

## Abstract

**Background:** Nursing professionals are key to providing safe care that improves patient outcomes. Hence, it is essential to focus on developing nurses' patient safety competencies and principles.

**Purpose:** This review examined the effectiveness of educational interventions in developing patient safety knowledge, skills, behaviors and attitudes in undergraduate nursing students.

**Methods:** The search strategy aimed to identify published and unpublished studies in databases and grey literature. Studies were assessed using Joanna Briggs Institute critical appraisal tools.

**Results:** A total of 36 studies met the inclusion criteria. The teaching methods employed single or combined interventions and the educational interventions suggested either improvements in outcomes or no impact.

**Conclusion:** The effectiveness of educational interventions to develop patient safety competencies in undergraduate nursing students, either as a single or combined strategy, was mixed. Further research is needed to provide more robust evidence on which teaching method for patient safety is most effective.

## Keywords

Patient safety; Curriculum; Teaching; Student, nursing; Systematic Review

21

## 22 **Introduction**

23 Patient safety is defined as a framework of activities that create cultures, processes,  
24 procedures, behaviors, technologies, and environments in healthcare that  
25 consistently minimize risks, prevent avoidable harm, and reduce the impact of  
26 errors.<sup>1</sup> Despite worldwide efforts to reduce harm, patient safety incidents remain  
27 the leading cause of death and disability globally<sup>2</sup> and incur significant financial and  
28 economic costs, reducing trillions of dollars in global economic output annually.<sup>3</sup>

29 Nurses play a pivotal role in the provision of safe care. A significant portion of the  
30 nursing workforce is responsible for delivering and coordinating care and  
31 contributing to the development of organizational structures that aim to enhance  
32 patient outcomes.<sup>4</sup> Nurses are also essential for addressing the healthcare system's  
33 challenges with their comprehensive and specialized skills, participation in  
34 leadership and management, and quality and safety measures.<sup>5</sup> Therefore,  
35 undergraduate nursing education should be designed to develop nurses'  
36 knowledge, skills, behaviors, and attitudes that align with patient safety principles  
37 and improve the quality of healthcare systems.<sup>6,7</sup>

38 Despite the indication that patient safety education is a key priority, it is yet to be  
39 fully implemented and there exist several inconsistencies in patient safety education  
40 across nursing programs.<sup>8,9</sup> Additionally, there is a necessity for greater agreement  
41 and understanding of the best approaches for teaching patient safety to pre-  
42 licensure nursing students and to identify the most effective teaching methods.<sup>10-12</sup>

43 A preliminary search of PROSPERO and MEDLINE identified 2 published  
44 systematic reviews on this topic. A rapid review<sup>13</sup> investigated only clinical learning  
45 environments that facilitate nursing students' development of patient safety  
46 competencies. The other explored only the core concepts of patient safety, resulting  
47 in few articles investigating nursing students.<sup>14</sup> Thereafter, students from other  
48 disciplines were included.

49 Given these limitations, this systematic review sought to contribute to the evidence  
50 on this topic and aims to evaluate the effectiveness of educational interventions in  
51 developing patient safety knowledge, skills, behaviors and attitudes in  
52 undergraduate nursing students.

53

## 54 **Methods**

55 This review was conducted using the Joanna Briggs Institute (JBI) methodology for  
56 systematic reviews of effectiveness<sup>15</sup> and reported according to the Preferred  
57 Reporting Items for Systematic Review and Meta-analysis Protocol guidelines  
58 (PRISMA).<sup>16</sup> A review protocol was published previously<sup>17</sup> and registered in  
59 PROSPERO (CRD42021254965).

60

## 61 *Inclusion and Exclusion Criteria*

62 A review question was developed to support the inclusion criteria: How effective are  
63 educational interventions in developing patient safety knowledge, skills, behaviors,  
64 and attitudes among undergraduate nursing students?

65 Inclusion criteria were as follows: (1) participants were fully composed of  
66 undergraduate nursing students; (2) evaluated any educational intervention aimed  
67 at teaching patient safety within the existing topic areas of the WHO Multi-  
68 professional Patient Safety Curriculum Guide: Multi-professional edition,<sup>18</sup> (3)  
69 considered studies that described and evaluated at least one of the subsequent  
70 outcomes: nursing students' knowledge, skills, behaviors and attitudes related to  
71 patient safety. Furthermore, this review considered experimental and quasi-  
72 experimental study designs, including non-randomised and randomised controlled  
73 trials (RCTs), before-and-after studies, and interrupted time series studies.  
74 Additionally, analytical observational studies, including prospective and  
75 retrospective cohort, case-control, and analytical cross-sectional studies, were  
76 considered for inclusion. Excluded studies included non-nursing subjects and  
77 studies that did not assess an educational intervention and did not address the  
78 outcomes stated above.

