Nursing Students' Decision-Making Regarding Postpartum Hemorrhage: An Exploration Using the Recognition-Primed Decision Model

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ABSTRACT

Aim: To explore the knowledge content and structure of nursing students' decision-making in a high-stake clinical situation of postpartum hemorrhage using the Recognition-Primed Decision Model.

Background: According to research on clinical judgment, a nurse's expectations for a patient situation are central to the clinical decision-making process. However, little research has addressed the expectation concept and its relationship with the nurse's knowledge. Grounded in the naturalistic decision-making paradigm, the Recognition-Primed Decision Model provides a potential framework to describe the content and structure of nurses' knowledge and expectations as they unfold in high-stake clinical situations, such as postpartum hemorrhage. As it is typically used in studies of expert decision-making, it is crucial to test the adequacy of the Model with a student population and refine the research methods for using this framework.

Design: Descriptive design where qualitative data were analyzed using qualitative and quantitative methods.

Methods: A convenience sample of 53 students enrolled in a maternal and child health course in the Fall of 2021 was formed. As part of an online exercise to prepare for a simulation, they read a vignette presenting the story of a woman experiencing postpartum hemorrhage and recorded their answers to questions designed to probe their decision-making. Recordings were transcribed and subjected to content analysis based on the four components of recognition according to the Recognition-Primed Decision Model (i.e., cues, expectations, goals, and actions).

Findings: All participants recognized the postpartum hemorrhage. Their knowledge was organized into clusters representing the potential causes (i.e., tone, trauma, tissue, and thrombin) and consequences (i.e., hemodynamic instability) of postpartum hemorrhage, as well as other potential issues (e.g., pain and comfort, baby and partner, infection). Although students could identify relevant cues and actions, they had difficulties articulating their longer-term goals and expectations for the mother and care outcomes.

Conclusions: This study showed the potential of the Recognition-Primed Decision Model to organize the content and structure of the knowledge that supported nursing students' decision-making in a high-stake situation. The findings suggest that their knowledge disproportionately focuses on the cause-and-effect relations between cues and actions. They invite further consideration of longer-term goals and expectations in nursing education to prepare students to anticipate events and assess patient responses appropriately.

Keywords: clinical judgment, clinical decision-making, knowledge, nurses, nursing students, postpartum hemorrhage, Recognition-Primed Decision Model, naturalistic decision-making

INTRODUCTION

The concept of clinical judgment describes the process and result of a nurse's clinical decision-making and remains a significant focus of nursing education and research (Jessee, 2021). The seminal publication of Tanner's (2006) Clinical Judgment Model marked a turning point in the understanding and teaching of decision-making in nursing. With this Model, Tanner (2006) shed light on the role of the nurse's background, relationship with the patient, and context in clinical judgment. Furthermore, she identified four aspects—or cognitive operations—that characterize a nurse's clinical judgment, i.e., noticing, interpreting, responding, and reflecting. Noticing important or salient features of a patient situation—the first aspect of clinical judgment—is a function of a nurse's expectations for that situation. These expectations stem from the nurse's knowledge of the individual patient, knowledge of patients experiencing similar situations, and textbook knowledge. Together, they shape the possibility of noticing depending on whether the situation meets the nurse's expectations or not.

Despite its critical importance in clinical judgment, little research has addressed the concept of expectations and its relationship with the nurse's knowledge. Prior research has devoted much attention to the role and structure of knowledge in nurses' and other clinicians' memory (Buckingham & Adams, 2000; Deschênes & Goudreau, 2017; Koufidis et al., 2021a, 2021b). However, this work does not explicitly refer to the expectation concept and has not always involved well-defined research methods. In addition, nurses' decision-making is often studied under controlled conditions, in situations with explicit goals, without accounting for high-stakes situations where nurses are under pressure to make judgments and clinical decisions due to the urgency of patients' conditions. Therefore, it is crucial to identify frameworks that address the concept of expectation in clinical decision-making, consider authentic decision-making conditions, and provide methodological guidance to study the structure and content of the knowledge involved.

