementary Table 4 for details). Red dots refer to the management of hemorrhage; blue dots refer to the recognition of hemorrhage.

**Table 1. Characteristics of included studies (n=38)**

| Study characteristics | No. (%) |
|---|---|
| **Location** | |
| America | 17 (45) |
| Asia | 11 (29) |
| Africa | 8 (21) |
| Europe | 2 (5) |
| **Participants**[1] | |
| Professionals | 28 (74) |
| Midwives | 18 (47) |
| Nurses | 15 (39) |
| Auxiliary nurses | 4 (11) |
| Auxiliary midwives | 4 (11) |
| Nurse anesthetists | 1 (3) |
| Students | 13 (34) |
| Nursing students | 7 (18) |
| Midwifery students | 6 (16) |
| **Setting** | |
| Hospital | 20 (53) |
| University or college | 9 (24) |
| Community settings | 7 (18) |
| Unclear | 2 (5) |
| **Sample size** | |
| 0-50 participants | 13 (34) |
| 51-100 participants | 6 (16) |
| 101-150 participants | 6 (16) |
| 151-300 participants | 4 (11) |
| 301-500 participants | 4 (11) |
| >500 participants | 1 (3) |
| Not reported | 4 (11) |
| **Study design** | |
| Experimental | 7 (18) |
| Quasi-experimental | 31 (82) |
| Single group | 26 (68) |
| With a comparison group | 5 (13) |

[1] Some studies involved more than one type of participant

**Table 2. Summary of learning outcomes (n=38)**

| | No. (%) | Sig. Δ | NS Δ | NA |
|---|---|---|---|---|
| **Hemorrhage recognition** | 19 (50) | | | |
| Level 2 – Knowledge | 10 (26) | | | |
| About PPH | 9 (24) | 7 | 1 | 1 |
| Trauma and hemorrhage[1] | 1 (3) | | 1 | |
| Level 2 - Skills | 7 (18) | | | |
| Estimation of blood loss | 5 (13) | 5 | | |
| Critical thinking | 1 (3) | 1 | | |
| Situation awareness | 1 (3) | | | 1 |
| Clinical judgment with PPH | 1 (3) | 1 | | |
| Level 3 – Behavior | 5 (13) | | | |
| Diagnosis of PPH | 3 (8) | 2 | 1 | |
| Estimation of blood loss | 2 (5) | | | 2 |
| **Hemorrhage management** | 27 (71) | | | |
| Level 2 – Knowledge | 3 (8) | | | |
| Bleeding control[1] | 2 (5) | 1 | | 1 |
| Advance life support in obstetric | 1 (3) | 1 | | |
| Level 2 – Confidence | 11 (29) | | | |
| Management of PPH | 8 (21) | 5 | 1 | 2 |
| Response to a major hemorrhage[1] | 2 (5) | 2 | | |
| Preparedness to respond[1] | 1 (3) | | 1 | |
| Level 2 – Attitude | 1 (3) | | | |
| Willingness to respond[1] | 1 (3) | | 1 | |
| Level 2 – Skills | 10 (26) | | | |
| Management of PPH | 6 (15) | 3 | 1 | 2 |
| Bimanual uterine compression | 1 (3) | 1 | | |
| Clinical examination | 1 (3) | | | 1 |
| Bakri balloon insertion | 1 (3) | 1 | | |
| Tourniquet and wound packing[1] | 1 (3) | 1 | | |
| Level 3 – Behavior | 11 (29) | | | |
| Administration of IV fluids and uterotonic | 5 (13) | 2 | 1 | 2 |
| Bimanual uterine compression | 2 (5) | | | 2 |
| Management of PPH | 3 (8) | 2 | | 1 |
| Completion of case sheet | 1 (3) | 1 | | |
| **Results outcomes** | 9 (24) | | | |
| Level 4 – Results on organization | 2 (5) | | | |
| Facility readiness for managing PPH | 1 (3) | 1 | | |
| Massive transfusion rate[2] | 1 (3) | | 1 | |
| Level 4 – Results on patients | 9 (24) | | | |
| PPH rate[2] | 5 (13) | 2 | 1 | 2 |
| Maternal mortality[2] | 1 (3) | | | 1 |
| ICU admission[2] | 1 (3) | | 1 | |
| Discharge rate | 1 (3) | 1 | | |
| **Postpartum blood loss**[2] | 1 (3) | | | 1 |

PPH: postpartum hemorrhage; IV: intravenous; ICU: intensive care unit; Sig. Δ: change in outcome reached statistical significance; NS Δ: change in outcome did not reach statistical significance; NA: not applicable (i.e., posttest only); [1]Outcomes not related to PPH; [2]Outcomes showing a decrease.