79

## 80 *Search Strategy*

81 An initial search was performed in MEDLINE and CINAHL, in consultation with a  
82 university librarian, to identify articles on this topic. The index terms and keywords  
83 in the titles and abstracts were used to develop a full search strategy. A second  
84 search was conducted across 7 databases: MEDLINE (PubMed), CINAHL

85 (EBSCOhost), Scopus (Elsevier), Education Research Complete (EBSCOhost),  
86 Cochrane Central Register of Controlled Trials (CENTRAL), Latin American and  
87 Caribbean Health Sciences Literature (LILACS), Medes (Spain) and  
88 ClinicalTrials.gov for registers. Sources of unpublished studies and grey literature  
89 searches were Google Scholar, DART-Europe, ProQuest Dissertations and Theses,  
90 Coordination for the Improvement of Higher Education Personnel, Brazil (CAPES  
91 thesis and dissertations), The Virginia Henderson Global e-Repository, Mednar, and  
92 Thesis Canada. The third search included screening the reference lists of all studies  
93 selected for critical appraisal to identify additional studies.

94 Studies published in English, Spanish, and Portuguese were included. The  
95 timeframe for searching the literature was from July 2011, reflecting when the WHO  
96 National Patient Safety Curriculum Guide: Multi-professional Edition<sup>18</sup> was  
97 published, to May 31, 2024. See the results of all search strategies in Supplemental  
98 Digital Content Table 1.

99

## 100 *Study Selection*

101 Following the search, all identified citations were collated and uploaded to EndNote  
102 online (Clarivate Analytics, Pennsylvania, USA), and duplicates were removed.  
103 After a pilot test, titles and abstracts were screened by 2 independent reviewers.  
104 Furthermore, potentially relevant studies were retrieved and their citation details  
105 were imported to Ryyan.<sup>19</sup> The full texts of the selected citations were assessed in  
106 detail against the inclusion criteria. The reasons for excluding full-text studies that  
107 did not meet the inclusion criteria were recorded and reported. Any disagreements

108 between the reviewers at each stage of the study selection process were resolved  
109 through discussion or by consultation with a third reviewer.

110

### 111 *Assessment of Methodological Quality*

112 Two independent reviewers critically appraised the eligible studies using  
113 standardized critical appraisal instruments from the JBI for experimental, quasi-  
114 experimental, and observational studies.<sup>15</sup> Disagreements were resolved through  
115 discussion or by a third reviewer. The authors of the papers were contacted to  
116 request missing or additional data for clarification. Regardless of the methodological  
117 quality, all studies were included in the data extraction and synthesis.

118

### 119 *Data Extraction*

120 Data were extracted from the included studies by 2 independent reviewers and  
121 verified by other authors. The data extraction tool included specific details about the  
122 study author(s), country, setting of the intervention, characteristics of participants,  
123 study design, and description of the intervention (including the type of educational  
124 method and duration of the intervention). Outcomes of significance to the review  
125 question assessed (knowledge, skills, behaviors and attitudes), follow-up time, main  
126 results, limitations, and additional data, when required, were also extracted.

127

### 128 *Data Synthesis*

129 The literature suggests that synthesizing data from educational interventions is  
130 challenging due to heterogeneities in interventions and study methodologies.<sup>20,21</sup> In  
131 line with this evidence, the studies included in this review were heterogeneous in  
132 their interventions, designs and outcome measures; therefore, statistical pooling of  
133 results was not possible. Owing to these heterogeneities, the findings were  
134 presented in the narrative form following the synthesis without meta-analysis  
135 (SWiM)<sup>22</sup> in systematic reviews. A direction of effect plot was used to help visualize  
136 the effectiveness of the interventions.<sup>23</sup>

137

## 138 **Results**

139 Thirty-six studies met the inclusion criteria and were included in the review. Search  
140 results and screening are summarised in the PRISMA<sup>16</sup> flow diagram (see  
141 Supplemental Digital Content Figure 1).

142

### 143 *Characteristics of Included Studies*

144 The detailed characteristics of all included studies were presented in the  
145 Supplemental Digital Content Table 2 and are summarised below. The studies were  
146 published in 14 countries between 2012 and 2024. There were 3534 students, and  
147 the number of participants ranged from 23 to 373.

148 Various teaching methods were used in the interventions. Sixteen studies applied  
149 single interventions, with simulation being the most common. Other single

150 interventions included problem-based learning (PBL), traditional lectures, lectures  
151 using video demonstrations, group work, individual tutorials, flipped classrooms, and  
152 mobile web-based training.

153 A range of combined interventions were employed in 20 studies. Lectures were the  
154 most common teaching method presented and were combined with several other  
155 approaches, such as group discussions, skills laboratories, clinical placements,  
156 flipped classrooms, simulation, online activities (synchronous and asynchronous),  
157 PBL and virtual reality. Other combined interventions included group and individual  
158 discussions during placements, skills and simulation, video presentation and group  
159 discussions, online modules followed by seminars using a flipped classroom, online  
160 workshop, videos and PBL, a lecture, skill laboratory, and 2 clinical days in  
161 placement, design thinking and case-based learning and finally, online seminar and  
162 simulation.