One such framework, the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993), is grounded in the naturalistic decision-making paradigm. Naturalistic decision-making researchers describe effective decision-making in the real world based on research in high-stakes, authentic situations marked by high risk and uncertainty (Klein, 2008). Under such conditions, Klein et al. (2010) found that experts were not comparing options, making choices, or assessing probabilities to select the optimal alternative. Instead, their decision-making was rapid and aimed at finding a satisfying, workable solution. It implied two processes: recognition and mental simulation. Recognition consists of classifying a situation—i.e., determining what type of case it is—and mental simulation entails evaluating the suitability of the typical course of action for such a situation—i.e., imagining its implementation and making necessary adjustments. These two concepts are at the core of the Recognition-Primed Decision Model, which has been applied in various fields, including nursing (Bond & Cooper, 2006; Cioffi, 2012; Reay & Rankin, 2013).

One critical contribution of the Model was defining the four recognition components: cues, expectations, goals, and actions. Cues are indicators of larger patterns associated with expectations regarding how things should unfold; their recognition is associated with understanding the goals to pursue and the typical actions to achieve them (Ross et al., 2005). Together, patterns of cues, expectations, goals, and actions form the structure of mental models, the content of which "include both contextualized technical knowledge and cause-and-effect relationships" (Ross et al., 2005, p. 330).

Thus, the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993) provides a potential ontological framework to describe the knowledge nurses and nursing students mobilize in high-stakes clinical situations (Nibbelink & Brewer, 2018). Considering that this model is typically used in studies of expert decision-making, it is crucial to test its adequacy with a student population and refine the methods to collect and analyze research data using this framework. Therefore, this study aimed to explore the knowledge content and structure of nursing students' decision-making in a high-stake clinical situation of postpartum hemorrhage using the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993). We selected a postpartum hemorrhage case for convenience of access to research data and consistency with our work on nurses' decision-making regarding hemorrhage (Lavoie et al., 2022).

METHODS

This study used a descriptive, mixed-methods design where qualitative data (i.e., students' answers to a clinical decision-making vignette) were analyzed using qualitative and quantitative methods (i.e., quantitative content analysis). We adopted a systemic view of research design based on the evolving interaction between the study's goal, conceptual framework, questions, methods, and validity. According to Maxwell et al. (2015), such an approach is more representative of a study's complexity and "logic-in-use." The goal here is to detail how the relationship between the components of the study evolved to meet the study's purpose. Thus, this report presents both the findings of the study and considerations regarding the evolution of the methods to collect and analyze data.

This dataset was drawn from a parent study of nursing students' decision-making regarding hemorrhage throughout their baccalaureate education. The parent study examined students' decision-making whenever they encountered situations in which patients presented with bleeding complications. In each case, students were invited to record their answers to a clinical decision-making vignette consistent with their course. The current dataset was analyzed separately because postpartum hemorrhage is unique in its causes, manifestations, and management compared with the other bleeding complications under study—which were primarily iatrogenic (e.g., hemorrhage following a surgery or an arterial puncture).

Participants and setting

Participants were enrolled in a competency-based baccalaureate nursing program at two campuses of a French-language university in Montreal, Canada. This three-year program features active learning opportunities (e.g., problem-based learning, simulation, clinical placement) that allow students to encounter authentic nursing situations. All students in the cohort attending the program from September 2020 to May 2023 were eligible.

The current dataset was collected in the fall of 2021 (fourth term) as part of a second-year maternal and child health course addressing postpartum hemorrhage. In this course, students participated in a mandatory postpartum hemorrhage simulation, which took place on the fifth of seven weeks of the course. In the weeks preceding this simulation, they participated in problem-based learning and lab sessions to learn about pregnancy and perinatal care. They read about postpartum complications, including hemorrhage. Although the concept was mentioned, no activity focused on postpartum hemorrhage per se.