**Table 3. Characteristics and results of controlled studies (n=12)**

| Reference & Country | Population | Intervention[1] | Comparator | Outcome(s) | Results | Quality[2] |
|---|---|---|---|---|---|---|
| **Randomized controlled trial (n=7)** | | | | | | |
| Kato et al. (2017)<br><br>Japan | Midwives (n=76) | E-learning, simulation | None | Level 2 – Knowledge; about PPH | Greater improvement in intervention group (SMD 1.13; 95% CI 0.66, 1.60; P < 0.001) | High |
| | | | | Level 2 – Skills; managing PPH | Greater improvement in intervention group (SMD 2.02; 95% CI 1.48, 2.56; P < 0.001) | |
| | | | | Level 3 – Behavior; managing PPH (self-assessed) | No difference between groups (OR 0.07; 95% CI 0.00, 1.51; P = 0.09) | |
| Goldsworthy et al. (2019)<br><br>Canada | Undergraduate nursing students (n=59) | Manikin-based & virtual simulation | Manikin-based simulation | Level 2 – Confidence; responding to a major hemorrhage | Greater improvement in intervention group (SMD 1.23; 95% CI 0.57, 1.89; P < 0.001) | Moderate |
| Jayanna et al. (2016)<br><br>India | Nurses (n=487) from 108 primary health centers | Mentoring, case discussion, audit and feedback, written material | Audit and feedback, written material | Level 3 – Behavior; completion of case sheet | Intervention group more likely to complete documentation (OR 22.1; 95% CI 8.0, 61.4; P < 0.001) | Moderate |
| | | | | Level 4 – Results; facility readiness for managing PPH | Greater improvement in intervention group (OR 3.7; 95% CI 1.6, 8.3; P = 0.002) | |
| Kordi et al. (2016)<br><br>Iran | Midwifery students (n=105) | E-learning | Workshop & lecture<br><br>Lecture only | Level 2 – Skills; estimation of blood loss | No difference between groups: E-learning vs workshop & lecture (SMD -0.18; 95% CI -0.76, 0.29; P = 0.46); E-learning vs lecture (SMD -0.09; 95% CI -0.58, 0.40; P = 0.72) | Moderate |
| Klokkenga et al. (2019) | Midwives (n=146) | E-learning | None | Level 4 – Results; PPH rate | Lower, non-significant incidence in intervention | Low |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ghana | | | | | group (OR 0.86; 95% CI 0.59, 1.25; P = NR) | |
| | | | | Level 4 – Results; severe PPH rate | Lower, non-significant incidence in intervention group (OR 0.95, 95% CI 0.65, 1.40; P = NR) | |
| | | | | Level 4 – Results; postpartum blood loss | No difference between groups (MRD 5.3%, 95% CI -3.2%, 13.8%; P = NR) | |
| Kordi et al. (2015)<br><br>Iran | Midwifery students (n=41) | E-learning | Simulation & lecture | Level 2 – Confidence; managing PPH | No difference between groups (SMD 0.57; 95% CI -0.07, 1.20; P = 0.08) | Low |
| | | | | Level 2 – Skills; managing PPH | Greater improvement in intervention group (SMD 0.91; 95% CI 0.24, 1.56; P = 0.007) | |
| Weiler et al. (2018)<br><br>United States | Undergraduate nursing students (n=69) | Simulation (factorial design, students could be assigned to 5 different roles) | Simulation (factorial design, students could be assigned to 5 different roles) | Level 2– Skills; critical thinking | No effect of role assignment on critical thinking scores (P = 0.541) | Low |
| | | | | Level 2– Skills; situation awareness | No effect of role assignment on situation awareness (P = 0.317) | |
| | | | | Level 2 – Confidence; managing PPH | Unclear effect of role assignment | |
| **Quasi-experimental with a comparison group (n=5)** | | | | | | |
| Andrighetti et al. (2012)<br><br>United States | Midwifery students (n=28) | Simulation | Lecture | Level 2 – Confidence; managing PPH | Greater improvement in intervention group (SMD 1.64; 95% CI 0.33, 2.95; P = 0.01) | High |
| Sukprasert et al. (2006)<br><br>Thailand | Nurses (n=90) from a department of obstetrics and gynecology | Lecture | None | Level 2 – Skills; estimation of blood loss | Greater improvement in intervention group (OR 9.55; 95% CI 3.65, 24.99; P < 0.001) | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Nilsson et al. (2014)<br><br>Kenya | Undergraduate nursing students (n=27) | E-learning | Workshop & lecture | Level 2 – Skills; managing PPH | No difference between groups (SMD -0.29; 95% CI -1.08, 0.5; P = 0.47) | Moderate |
| | | | | Level 2 – Knowledge; test success | No difference between groups (OR 0.45; 95% CI 0.07, 3.07; P = 0.42) | |
| Ghosh et al. (2019)<br><br>India | Auxiliary or general nurse-midwives (n= not reported) from 320 emergency obstetrics care facilities | Mentoring, lecture, simulation | None | Level 3 – Behavior; diagnosing PPH | Greater improvement in intervention group (SMD 0.29; 95% CI 0.10, 0.48; P = 0.003) | Low |
| Rao et al. (2019)<br><br>India | Nurses and auxiliary nurse-midwives (n=335) from primary health care facilities | Mentoring, simulation, case discussion | None | Level 2 – Skills; managing PPH | Greater improvement in intervention group (SMD 1.55; 95% CI 1.30, 1.79, P < 0.001) | Low |

[1] The educational strategies reported for the interventions and comparators are based on the coding performed independently by two authors; [2] Methodological quality assessment based on JBI quality appraisal tools (Tufanuru et al., 2017); CI: Confidence interval, MRD: Mean relative difference, OR: Odd ratio, PPH: Postpartum hemorrhage, SMD: Standardized mean difference.