REVIEW ARTICLE

NursingOpen _Open Access_ WILEY

Patient safety educational interventions: A systematic review with recommendations for nurse educators

Seung Eun Lee[1] | Brenna L. Morse[2] | Na Won Kim[3]

[1]College of Nursing, Mo-Im KIM Nursing Research Institute, Yonsei University, Seoul, South Korea

[2]Solomont School of Nursing, University of Massachusetts Lowell, Lowell, MA, USA

[3]Yonsei University Medical Library, Yonsei University, Seoul, South Korea

Correspondence
Seung Eun Lee, College of Nursing, Mo-Im KIM Nursing Research Institute, Yonsei University, 50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, South Korea.
Email: leese@yuhs.ac

Abstract

Aim: This study identified and evaluated tested patient safety educational interventions. This study also described the content, curricular structures and teaching strategies of the educational interventions and determined the methods used for evaluating patient safety learning outcomes.

Design: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines directed this review.

Methods: Searches for articles describing and evaluating patient safety educational interventions were conducted using four scholarly databases. Study quality was assessed using the McMaster Critical Review Form.

Results: Seven studies met the inclusion criteria. Educational interventions were either presented as stand-alone courses or as lessons embedded in an existing course. All studies employed a mixture of various teaching modalities and several evaluation methods and outcomes. Mixed results were observed in terms of the effects of educational interventions. Future researchers should continue to develop patient safety curricula and examine their effect on student competencies with stronger methodological rigour.

KEYWORDS
nursing, nursing education, patient safety, patient safety education, pre-licensure nursing

1 | INTRODUCTION

Patient safety is an international healthcare priority. _Patient safety_ is defined as "the reduction of risk of unnecessary harm associated with health care to an acceptable minimum" (Runciman et al., 2009, p. 19). Although efforts have been made to improve patient safety in health care, patient harm still occurs in approximately 1 in 10 healthcare encounters (Slawomirski et al., 2017). Globally, patient harm is estimated to be the 14th leading cause of disease burden, resulting in around 15% of total hospital expenditure and activities (Slawomirski et al., 2017). Any incident resulting in unintended injury or illness to a patient is called an _adverse event_ (National Quality Forum, 2004). Examples of adverse events include medication errors, pressure ulcers and patient falls. Approximately half of patient care errors are preventable (World Health Organization [WHO], 2009, 2019), and many are related to nursing care (National Quality Forum, 2004). Errors related to nursing care may stem from individual or system-level factors. Nevertheless, nurses are key potential contributors for improving patient safety as they constitute the majority of the healthcare workforce and work closely with patients throughout their hospital stays (Institute of Medicine, 2003).

1.1 | Background

Due to the important role of nurses in improving patient safety, nursing students must be educated on how to improve and ensure patient safety. Although educators have long acknowledged that undergraduate education plays an essential role in equipping nurses with the patient safety competencies necessary to practice (American Association of Colleges of Nursing, 2006), many nursing students deny competence in patient safety matters (Gleason et al., 2019). According to a previous review of 20 international studies about patient safety education in nursing curricula, patient safety education is often implicit rather than explicit in the curriculum (Tella et al., 2014), which may leave room for confusion, or failure to meet safety competency standards by nursing students. The findings may indicate that patient safety education as a part of nursing education is insufficient in its current form (Lee, Dahinten, et al., 2020). To provide safe patient care, nursing students must learn patient safety principles (Bedgood & Mellott, 2018) and socio-cultural aspects of patient safety (Ginsburg et al., 2012; Lee, Lee, et al., 2020). However, much academic teaching continues to focus on individual clinical issues such as fall prevention, inflection control or medication safety, as opposed to a focus on systems-level challenges, such as workplace design or human factors that are required for nursing students to develop the critical reasoning and clinical skills that will improve patient safety (Lee, Dahinten, et al., 2020; Mansour, 2012; Roh, 2019).

To that end, the WHO (2011) emphasized that patient safety education should incorporate more comprehensive patient safety principles, taking into account system complexity, risk management and human issues so that future healthcare professionals can build foundational knowledge and skills to practise safe care. Similarly, according to the Safety Competencies Framework developed by the Canadian Patient Safety Institute, healthcare students should gain competence in six specific patient safety competency areas (Frank & Brien, 2008). They should be able to contribute to a culture of patient safety; work in teams for patient safety; communicate effectively for patient safety; manage safety risks; optimize human and environment factors; and recognize, respond to, and disclose adverse events (Frank & Brien, 2008). In response to these calls for teaching comprehensive patient safety principles to healthcare students, some schools of nursing have adopted patient safety education curricula to help nursing students enhance their patient safety competencies in today's complex healthcare environment (Gleason et al., 2019; Mansour et al., 2015). Previous research also supported that introducing student nurses to patient safety concepts early in their educational journey has a significant positive impact on their long-term patient safety knowledge, skills and behaviours (Mansour et al., 2018). Hence, there is a need for a systematic review of tested educational interventions to determine best practices for providing patient safety education to nursing students.

2 | PURPOSE

The research question guiding this review was: *What tested educational interventions are helpful to teach nursing students about patient safety?* The purpose of the present study was to identify and evaluate tested patient safety educational interventions for nursing students. To that end, we aimed to describe the educational content, curricular structures and teaching strategies of tested educational interventions, determine the methods they used for evaluating patient safety learning outcomes and synthesize the evidence.

3 | DESIGN

This study is a systematic review of published literature guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009).

4 | METHOD

4.1 | Search strategy

Extensive searches were conducted using the electronic databases of PubMed, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL) and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The search strategy covered the following broad areas: *patient safety* and *undergraduate nursing education*. The primary search began in PubMed with major keywords listed on the Medline Medical Subject Headings (MeSH) terms, such as *"patient safety," "education, nursing, baccalaureate,"* and *"curriculum."* Search terms were used in conjunction with Boolean Operators "AND" and "OR." Appendix A provides details of the full search strategy.