The researchers invited students to participate in one of the first classes of the maternal and child health course and formed a convenience sample with all volunteers. The sole inclusion

criterion was course enrolment at the time of data collection; no exclusion criteria were applied. To prevent students from preparing for data collection, the researchers explained that the study focused on their decision-making without mentioning postpartum hemorrhage.

Data collection

This study's data consisted of students' answers to a clinical decision-making vignette. The vignette (Figure 1) depicted the story of a woman experiencing postpartum hemorrhage, followed by six questions based on the four components of recognition Evans et al. (2015) using terms students were accustomed to (see Figure 1 for the correspondence between the components of recognition and the questions). The vignette was constructed so the hemorrhage would be readily recognizable without being named or providing details regarding the woman's condition. Information about her pregnancy and delivery was typical, except for risk factors for postpartum hemorrhage and a sudden increase in bleeding. The vignette and questions were developed based on the recommendations of Evans et al. (2015) and reviewed by the course teachers, both clinical experts with extensive teaching experience. Of note, the six questions had been used to collect data with a different vignette in a previous surgical nursing course.

[Figure 1. Clinical decision-making vignette]

The data collection procedure was integrated into the regular course activities. In preparation for the simulation, all students enrolled in the course, whether participating in the study or not, were instructed to access and read the vignette on the online course management system (Moodle, Australia). Using a built-in function of the course management system, they verbalized and recorded their answers to the six questions of the vignette in 5 min or less without referring to resources, such as textbooks or colleagues. They were instructed to provide comprehensive answers and justification within the allotted time and to avoid one-word answers. Students were told that this was not a test or evaluation, that they would not receive a grade, and that we were trying to access their 'natural' thinking. They had one week before the simulations to record their answers.

Only the recordings from students who had consented to the study were considered. If students wanted to participate, they had to click a link on the course management system to access the LimeSurvey (Hamburg, Germany) consent form and complete a questionnaire about their sociodemographic characteristics and experience caring for bleeding patients.

Data analysis

Sociodemographic and experience data were summarized using descriptive statistics. Recordings for students who provided consent were exported and transcribed verbatim. A research assistant verified the accuracy of the transcripts. Transcripts were imported in MAXQDA 2020 (VERBI Gmbh, Germany) and subjected to content analysis, a descriptive method that can serve qualification and quantification purposes (Elo & Kyngas, 2008; Vaismoradi et al., 2013).

A research assistant first divided the transcripts according to the six questions of the vignette. The research assistant then inductively coded the data for each question. Codes were organized hierarchically to reflect the precision of participants' answers (see Table 1 for examples). Because the unit of analysis was the individual participant, codes and subcodes were mutually exclusive and could only be attributed once to each transcript (or participant). If a participant repeatedly addressed a particular piece of information, the most detailed segment was coded, and the other

segments were coded as duplicates. This procedure allowed for calculating the exact number of participants who discussed a specific piece of information and the number who discussed the various pieces of information included under a broader code. For example, 32 students had the code "low blood pressure," and six had the broader code "blood pressure." Thus, 38 students discussed blood pressure, and 32 expected low blood pressure. A researcher verified the coding at two levels: by transcript (to ensure that all relevant codes were attributed and avoid duplicates) and by code (to ensure that all segments under a code were similar and that no additional coding was warranted).

[Table 1. Examples of coding by level]

In the second analysis stage, the researchers associated each code with one of the four components of recognition using the following definitions: “cues” are meaningful pieces of data used to identify larger patterns, “expectations” are hypotheses regarding how things should be or unfold in the situation despite the absence of information in the vignette, “goals” are statements regarding desired outcomes, and “actions” are interventions to modify the situation or solve the clinical problem. The researchers then organized the codes into clusters and subclusters based on observed patterns in the data and their knowledge of postpartum hemorrhage. Most clusters represented students' mental models of the causes and consequences of hemorrhage; they reflected the expected structure of students’ knowledge according to the Recognition Primed Decision Model (Klein et al., 2010; Klein, 1993) and included codes associated with the four components of recognition. However, some clusters only contained codes associated with one or two components of recognition. Clustering continued until most codes were categorized, and the remaining codes did not fit into any cluster. The research team discussed the resulting clusters to challenge the inclusion and exclusion of codes until consensus.

Finally, researchers examined the codes in each cluster and their belonging to the four components of recognition. They then quantified the number of participants who had discussed at least one piece of information in each cluster and the number of participants who had explicitly discussed the cues, expectations, goals, and actions associated with each cluster.

Rigour and trustworthiness

Strategies to ensure rigour and trustworthiness in qualitative research were implemented (Elo & Kyngas, 2008; Lincoln & Guba, 1985). Multiple independent verifications in coding and clustering were applied to ensure the accuracy and reproducibility of the findings. An audit trail was constituted to capture the research process and justify methodological choices, from data collection to analysis and reporting. The findings were presented to the course teachers to ensure they resonated with their experience with students; the teachers' feedback on students’ answers and relationship with what was taught in the course increased the researchers' understanding of the data's context. The current report describes the context, analysis process, and findings with sufficient details to illustrate how the study was carried out and allow for replication.

Ethical considerations

The University's Institutional Review Board approved the study (CERSES-21-035-D). Informed consent was sought from all participants, and, as a token of appreciation, they were enrolled in a raffle to win one of three $50 gift cards. Participants had met the researchers during research recruitment activities in previous courses. Researchers were not involved in the course delivery and had no dependency relationships with participants.

FINDINGS

A total of 53 students agreed to participate in the study (35% of 153 students enrolled in the course). They were 24 years old on average (standard deviation: 6.1), and most identified as female (n=45, 85%). Twelve students (23%) had previous training in a health discipline (e.g., paramedics, nutrition, physical therapy), but only four (8%) had worked in that capacity. Regarding prior experience or knowledge, eleven students (21%) had encountered a bleeding patient during clinical placement, and six (11%) had previously received bleeding education in a first aid course or hospital orientation.

Analysis process

Data from the 53 transcripts were condensed into 1,797 segments under 182 codes. A total of seven clusters and four subclusters containing 154 codes (85%) and 1,241 segments (69%) were created (see Table 2). Codes excluded from the clusters mainly represented students' answers to the first question (i.e., important data). Most students read parts of the vignette aloud without specifying what they believed was important. Thus, most codes (n=19, 10%) and segments (n=542, 30%) associated with the first question provided little information regarding students' decision-making and were excluded from further analysis. Other excluded codes (n=9, 5%) and segments (n=12, <1%) were vague (e.g., "giving a medication" or "taking blood samples" without further details) or exclusive to one or two students (e.g., "checking for consent" or "assessing nausea").

[Table 2. Clusters representing nursing students' decision-making regarding postpartum hemorrhage]

The codes for cues, actions, and goals were readily defined, but those for expectations were not. We found that students discussed two types of expectations related to assessment findings (i.e., cue expectations) and longer-term developments (i.e., outcome expectations). We also noted that it was easier for students to discuss the former than the latter. In the analysis process, describing the cues that students sought and their expectations for them proved informative from a qualitative perspective because it helped to detail and nuance the content of their mental models. In contrast, separate reporting of quantitative data regarding cues and cue expectations added little information because students often discussed the two components together. Thus, we combined data regarding cues and cue expectations in Table 2 but reported them separately in the text. As for outcome expectations, students talked about them in general terms, which prevented us from associating them with specific patterns or mental models. Therefore, we decided to address them in a separate section from the clusters.

Students' decision-making

Five clusters and four subclusters represented complete patterns—or mental models—structured with codes for the four components of recognition. The other two clusters only included cues or actions and could not be attached to a specific pattern due to the absence of the other components of recognition. The following section describes the content of the clusters using the structure of cues and expectations, goals, and actions.