4.2 | Inclusion and exclusion criteria

Our initial intention was to include articles that reported studies involving only undergraduate, pre-licensure nursing students. However, despite an intensive search, we were able to identify only four articles describing and evaluating patient safety educational interventions for pre-licensure nursing students. Therefore, studies of pre-licensure nursing students in addition to students of other disciplines (e.g. medical students) were included. Articles were included if they were (a) quantitative studies that described and evaluated an educational intervention that included patient safety as core content; (b) had empirical data for analysis; (c) were available in the English language; (d) were published in peer-reviewed scholarly journals; and (e) were published between 1990–2020.

Articles were excluded if they (a) focused only on individual, clinical safety issues (e.g. medication safety or infection control) rather than a conceptual approach to patient safety principles (Wu & Busch, 2019); (b) focused only on a limited aspect of patient safety education in nursing education (e.g. use of simulation to practice Situation, Background, Assessment, Recommendation communication); (c) described educational interventions with a primary purpose other than patient safety education; and/or (d) did

not evaluate the effects of educational interventions. For example, nursing articles reporting patient safety as only one component of a larger course or educational module (e.g. courses guided by the Quality and Safety Education for Nurses [QSEN] framework (Cronenwett et al., 2007)) were not included in the present review, as patient safety was not the main focus of such educational interventions. Although the development of the QSEN framework has improved the integration of patient safety and quality of care in nursing curricula to prepare nursing students in order to provide safe and high-quality care to patients (Bedgood & Mellott, 2018), this framework misses several important aspects of non-technical skills that are crucial for maintaining safety. For instance, the importance of human factors and the contributions of systems-level elements on patient safety in complex healthcare systems are missing in the QSEN framework (Mansour, 2012). Therefore, we did not include QSEN in this review.

4.3 | Article review process

The search strategy yielded 2,859 articles. After removing 787 duplicates, the titles and abstracts of the remaining 2,072 articles were screened for inclusion. Following this review of titles and abstracts, 57 articles were selected for a full-text review. Of those,

seven studies met the inclusion criteria and were included in this review. Common reasons for exclusion during the screening process included study type (e.g. editorial, discussion paper or literature review), study population (e.g. physicians or nurses other than pre-licensure nursing students), or no evaluation of interventions. Figure 1 displays the PRISMA flow diagram.

4.4 | Data extraction and quality assessment

Data were extracted from each article and organized into a matrix. Extracted data included author, year, sample characteristics, sample size, setting, country of origin, study design, intervention structure, intervention content, intervention duration, outcome measured, measurement instrument and main findings.

Study quality was assessed using the McMaster Critical Review Form—Quantitative Studies, which has been used extensively and caters to a range of research designs (Law et al., 1998). This form contains guidelines on how quality evaluation items should be interpreted and comprises nine assessment criteria: study purpose, literature, design, sample, outcomes, intervention, results, conclusions and clinical implications. Each criterion was given a rating of "yes," "no," "N/A," or "not addressed," except for the design criterion, which outlined seven different study designs. The form provides
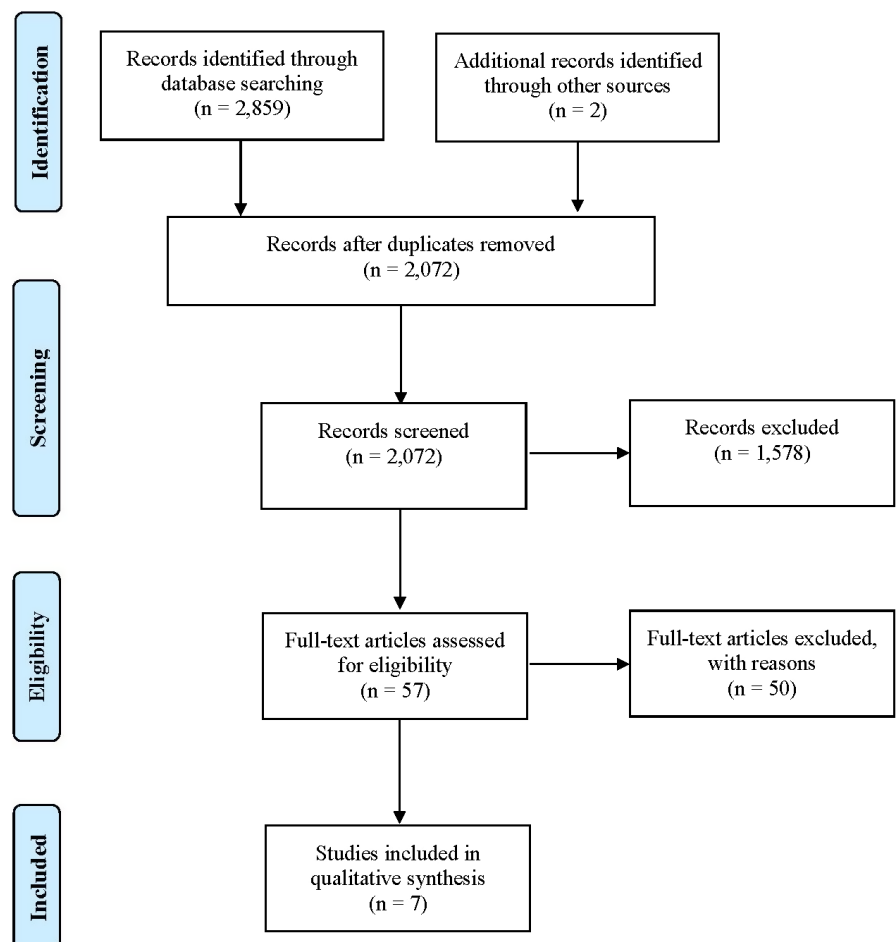

FIGURE 1 PRISMA flow diagram

only narrative assessment and no grading. The key findings of quality assessments of articles reviewed are shown in Table S1.