Postpartum hemorrhage

The first cluster was ‘postpartum hemorrhage’ (Figure 2). All students recognized the postpartum hemorrhage using a variety of cues. Most students discussed the blood flow: 52 highlighted that the woman had soaked a pad in 30 min, but only 28 mentioned that the flow was

abnormal; 24 students wanted to assess the blood flow further (e.g., quantity, rate, trend since delivery, frequency of pad changes). In addition, 21 students discussed risk factors for postpartum hemorrhage, 19 asked for a complete blood count expecting lower hemoglobin and hematocrit, and five commented that clear, bright red blood indicated active bleeding.

[Figure 2. Postpartum hemorrhage cluster]

If all students recognized the hemorrhage, only 46 stated their goal was to stop the bleeding. Their decision-making for this cluster was further organized around four subclusters to explain the cause of the hemorrhage, which we classified according to the 4 T's of postpartum hemorrhage: tone, trauma, tissue, and thrombin (Anderson & Etches, 2007).

The 'tone' subcluster included codes related to uterine atony. The cues for this subcluster included the fundal tone (n=47), position and height (n=24), and the woman's urine output (n=19). Most students (n=47) expected insufficient contraction of the uterus, and some (n=22) thought it might be deviated or enlarged due to urinary retention. Uterine massage (n=47) and uterotonic medication (n=36) were the two most frequent actions mentioned, with 15 students stating that their goal was to help the uterus contract for hemostasis. Eleven students said they would perform a urinary catheterization or ask the mother to void.

The 'trauma' subcluster included codes related to vaginal tear; one student believed the mother was experiencing uterine rupture. Regarding cues, 28 students wanted to assess the sutures to determine if the vaginal tear had reopened; two mentioned that early mobilization could increase bleeding. Most students who discussed the baby's weight (n=13/14) mentioned that it was a risk factor for trauma. Although seven students stated their goal of identifying the source of the bleed and one sought proper wound healing, actions directly related to the trauma hypothesis were scarce; four students asked a physician to repair the tear or install a balloon, and one student applied compression to the perineum.

The 'tissue' subcluster included codes related to retained placenta. For cues, 29 students asked about the texture, and 13 asked about the size of the clots because breakable/disintegrating clots and clots larger than 4 cm could indicate placental retention. Eight students asked about the integrity of the placenta at delivery. The goals, actions, and expectations associated with the tissue hypothesis resembled those of the tone subcluster; the students' objective was to help the uterus contract and expulse the placenta. In addition, one student mentioned surgical removal of the placenta.

The 'thrombin' subcluster included codes related to the woman's coagulation. Three students inquired about her prothrombin or partial thromboplastin time, and one asked if she took anticoagulants. No goals, actions, or expectations were explicitly associated with this subcluster.

Instability & shock

The second cluster was 'instability and shock' (Figure 3). All students inquired about the consequences of postpartum hemorrhage for instability, and ten believed the woman was currently in hypovolemic or hemorrhagic shock. In terms of cues, 47 students asked about the mother's vital signs, most expecting decreased blood pressure (n=32), increased heart and respiratory rates (n=23 and 21, respectively), and decreased pulse oximetry (n=17). Twenty-two students discussed neurological symptoms of instability, including dizziness (n=16), decreased level of consciousness (n=12), and disorientation (n=1). Of note, 42 students noted the dizziness in the vignette, but only 16 linked it to hypovolemia, and four thought it could be associated with

an epidural. Twelve students looked for pale, cold, clammy skin, and two sought additional symptoms of hypovolemia (e.g., thirst, slow capillary refill, shivers).

[Figure 3. Instability & shock cluster]

Regarding instability, students' goals were to stabilize the patient (i.e., her vital signs, dizziness, and level of consciousness; n=15), replace the loss of intravascular volume (n=10), and avoid hypovolemic shock (n=7). Their actions included administrating intravenous fluids (n=31), packed red blood cells (n=19) or oxygen (n=19). They monitored the mother's vital signs (n=13), ensured intravenous access (n=12), and positioned her to increase cerebral blood flow (n=8). One student mentioned that a cold towel might help her blood pressure, and another wanted to cover her to help with thermoregulation.

Other clusters

Fewer students discussed other clusters. Regarding the 'baby & partner' cluster, four students sought cues about the baby's condition, and three asked who accompanied the mother. Seven students aimed to calm her and her partner, and 13 mentioned actions to inform and reassure them. For the 'pain & comfort' cluster, 12 students asked if the mother experienced pain or had an analgesic prescribed, and five aimed to ensure her comfort. The 'infection' cluster was discussed by six students who sought cues regarding the odour of lochia (n=4), signs of wound infection (n=3), and hyperthermia (n=2)—one had a goal of preventing infection and wanted to administer an antibiotic.

Two clusters were not based on a specific pattern. One cluster only included the action of asking for help (n=38): 34 students notified the physician—often to obtain prescriptions to manage the mother's condition—and ten students asked for their colleagues' help. The other cluster only included a set of cues regarding health history (n=8); those students asked about the mother's current and prior pregnancies.

Outcome expectations

Students had difficulties answering the question about the outcomes they expected if they intervened or not. Their explanations were often concise and dichotomous (i.e., they expected one outcome or the opposite). The most frequent outcome expectations concerned bleeding; 38 students believed the hemorrhage would diminish or stop if they intervened or continue if they did not. Next, 36 students discussed the possibility—or prevention—of hypovolemic shock and its manifestations; stabilization or deterioration of the mother's neurological status and vital signs were discussed by 17 and 12 students, respectively. Eighteen students mentioned that she would live or die, and 17 explained that she would stabilize or deteriorate. Besides, nine students explained that proper interventions would facilitate her recovery and reduce her hospital length of stay—or the opposite. Four students believed that the mother would feel supported and comforted. Three students and one student expected to ensure her safety and reassure the healthcare team.

DISCUSSION

This study aimed to explore the knowledge content and structure of nursing students' decision-making regarding postpartum hemorrhage using the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993). Although it had been used in prior studies of expert nurses' decision-making (Bond & Cooper, 2006; Cioffi, 2012; Reay & Rankin, 2013), this was the first study to utilize the Model with a student population. The findings indicate that the four components of

recognition can structure the knowledge that supports students' decision-making in a high-stake clinical situation. Qualitative content analysis allowed describing the content of this knowledge.

To set the stage and trigger students' recognition process, we opted for a vignette reflecting the conditions in which students might encounter a hemorrhaging patient, i.e., with data obviously indicating bleeding but no further information. We provided questions to guide their decision-making, but they still had to determine the relevant data. A vignette represented a flexible and efficient way to access students' decision-making without the practical issues of interviews or observations (Evans et al., 2015). It was also compatible with online data collection, a significant advantage during the COVID-19 pandemic. Although involving clinical experts was a strength, the validity of clinical decision-making vignettes should not be solely judged on the extent to which they resemble the real world; their primary function is instead to activate the mental and behavioural processes that would unfold if participants encountered similar situations in real life (Evans et al., 2015). Considering that all students recognized the hemorrhage, the vignette presented a high level of authenticity and achieved its function. However, students had difficulty verbalizing some parts of their clinical decision-making, such as goals or outcome expectations. This difficulty could be due to the conditions and methods of data collection or students' incapacity to fully articulate the content of their thoughts. Some probing could have been helpful to capture their reasoning fully, but the data might not have been representative of their thought process as it occurs in the real world.

Still, we were able to structure most students' answers according to the four components of recognition, i.e., cues, expectations, goals, and actions (Klein et al., 2010; Klein, 1993). As an analytic method, content analysis (Elo & Kyngas, 2008; Vaismoradi et al., 2013) was flexible enough to achieve this purpose. However, we could not analyze their answers to the first question (i.e., most important data) because students read the vignette rather than pinpoint what they deemed important. It could have been worthwhile to have them read the vignette aloud before verbalizing what data they thought were important. Besides these adjustments, we contend that the proposed design provided an adequate option for studying students' clinical decision-making under the lens of the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993).