All included articles were assessed independently by two authors (SEL and BLM), and any disagreements were resolved by discussion until a consensus was reached. The two authors confirmed the accuracy of the extracted data and the research quality of each article. Due to the heterogeneity of the included studies, meta-analysis was not performed. Additional information about evaluation method concerns is included in the discussion section.

5 | ETHICS

Ethical approval was not required for this systematic review of published literature.

6 | RESULTS

6.1 | Study characteristics

Table 1 displays the characteristics of the seven included studies. The studies were published between 2013–2019. Three studies were conducted in the United States (U.S.) (Gleason et al., 2019; Mariani et al., 2015; Thom et al., 2016), two in the United Kingdom (U.K.) (Gough et al., 2013; Mansour et al., 2015) and two in South Korea (Hwang et al., 2016; Kim et al., 2019). All seven studies used a pre- and a post-test research design, but only two used control groups (Gleason et al., 2019; Kim et al., 2019). Samples included only pre-licensure nursing students in four studies (Gleason et al., 2019; Kim et al., 2019; Mansour et al., 2015; Mariani et al., 2015), and a combination of nursing students and students of other health professions in the other three studies (Gough et al., 2013; Hwang et al., 2016; Thom et al., 2016). The total sample size ranged from 12–223; however, in some studies the sample size that was actually used for evaluating the educational interventions was different from the total sample size of the study.

6.2 | Characteristics of the educational interventions

Table 2 summarizes the features of the educational interventions, including the framework they were based on, course content, course structure, teaching modalities and duration or frequency of the interventions. The interventions were stand-alone patient safety courses in four studies (Gleason et al., 2019; Gough et al., 2013; Hwang et al., 2016; Kim et al., 2019) while in others, the interventions were incorporated in existing courses (Mansour et al., 2015; Mariani et al., 2015; Thom et al., 2016). For example, three sessions (two lectures and one facilitated group discussions) were incorporated into an existing professional management course (Mansour et al., 2015) and two simulation sessions were incorporated into a

nursing leadership and management course (Mariani et al., 2015). The duration of the interventions varied from only two sessions (Mariani et al., 2015) to as long as four semesters (Gleason et al., 2019). As displayed in Table 2, the most commonly used framework/guide for educational curricula content was the WHO Patient Safety Curriculum Guide (N = 4) (WHO, 2011). However, the number of topics used in the interventions varied among the studies. For instance, one study included only two WHO patient safety topics from the guide (Mansour et al., 2015), whereas another study included six topics in the intervention (Gough et al., 2013). One study did not identify a framework/guide used for developing the course curricula (Mariani et al., 2015).

As presented in Table 2, the most frequently noted content in the educational interventions included a general overview of patient safety. General overviews included key patient safety concepts (N = 5), a systems approach (N = 5), teamwork (N = 4), communication (N = 4) and error reporting (N = 4). Less commonly identified content included safety culture, error disclosure and leadership. All seven studies employed a mixture of teaching modalities. Face-to-face lectures, online lectures, case studies and discussions were commonly used approaches. Simulation was used in only two studies (Gough et al., 2013; Mariani et al., 2015).

6.3 | Outcomes measured and the effects of the interventions on the outcomes

Table 3 summarizes the outcomes examined in relation to the educational interventions. Patient safety competency was the most commonly assessed outcome (N = 3); however, studies used different measurements for this specific outcome. For example, two studies used the Health Professional Education in Patient Safety Survey and measured six domains of patient safety competency (Gleason et al., 2019; Hwang et al., 2016) while one study employed the Patient Safety Competency Self-Evaluation (PSCSE) scale and examined the patient safety skills, knowledge and attitudes of the students (Kim et al., 2019). Similarly, students' perceptions about understanding of patient safety were assessed in two studies, but these researchers employed different instruments to measure the outcome (Mansour et al., 2015; Mariani et al., 2015). Other outcomes measured in the studies involved students' perceptions and attitudes towards multiprofessional learning, including teamwork and collaboration in two studies (Gough et al., 2013; Thom et al., 2016) and system-based thinking in one study (Gleason et al., 2019). Students' reactions to, or satisfaction with the educational interventions were evaluated in four studies, but there were no uniform criteria for such evaluations. Although the authors of two studies stated that objective multiple-choice questions were used to assess students' patient safety knowledge (Hwang et al., 2016; Mansour et al., 2015), all seven studies used self-reported questionnaires to evaluate outcomes. None of the studies examined behaviour changes as an effect of the implemented interventions.

TABLE 1 Characteristics of reviewed studies

First author, Year	Study design/Type	Sample	Setting/Country	Sample size Total N (EG/CG)[a]
Gleason, 2019	Pre- and post-test quasi-experimental design with focus group	Nursing students in a leadership programme with a focus on care quality and safety	1 nursing school USA	115 (36/37)[b]
Gough, 2013	Sequential mixed-methods evaluation	Students of three universities in nursing, medicine, physiotherapy and pre-registration pharmacists	1 hospital UK	12 (12/0)
Hwang, 2016	Cross-sectional design with pre- and post-study	Students in nursing, medicine and traditional Korean medicine	1 university South Korea	223 (74/0)
Kim, 2019	Pre- and post-test quasi-experimental design	Nursing students	1 nursing school South Korea	75 (32/43)
Mansour, 2015	Pre-test, post-test, non-experimental design	Nursing students in a professional management module	1 university UK	181 (141/0)[b]
Mariani, 2015	Non-experimental pre-test–post-test design	Nursing students in a leadership and management course	1 nursing school USA	175 (175/0)
Thom, 2016	Cross-sectional design with a before and after study	Students in medicine, nursing, pharmacy in a clinical course	1 academic medical centre USA	43 (24/0)[b]

Abbreviations: CG, control group; EG, experimental group; RCA, root cause analysis.

[a]The numbers indicate participants for group comparisons.

[b]Sample sizes differed for each outcome measured.