In terms of content and structure, we organized students' answers in clusters containing cues and cue expectations, goals, and actions, which represents a contribution compared to prior studies of postpartum hemorrhage decision-making that either focused on cues or actions (Bento et al., 2021; Scholes et al., 2012). Most clusters represented patterns of causes and consequences of postpartum hemorrhage. Regarding causes, all students discussed uterine atony, which represents approximately 70% of cases of postpartum hemorrhage (Bienstock et al., 2021), and most were able to discuss the associated cues and actions. This observation aligns with the course content: the problem-based learning and lab sessions before data collection addressed uterine atony, uterine massage, and uterotonic medications in greater depth than other postpartum complications.

Fewer students discussed the other three causes of postpartum hemorrhage, reflecting the lower incidence of these cases (i.e., tissue, trauma, and thrombin account for 20%, 10%, and less than 1% of cases, respectively; Bienstock et al., 2021). Although students could name the cues to assess, they had more difficulties describing the actions they would carry out regarding these causes. Furthermore, the course teachers mentioned that these causes were unlikely, considering the vignette's clinical content and the bleed's timing in relation to the delivery time. Besides, all students inquired about the consequence of the hemorrhage on the mother's hemodynamic

stability, and the majority identified relevant cues and actions. Overall, the knowledge content of students' decision-making was similar to prior studies of postpartum hemorrhage decision-making (Bento et al., 2021; Scholes et al., 2012) and to the content of educational interventions in that regard (Lavoie et al., 2022).

Perhaps the greatest challenge for students was to describe the goals they were pursuing. Regardless of whether it concerned the causes or consequences of hemorrhage, less than half of the participants could clearly articulate their goals or intentions for the mother. This finding suggests that their mental models disproportionately focused on the cause-and-effect relations between cues and actions—possibly in the form of 'if-then' rules—without as much attention dedicated to typical goals for these situations. This gap in their knowledge might reflect that clinical decision-making and judgment continue to be taught based on the nursing process, even though proponents of the Clinical Judgment Model (Tanner, 2006) argue for increased attention to care outcomes (Jessee, 2021). More importantly, it indicates that nursing educators must help students understand and articulate their care goals to make proper clinical decisions and assess patient responses effectively.

It was easier for students to discuss what they expected to find in their assessment (i.e., cue expectations) than how they anticipated the situation to evolve (i.e., outcome expectations). It was particularly striking to see the dichotomous and often poorly nuanced depictions of the outcome expectations, which were often limited to worsening or improvement in what they had observed. In a sense, this was reassuring because students knew what they could expect to see if the situation deteriorated or improved. From the Clinical Judgment Model's perspective (Tanner, 2006), most seemed to know the typical patterns of response for patients experiencing similar situations and knew what aspects deserved their attention, thereby creating a perceptual opportunity for noticing. However, students primarily focused on the immediate presentation of the issue; they could hardly project into the future and anticipate what could happen to the mother. Considering the importance of anticipatory thinking according to the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993), especially for mental simulation processes, educators must provide students with opportunities to develop an understanding of the trajectories that patients may experience as their situations evolve beyond stereotypical conceptualizations of the outcome of care (e.g., healing or dying). It must be remembered that anticipatory thinking is a hallmark of expertise linked to multiple aspects of decision-making, including problem detection, preparation for future events, and adaptation to unexpected events (Klein et al., 2011). It is also important to note that students, by definition, lack clinical experience and may not have been exposed to sufficient cases to understand the subtleties of the various paths that patients may take as their health experience unfolds. Anticipatory thinking requires a form of sensemaking that narratives and narrative thinking can propel. Of note, narrative reasoning is a type of meaning-making discussed in the Clinical Judgment Model (Tanner, 2006) that could represent an opportunity for nursing education.