TABLE 2 Characteristics of educational interventions

First author, Year	Intervention	Framework/Guide
Gleason, 2019	4 stand-alone patient safety courses	The Essentials of Baccalaureate Education for Professional Nursing Practice
Gough, 2013	1 stand-alone patient safety course	WHO multiprofessional patient safety curriculum guide
Hwang, 2016	1 stand-alone patient safety course	WHO patient multiprofessional patient safety curriculum guide
Kim, 2019	1 stand-alone patient safety course	WHO multiprofessional patient safety curriculum guide
Mansour, 2015	3 sessions of a course	WHO mutliprofessional patient safety curriculum guide
Mariani, 2015	2 simulation sessions of a course	N/R
Thom, 2016	3 sessions of a course	Core competencies of interprofessional education and patient safety

Abbreviations: N/R, not reported; QI, quality improvement; RCA, root cause analysis; WHO, World Health Organization.

As displayed in Table 3, mixed results were observed in terms of the effects of educational interventions on the various outcomes measured. In some studies, educational interventions had positive effects on the outcomes measured. For example, significant improvements were observed in students' reported scores on some aspects of patient safety competencies after educational interventions (Gleason et al., 2019; Hwang et al., 2016; Kim et al., 2019). Additionally, nursing students reported higher systems thinking scores (STS) after the 4-semester educational intervention, and STS scores were significantly higher in the experimental group compared to the control group (Gleason et al., 2019). Researchers also reported a significant score improvement in nursing students' comfort level related to reporting and disclosing an error after two simulation sessions that were focused on quality and safety practice standards (Mariani et al., 2015). Two studies reported improvements in post-course scores of teamwork and communication, and professional identity, and professional roles and responsibility (Gough et al., 2013; Thom et al., 2016). However, statistical significances were not reported in these studies, limiting our understanding of the significance of the interventions' effects on the outcomes. In some studies, educational interventions had no significant impact on the measured outcomes. For instance, researchers reported no significant score differences in patient safety attitudes between the experimental and control group after a one-semester patient safety educational intervention for nursing students (Kim et al., 2019). Similarly, no significant differences were found in student-reported scores for recognizing and responding to adverse events between the control and intervention groups after a 4-semester educational programme focused on patient safety (Gleason et al., 2019). Finally, there was no significant improvement in nursing students' perceptions towards errors and safety in health care after an intervention following two simulation sessions (Mariani et al., 2015).

Additionally, inconsistent results were found about the effects of educational interventions on the outcomes measured. For instance, while students' patient safety knowledge scores increased significantly in one study after a one-day patient safety education programme (Hwang et al., 2016), there was no significant change in patient safety knowledge among nursing students in another study (Mansour et al., 2015). Further, significant improvements were reported in students' understanding of patient safety after an intervention involving three patient safety education sessions in one study (Mansour et al., 2015), whereas no score improvement was measured for nursing students' understanding of patient safety in another study (Mariani et al., 2015). In general, students reported high satisfaction with the educational interventions.

Core content	Structure/Format/Educational modality	Duration/Frequency
Safety science, safety culture, enabling and contextual factors influencing safety and quality, methods for quality and safety, leadership to improve safety in complex systems, advocacy for patients, families and colleagues	Case studies, case-based quizzes, mentored QI project (50 hr per semester for 2 semesters), monthly seminar, poster presentation disseminating results of the QI project	4 semesters
What is patient safety? Why is applying human factors important for patient safety? being an effective team player, learning from errors to prevent harm, infection prevention and control, improving medication safety	Tutorials, group activities, video case studies, simulated case studies, simulated ward event	4 consecutive days
Key concepts and principles, culture of patient safety, human factors and systems approach, patient safety incidents and reporting, clinical risk management, patient/caregiver engagement and error disclosure, effective team work and communication, infection control, invasive procedures and medication, team communication	Lecture, online lecture, interactive lecture, discussion, case-based learning	1 day
Key concepts and principles of patient safety, international patient safety goals, understanding human factors and system approach, culture of safety, effective teamwork and communication, clinical risk management, QI methods, reporting systems of patient safety incidents	Flipped classroom approach, online lecture, quiz, discussion, case studies, group presentations	14 sessions (28 hr) in 1 semester
What is patient safety? How we understand and learn from errors to prevent harm?	Lecture, facilitated group work	3 sessions (6 hr) in 10 weeks
Quality and safety practice standards related to caring patient with Crohn's disease	Assigned readings, voice-recorded PowerPoint presentation, simulation	2 sessions
Roles and responsibilities for multiple healthcare professionals; communication across disciplines; teams and teamwork to provide high-quality care; potential systems errors, near misses, and risks; error reporting at the healthcare facility, use of RCA for process and system improvement	Case-based discussion, mock RCA	3 sessions in 3 weeks

7 | DISCUSSION

This systematic review was conducted to identify and describe the educational content, curricular structures and teaching strategies of patient safety educational interventions for nursing students and to determine the methods used for evaluating patient safety learning outcomes. The literature consistently encourages nursing faculty to teach patient safety principles so that future nurses may become competent in delivering safe care to patients (Lee, Dahinten, et al., 2020; Usher et al., 2018). While safety education is undoubtedly a necessary component of pre-licensure education for nurses, nursing faculty have limited evidence-based guidance on how to *meaningfully* include safety concepts in nursing curricula. Although nursing schools have made efforts to incorporate patient safety concepts into their curricula, little has been published so far about their efforts. Our initial literature search which employed four electronic databases yielded over 2,000 sources across two specific areas: *patient safety* and *undergraduate nursing education*, with only seven studies that were data-based and described patient safety as the main topic of an educational intervention (as opposed to patient safety as one component of a course meeting). Researchers in this area have pointed out a lack of literature on this topic in nursing, for the better part of the last decade (Lee, Dahinten, et al., 2020; Mansour, 2012; Robson et al., 2013). The articles included in this review may reflect progress in research on patient safety education for nursing students; however, the nursing literature pales in comparison with that in other health disciplines in both quality and quantity.

Although course content differed across the seven studies reviewed, the most commonly included concepts were key patient safety principles, such as human factors, systems approach, teamwork, communication, and error reporting. This finding is very encouraging as these concepts are essential components to teaching patient safety that are not presently commonplace in pre-licensure nursing education (Mansour, 2012; Ranjbar & Zeydi, 2018; Robson et al., 2013; Tella et al., 2014). Generally, nursing curricula related to patient safety focus on individual safe clinical practices (e.g. medication safety and infection prevention) (Lee, Dahinten, et al., 2020; Usher et al., 2018) and technical skills related to patient safety (e.g. the five rights for medication safety). Nurse educators must also teach non-technical skills (e.g. communication and teamwork) to students for improving patient safety (Mansour, 2012; Wu & Busch, 2019) and ensure that systems-level threats to patient safety can be recognized and mitigated by future nurses (Lee, Dahinten, et al., 2020).

Healthcare colleagues in medicine shifted the focus of patient safety education over 10 years ago. In a systematic review of 26 international studies on patient safety education in medicine, researchers

TABLE 3 Outcomes measured and main findings

First Author, year	Outcome	Outcome measure	Main finding
Gleason, 2019	• Patient safety competency: culture of safety, working in teams with other healthcare providers, effective communication, managing risk, optimizing human and environmental factors, recognizing and responding to adverse events to measure patient safety • Systems thinking • Programme evaluation	• Health Professional Education in Patient Safety Survey (H-PEPSS) • Systems Thinking Scale (STS) • Experience of participants and project mentors	In EG, significant improvements in all H-PEPSS subscale scores and STS score after intervention. Compared to CG, participants in EG reported significantly higher mean scores in 5 of 6 H-PEPSS subscales: culture of safety, working in teams with other healthcare providers, effective communication, managing risk, optimizing human and environmental factors. The mean STS score was significantly higher in EG. High participant satisfaction
Gough, 2013	• Perceptions and attitudes to multiprofessional learning: teamwork and collaboration, professional identity, professional roles and responsibility • Satisfaction and efficacy of course	• Readiness for Interprofessional Learning Scale (RIPL) • Course evaluation • 3-month follow up questionnaire	Improvements in post-course scores in teamwork and communication, professional identity, and professional roles and responsibility. Opportunities to use new knowledge from the educational intervention during clinical placements of all content areas with exception of medication safety. Positive participant satisfaction. (statistical significance not reported).
Hwang, 2016	• Patient safety competency: culture of safety, working in teams with other healthcare providers, effective communication, managing risk, optimizing human and environmental factors, recognizing and responding to adverse events to measure patient safety • Patient safety knowledge • Course evaluation	• H-PEPSS • Objective knowledge test (5-multiple choice questions)	Significant improvements in all H-PEPSS subscale scores. Patient safety knowledge test scores were significantly improved. Positive participant satisfaction, perceived usefulness, and applicability to practice
Kim, 2019	• Patient safety competency (skills, knowledge, attitudes)	• Patient Safety Competency Self-Evaluation (PSCSE)	Significant improvements in all PSCES subscales in EG. Scores in skills and knowledge in EG were statistically higher than scores in CG after intervention but no significant difference was noted in patient safety attitude scores.
Mansour, 2015	• Attitudes towards understanding patient safety: error and patient safety, safety of healthcare systems, personal influence over safety, personal attitudes to patient safety • Patient safety knowledge • Course evaluation	• 23-item questionnaire developed by WHO Patient Safety Program • Objective knowledge test (5-multiple choice questions)	Significant improvements in error and patient safety and the error and patient safety and personal influence over safety subscales. No significant score improvements in the subscales of the healthcare system and personal attitude to patient safety subscales. No differences in the number of correct answers for the knowledge test. High participant satisfaction
Mariani, 2015	• Understanding of patient safety: perception towards errors and safety in health care, comfort level related to reporting and disclosing errors	• Healthcare professionals • Patient Safety Assessment	No significant improvement in mean score for perception towards errors and safety in healthcare subscale. Significant score improvement in students' comfort level related to reporting and disclosing an error subscale

TABLE 3 (Continued)

First Author, year	Outcome	Outcome measure	Main finding
Thom, 2016	• Perceptions and attitudes to multiprofessional learning • Perceptions of patient safety and quality	• RIPL • 4 questions developed by the course leaders	Students rated positively on RIPL items at pre- and post-tests. Improvements in per cent answering "strongly agree" or "agree" on the 4 patient safety and quality items (statistical significance not reported)

Abbreviations: CG, control group; EG, experimental group.

determined that there was a significant shift in safety education core concepts (Kirkman et al., 2015). Before 2009, the core patient safety content among medical education courses included root cause analysis, error reporting and basic patient safety concepts. In contrast, after 2009, communication, teamwork and human factors were added as core safety foci. This change may have followed the dissemination of resources for patient safety education, such as the WHO Patient Safety Curriculum Guide for Medical Schools (WHO, 2009, 2019) and for Multi-Professionals (WHO, 2011). The two guides promote the inclusion of 11 key safety topics in patient safety lessons. These 11 topics were fairly well represented across the studies included in the present review. Researchers in patient safety education have encouraged health professions educators to implement patient safety education that covers these essential topics for teaching patient safety (Wu & Busch, 2019). Nurse educators should continue to teach these topics to pre-licensure nursing students to support student competence in the delivery of care that is not only effective but also safe.

Consistent with a previous systematic review of seven studies on patient safety education for undergraduate medical students (Nie et al., 2011), we found that most patient safety courses have not been formally and fully included in pre-licensure nursing education; none of the educational interventions discussed in the literature were mandatory for students or for programme completion. Moreover, among the seven studies reviewed, four educational interventions were stand-alone, and three interventions were incorporated in existing courses. In general, stand-alone courses included most of the key patient topics suggested by the WHO Patient Safety Curriculum Guide and had positive effects on students' patient safety competencies. However, the duration of the interventions varied from one day to four semesters. This wide variation limits our understanding of the effect of the educational interventions on the outcomes, and the ideal implementation model.