CONCLUSION

This study used the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993) as a conceptual framework to describe the knowledge content and structure involved in nursing students' clinical decision-making. The findings invite consideration of which aspects of clinical decision-making students are well prepared for and which deserve more attention. Educators are encouraged to emphasize longer-term goals and expectations regarding care outcomes so that nursing students can anticipate the most predictable events and those less likely that still pose a

significant risk to patients. In addition, the clusters resulting from this study are potentially pedagogically relevant tools that summarize and illustrate the knowledge content and structure of clinical decision-making in postpartum hemorrhage.

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Table 1. Examples of coding by level

Level	Code	Coded segment
First	Vital signs	"I would take her vital signs to compare with previous values to ensure the patient's overall health status."
	Blood tests	"There will also be blood tests to be done, which the doctor will prescribe."
Second	Blood pressure	"For the additional data, I would like to take her blood pressure."
	Complete blood count	"Of course, it will probably be necessary to take blood samples—the hematocrit, the hemoglobin—to evaluate the effects of the blood loss."
Third	Low blood pressure	"Another data I would like to get would be her blood pressure. I expect it to be lower than 120 over 80 since she's dizzy, bleeding heavily, and she lost 400 mL of blood during the delivery."
	Low hemoglobin	I would also like to have her CBC, specifically the hemoglobin, red blood cells, and erythrocytes. I expect the hemoglobin to be lower as she has lost blood."

Table 2. Clusters representing nursing students' decision-making regarding postpartum hemorrhage

Clusters	Total	Cues & expectations	Actions	Goals
Pattern-based				
1. Postpartum hemorrhage [a]	53 (100)	53 (100)	50 (94)	46 (87)
a. Tone	53 (100)	49 (92)	49 (92)	15 (28)
b. Trauma	38 (72)	28 (53)	5 (9)	8 (15)
c. Tissue	34 (64)	34 (64)	33 (62)	8 (15)
d. Thrombin	4 (8)	4 (8)	-	-
2. Instability & shock	53 (100)	48 (91)	43 (81)	27 (51)
3. Baby & partner	21 (40)	7 (13)	13 (25)	7 (13)
4. Pain & comfort	16 (30)	11 (21)	2 (4)	5 (9)
5. Infection	6 (11)	6 (11)	1 (2)	1 (2)
Not pattern-based				
6. Asking for help	38 (72)	-	38 (72)	-
7. Health history	8 (15)	8 (15)	-	-

NOTE. Data are numbers (percentages) of participants. [a] Data for the "hemorrhage" cluster include data from the four clusters associated with the 4Ts of postpartum hemorrhage.

Figure 1. Clinical decision-making vignette

Sophie Lessard is a 37-year-old female, $G^3P^3A^0$, with no known allergies. She is 39 3/7 weeks pregnant, and her pregnancy was unremarkable. She is not taking medication except for a prenatal multivitamin recommended by her physician.

At noon today, Ms. Lessard delivered a 4,000-gram baby vaginally. Active labour lasted for 2 1/2 hours. The placenta was spontaneously expelled within five minutes of delivery. Ms. Lessard lost approximately 400 mL of blood during delivery and suffered a second-degree vaginal tear.

At 2:30 PM, Ms. Lessard got up to go to the bathroom for the first time. She tolerated mobilization well. You helped her change her pad which was 75% soaked with light red lochia.

It is 3:00 PM, and you enter Mrs. Lessard's room. She complains of slight dizziness and asks for help to change her pad again, as she felt some discharge. The pad is 90% soaked with bright red lochia and clots.

Record your answers to the following questions:

- What are the most important data? [*cues*]
- What other data would you like to have? What do you expect the results to be? [*cues and expectations*]
- What are your first impressions? What are your hypotheses? [*larger patterns to which cues point*]
- What would be your priority actions? Why are these actions relevant? [*actions*]
- What would be your goals in the situation? What do you want to accomplish? [*goals*]
- What will happen to Ms. Lessard in the next few minutes if you do not intervene? What if you do intervene? [*expectations*]

NOTE. Words between brackets were not displayed to students; they are presented to link the questions with the elements of the Recognition-Primed Decision Model (Klein et al., 2010; Klein, 1993).