In a majority of the studies in this review, the sample sizes varied between the beginning and conclusion of the study; however, neither a rationale for this, nor the different outcomes in the same study were reported. They also relied on single-centre recruitment and were designed as pre- and post-studies with no control group. Such variations in research design may have contributed to the inconsistent findings about the effects of educational interventions in the seven studies reviewed. These findings pose a question about the overall methodological quality of the studies designed to

examine the effectiveness of patient safety interventions. Moreover, all seven reviewed studies examined students' reactions to the interventions, their perceived patient safety competencies or their perceptions towards the overall understanding of patient safety and quality. However, patient safety interventions should be evaluated by the long-term effect on learners, such as their behavioural changes (Myers & Wong, 2019). In other words, researchers should evaluate nursing students' knowledge and skills of patient safety following course completion and the maintenance of knowledge and skills over time (Myers & Wong, 2019). Therefore, a longitudinal study of knowledge, skills and attitudes of patient safety concepts among nurses who have, and have not had formal training as part of their pre-licensure educational pathway should be a priority for future research. Given these limitations, the findings cannot be conclusive, and more research is needed to truly determine the most effective structure and duration of patient safety nursing courses.

All seven reviewed studies employed a mixture of teaching modalities, including face-to-face lectures, online lectures, case studies and discussions. Simulation was also used in two studies. These findings are encouraging, as using lectures alone is not an effective method for teaching patient safety (Mansour et al., 2018). Additionally, depending on the size of the class, different teaching modalities will be most effective in engaging each class member in the lesson. Researchers and educators are encouraged to find opportunities for hands-on teaching and critical thinking even with larger student groups that would traditionally be presented with content in a lecture-only format.

Students and faculty alike often view pre-licensure curricula as overloaded (Baron, 2017; Lee, Dahinten, et al., 2020; Repsha et al., 2020). Unfortunately, when nursing students are not afforded a stand-alone patient safety course, they may not be able to fully appreciate patient safety lessons woven into their nursing specialty courses. Although adding a course specific to patient safety may seem counterintuitive in initiatives aiming to decrease content presentation in pre-licensure education, developing a stand-alone patient safety course can actually increase curricular efficiency. For example, foundational courses, such as nursing fundamentals, may be restructured to have an overarching theme of patient safety. Patient safety principles may guide the course, while fundamental skills serve as topics or exemplars of how nurses may safely implement all phases of patient care. Then, as students move through their course pathway, they can draw on the fundamental safety

lessons and have opportunities to apply safety knowledge and skills to care of patients of different ages and populations.

When developing courses or course lessons on patient safety, nurse educators are also encouraged to consult the WHO (2011) Patient Safety Curriculum Guide. Without evidence-based or standardized guidance, nursing faculty members may find it overwhelming to develop patient safety curricula. To that end, accrediting bodies, boards of education and nursing education leaders should promote the use of this guide, as many nursing faculty may not know about this valuable resource.

7.1 | Limitations

This review has several limitations. First, a limited number of research studies were available for this review. Second, as this review only included articles published in the English language, some relevant evidence published in other languages may have been missed. Third, we were not able to perform a quantitative synthesis of the study findings due to significant heterogeneity across the studies in terms of number and type of targeted samples, educational interventions used and the assessment instruments and outcomes measured. Finally, even though we performed extensive database search, some relevant studies may have been unintentionally excluded from this review due to improper indexing or other factors.

8 | CONCLUSION

To prevent errors in healthcare settings, it is of vital importance that all members of healthcare delivery teams receive adequate training in patient safety. Nurses require patient safety training during their pre-licensure education so that safety knowledge, skills and behaviours may become a part of everyday practice. Compared to other health disciplines, there are very few evidence-based nursing educational interventions that faculty members employ to teach patient safety to undergraduate nursing students. The educational interventions included in the present review may be helpful in guiding new initiatives. Researchers must continue to develop patient safety curricula and examine the effects of participation on student competencies with stronger methodological rigour. For example, the use of control groups will help educators more clearly identify effective options for patient safety teaching. With increased effort towards intervention development, future patient safety initiatives may be strengthened and adopted widely.

CONFLICT OF INTEREST
Drs. Lee and Kim declare no conflicts of interest. Dr. Morse has received honoraria in the last 12 months from Bayer in support of an educational presentation for nurses.

AUTHOR CONTRIBUTIONS
All authors meet the authorship criteria and are agreement with the content of the manuscript. SEL designed the study; SEL, NWK and BLM collected the data; SEL and BLM analysed the data; SEL, NWK and BLM wrote the manuscript; and SEL and BLM made critical revisions for important intellectual content.

DATA AVAILABILITY STATEMENT
Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

ORCID
Seung Eun Lee [ID] https://orcid.org/0000-0002-4173-3337
Brenna L. Morse [ID] https://orcid.org/0000-0001-9876-4700

REFERENCES
American Association of Colleges of Nursing (2006). Hallmarks of quality and patient safety: Recommended baccalaureate competencies and curricular guidelines to ensure high-quality and safe patient care. *Journal of Professional Nursing*, *22*(6), 329–330. https://doi.org/10.1016/j.profnurs.2006.10.005

Baron, K. A. (2017). Changing to concept-based curricula: The process for nurse educators. *Open Nursing Journal*, *11*, 277–287. https://doi.org/10.2174/1874434601711010277

Bedgood, A. L., & Mellott, S. (2018). The role of education in developing a culture of safety through the perceptions of undergraduate nursing students: An integrative literature review. *Journal of Patient Safety*. https://doi.org/10.1097/pts.0000000000000548

Cronenwett, L., Sherwood, G., Barnsteiner, J., Disch, J., Johnson, J., Mitchell, P., Sullivan, D. T., & Warren, J. (2007). Quality and safety education for nurses. *Nursing Outlook*, *55*(3), 122–131. https://doi.org/10.1016/j.outlook.2007.02.006

Frank, J. R., & Brien, S. (2008). *The safety competencies: Enhancing patient safety across the health professions*. Canadian Patient Safety Institute.

Ginsburg, L., Castel, E., Tregunno, D., & Norton, P. G. (2012). The H-PEPSS: An instrument to measure health professionals' perceptions of patient safety competence at entry into practice. *BMJ Quality & Safety*, *21*(8), 676–684. https://doi.org/10.1136/bmjqs-2011-000601

Gleason, K. T., VanGraafeiland, B., Commodore-Mensah, Y., Walrath, J., Immelt, S., Ray, E., & Dennison Himmelfarb, C. R. (2019). The impact of an innovative curriculum to introduce patient safety and quality improvement content. *BMC Medical Education*, *19*(1), 156. https://doi.org/10.1186/s12909-019-1604-0

Gough, S., Jones, N., & Hellaby, M. (2013). Innovations in interprofessional learning and teaching: Providing opportunities to embed patient safety within the pre-registration physiotherapy curriculum. A pilot study. *Physical Therapy Reviews*, *18*(6), 416–430. https://doi.org/10.1179/1743288X13Y.0000000103

Hwang, J. I., Yoon, T. Y., Jin, H. J., Park, Y., Park, J. Y., & Lee, B. J. (2016). Patient safety competence for final-year health professional students: Perceptions of effectiveness of an interprofessional education course. *Journal of Interprofessional Care*, *30*(6), 732–738. https://doi.org/10.1080/13561820.2016.1218446

Institute of Medicine (2003). *Keeping patients safe: Transforming the work environment of nurses*. National Academies Press.

Kim, Y. M., Yoon, Y. S., Hong, H. C., & Min, A. (2019). Effects of a patient safety course using a flipped classroom approach among undergraduate nursing students: A quasi-experimental study. *Nurse Education Today*, *79*, 180–187. https://doi.org/10.1016/j.nedt.2019.05.033

Kirkman, M. A., Sevdalis, N., Arora, S., Baker, P., Vincent, C., & Ahmed, M. (2015). The outcomes of recent patient safety education interventions for trainee physicians and medical students: A systematic review. *British Medical Journal Open*, 5(5), e007705. https://doi.org/10.1136/bmjopen-2015-007705

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmorland, M. (1998). Critical Review Form-Quantitative Studies. Retrieved from https://srs-mcmaster.ca/wp-content/uploads/2015/05/Guidelines-for-Critical-Review-Form-Quantitative-Studies.pdf

Lee, S. E., Dahinten, V. S., & Do, H. (2020). Patient safety education in pre-registration nursing programs in South Korea. *International Nursing Review*, 67, 512–518. https://doi.org/10.1111/inr.12630

Lee, S. E., Lee, M. H., Peters, A. B., & Gwon, S. H. (2020). Assessment of patient safety and cultural competencies among senior baccalaureate nursing students. *International Journal of Environmental Research and Public Health*, 17(12), 4225. https://doi.org/10.3390/ijerph17124225

Mansour, M. (2012). Current assessment of patient safety education. *British Journal of Nursing*, 21(9), 536–543. https://doi.org/10.12968/bjon.2012.21.9.536

Mansour, M. J., Al Shadafan, S. F., Abu-Sneineh, F. T., & AlAmer, M. M. (2018). Integrating patient safety education in the undergraduate nursing curriculum: A discussion paper. *Open Nursing Journal*, 12, 125–132. https://doi.org/10.2174/1874434601812010125

Mansour, M., Skull, A., & Parker, M. (2015). Evaluation of World Health Organization Multi-Professional Patient Safety Curriculum topics in nursing education: Pre-test, post-test, none-experimental study. *Journal of Professional Nursing*, 31(5), 432–439. https://doi.org/10.1016/j.profnurs.2015.03.002

Mariani, B., Cantrell, M. A., Meakim, C., & Jenkinson, A. (2015). Improving students' safety practice behaviors through a simulation-based learning experience. *Journal of Nursing Education*, 54(3 Suppl), S35–38. https://doi.org/10.3928/01484834-20150218-05

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, 6(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Myers, J. S., & Wong, B. M. (2019). Measuring outcomes in quality improvement education: Success is in the eye of the beholder. *BMJ Quality & Safety*, 28(5), 345–348. https://doi.org/10.1136/bmjqs-2018-008305

National Quality Forum (2004). *National voluntary consensus standards for nursing-sensitive care: An initial performance measure set*. National Quality Forum.

Nie, Y., Li, L., Duan, Y., Chen, P., Barraclough, B. H., Zhang, M., & Li, J. (2011). Patient safety education for undergraduate medical students: A systematic review. *BMC Medical Education*, 11, 33. https://doi.org/10.1186/1472-6920-11-33

Ranjbar, H., & Zeydi, A. E. (2018). Patient safety: An important yet neglected issue in nursing education. *Journal of Patient Safety*, 14(3), e35. https://doi.org/10.1097/PTS.0000000000000231

Repsha, C. L., Quinn, B. L., & Peters, A. B. (2020). Implementing a concept-based nursing curriculum: A review of the literature. *Teaching and Learning in Nursing*, 15(1), 66–71. https://doi.org/10.1016/j.teln.2019.09.006

Robson, W., Clark, D., Pinnock, D., White, N., & Baxendale, B. (2013). Teaching patient safety and human factors in undergraduate nursing curricula in England: A pilot survey. *British Journal of Nursing*, 22(17), 1001–1005. https://doi.org/10.12968/bjon.2013.22.17.1001

Roh, H. (2019). Patient safety education for medical students: Global trends and Korea's status. *Korean Medical Education Review*, 21(1), 1–12. https://doi.org/10.17496/kmer.2019.21.1.1

Runciman, W., Hibbert, P., Thomson, R., Van Der Schaaf, T., Sherman, H., & Lewalle, P. (2009). Towards an international classification for patient safety: Key concepts and terms. *International Journal for Quality in Health Care*, 21, 18–26. https://doi.org/10.1093/intqhc/mzn057

Slawomirski, L., Auraaen, A., & Klazinga, N. S. (2017). The economics of patient safety: Strengthening a value-based approach to reducing patient harm at national level. Retrieved from https://www.oecd-ilibrary.org/content/paper/5a9858cd-en

Tella, S., Liukka, M., Jamookeeah, D., Smith, N. J., Partanen, P., & Turunen, H. (2014). What do nursing students learn about patient safety? An integrative literature review. *Journal of Nursing Education*, 53(1), 7–21. https://doi.org/10.3928/01484834-20131209-04

Thom, K. A., Heil, E. L., Croft, L. D., Duffy, A., Morgan, D. J., & Johantgen, M. (2016). Advancing interprofessional patient safety education for medical, nursing, and pharmacy learners during clinical rotations. *Journal of Interprofessional Care*, 30(6), 819–822. https://doi.org/10.1080/13561820.2016.1215972

Usher, K., Woods, C., Conway, J., Lea, J., Parker, V., Barrett, F., O'Shea, E., & Jackson, D. (2018). Patient safety content and delivery in pre-registration nursing curricula: A national cross-sectional survey study. *Nurse Education Today*, 66, 82–89. https://doi.org/10.1016/j.nedt.2018.04.013

World Health Organization (2009). Patient safety curriculum guide for medical schools. Retrieved from https://www.who.int/patientsafety/education/curriculum_guide_medical_schools/en/

World Health Organization (2011). Patient safety curriculum guide: Multi-professional. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/44641/9789241501958_eng.pdf;jsessionid=03D888E90A1D9482446BA0DFE95E9CC8?sequence=1

World Health Organization (2019). 10 facts on patient safety. Retrieved from https://www.who.int/features/factfiles/patient_safety/en/

Wu, A. W., & Busch, I. M. (2019). Patient safety: A new basic science for professional education. *GMS Journal for Medical Education*, 36(2), Doc21. https://doi.org/10.3205/zma001229

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

APPENDIX A

Search strategy

1. PUBMED

#1	Search "Patient Safety"[Mesh]	18404
#2	Search patient safety[Title/Abstract]	29358
#3	Search ("Patient Safety"[Mesh]) OR patient safety[Title/Abstract]	41020
#4	Search (curriculum[Title/Abstract] OR education[Title/Abstract])	476366
#5	Search "Curriculum"[Mesh]	82668
#6	Search (((curriculum[Title/Abstract] OR education[Title/Abstract])) OR "Curriculum"[Mesh]	513474
#7	Search undergraduate[Title/Abstract] OR nursing student[Title/Abstract] OR nursing education[Title/Abstract] OR prelicensure[Title/Abstract]	46163
#8	Search "Education, Nursing, Baccalaureate"[Mesh]	17758
#9	Search ((undergraduate[Title/Abstract] OR nursing student[Title/Abstract] OR nursing education[Title/Abstract] OR prelicensure[Title/Abstract])) OR "Education, Nursing, Baccalaureate"[Mesh]	58336
#10	Search (((("Patient Safety"[Mesh]) OR patient safety[Title/Abstract])) AND ((((curriculum[Title/Abstract] OR education[Title/Abstract]))) OR "Curriculum"[Mesh])) AND (((undergraduate[Title/Abstract] OR nursing student[Title/Abstract] OR nursing education[Title/Abstract] OR prelicensure[Title/Abstract])) OR "Education, Nursing, Baccalaureate"[Mesh])	577
#11	Search (((("Patient Safety"[Mesh]) OR patient safety[Title/Abstract])) AND ((((curriculum[Title/Abstract] OR education[Title/Abstract]))) OR "Curriculum"[Mesh])) AND (((undergraduate[Title/Abstract] OR nursing student[Title/Abstract] OR nursing education[Title/Abstract] OR prelicensure[Title/Abstract])) OR "Education, Nursing, Baccalaureate"[Mesh]) Filters: English	560

2. EMBASE

No.	Query	Results
#1	'patient safety':ab,ti	38,746
#2	'patient safety'/exp	117,087
#3	#1 OR #2	131,330
#4	'curriculum':ab,ti OR 'education':ab,ti	602,168
#5	'curriculum'/exp	88,166
#6	#4 OR #5	636,120
#7	'undergraduate':ab,ti OR 'nursing student':ab,ti 'nursing education':ab,ti OR 'prelicensure':ab,ti	51,098
#8	'nursing education'/exp	89,720
#9	#7 OR #8	126,095
#10	#3 AND #6 AND #9	862
#11	#3 AND #6 AND #9 AND [English]/lim	839

3. COCHRANE CENTRAL

#1	Patient Safety	72729
#2	MeSH descriptor: [Patient Safety] explode all trees	545
#3	#1 OR #2	72729
#4	curriculum OR education	75673
#5	MeSH descriptor: [Curriculum] explode all trees	1733
#6	#4 OR #5	75702
#7	undergraduate OR nursing student OR nursing education OR prelicensure	11078
#8	MeSH descriptor: [Education, Nursing, Baccalaureate] explode all trees	282
#9	#7 OR #8	11078
#10	#3 AND #6 AND #9	677

4. CINAHL

S1	TI Patient Safety OR AB Patient Safety	30787
S2	(MH "Patient Safety")	52800
S3	S1 OR S2	70946
S4	TI curriculum OR AB curriculum OR TI education OR AB education	251107
S5	(MH "Curriculum")	25058
S6	S4 OR S5	261588
S7	TI undergraduate OR AB undergraduate OR TI nursing student OR AB nursing student OR TI nursing education OR AB nursing education OR TI prelicensure OR AB prelicensure	52298
S8	(MH "Education, Nursing, Baccalaureate")	9896
S9	S7 OR S8	57591
S10	S3 AND S6 AND S9	819
S11	S3 AND S6 AND S9 narrow by Language: - English	783