163 The content within the existing topic areas of the WHO Patient Safety Curriculum  
164 Guide<sup>18</sup> varied between studies. Some included multiple topics, whereas others  
165 focused on only one topic.

166 Across the studies, most of the outcomes were measured immediately after the  
167 conclusion of the educational intervention, with some studies measuring outcomes  
168 in a short time and another 6 months later. Of the 25 assessment tools identified in  
169 our 36 studies, the issue of content validity was raised in the descriptions of 6 tools  
170 (24%). According to the response process, rater training was described for 3 tools  
171 (12%). The matter of internal structure was mentioned in 18 tools (72%). Most of the  
172 tools had acceptable reliability, and in eleven studies (44%), information regarding  
173 validity and reliability was not provided (see Supplemental Digital Content Table 3).



174

175 *Critical Appraisal*

176 The studies were graded as low (70 % score 'yes'), moderate (50–69 % score 'yes'),  
177 or high ( $\leq 49$  % score 'yes') risk of bias.<sup>24</sup> Among the 36 studies included in this  
178 review, 58.3% were found to have a moderate risk of bias.

179 Of the 33 before-and-after studies, most (60.6%) were graded as having a moderate  
180 risk of bias. The critical appraisal showed that 19 studies (57.6%) had a control  
181 group, none of the studies had multiple measurements of the outcome both before  
182 and after the intervention and only 6 studies (18%) had outcomes measured in a  
183 reliable way (see Supplemental Digital Content Table 4). The RCTs (n=2) were  
184 graded as having a low risk of bias. Owing to the nature of the educational  
185 interventions, it was not possible to blind the participants and instructors (see  
186 Supplemental Digital Content Table 5). The prospective cohort study was rated as  
187 having a moderate risk of bias. The method of exposure measurement was not  
188 clearly described, the study had a short follow-up time, and strategies to address  
189 incomplete follow-up were not utilized. Finally, the analytical techniques used were  
190 not clearly described and it was not clear how specific confounders were measured  
191 (see Supplemental Digital Content Table 6).

192

193 *Effectiveness of the Interventions*

194 Mixed results were observed regarding the effects of educational interventions on  
195 the various outcomes measured. Most studies (67.6%) assessed more than 1  
196 outcome.

197 Patient safety knowledge was assessed in 30 studies, including all 11 topics in the  
198 WHO multi-professional curriculum guide.<sup>18</sup> Of these, 11 studies reported a  
199 significant increase in all dimensions of patient safety knowledge after the  
200 educational interventions, while 6 reported a significant increase in only some  
201 dimensions.

202 Sixteen studies evaluated patient safety skills, covering all topics in the WHO multi-  
203 professional curriculum guide<sup>18</sup> except patient safety during invasive procedures  
204 (Topic 10). Of these, 9 reported a significant improvement in all dimensions of  
205 patient safety skills post-intervention, and 1 demonstrated a significant increase in  
206 only some dimensions of patient safety skills post-intervention.

207 Only 2 studies addressed patient safety behaviors, focusing on improving  
208 medication safety (Topic 11).<sup>18</sup> One study reported a significant increase in patient  
209 safety behaviors, whereas another showed no changes after the intervention.

210 Patient safety attitudes were addressed in 25 studies, which followed the contents  
211 of all topics of the WHO Patient Safety Curriculum Guide: Multi-professional  
212 Edition.<sup>18</sup> Eight studies reported a significant increase in all dimensions of patient  
213 safety attitudes after the intervention, while 5 studies only reported a significant  
214 increase in some dimensions. The Supplemental Digital Content Table 7 presents  
215 the visual summaries of the effect direction of all outcomes.

216

## 217 **Discussion**

218 To the best of our knowledge, this is the first systematic review to use a  
219 comprehensive search strategy and retrieve all relevant studies from databases and  
220 grey literature to assess undergraduate nursing students' patient safety knowledge,  
221 skills, behaviors, and attitudes.

222 The educational interventions varied highly and included single and combined  
223 strategies. They applied traditional methods such as lectures, seminars, group work,  
224 discussions, skills laboratories, simulation sessions, and clinical placements, as well  
225 as more innovative approaches such as flipped classrooms, online activities, PBL,  
226 quizzes, design-thinking, virtual reality and mobile web-based training. These  
227 findings are in line with those of a previous systematic review<sup>14</sup>, which demonstrates  
228 several types of teaching modalities that may be effective in engaging students to  
229 enhance patient safety learning and competencies.<sup>6</sup>

230 The most frequently included concepts were patient safety principles and theories,  
231 a systemic approach to errors, clinical risk management, and improving medication  
232 safety. This evidence shows that essential components of teaching patient safety  
233 that are often missing were covered in pre-licensure nursing education.<sup>1,25</sup>  
234 Conversely, the topic of engaging with patients and carers was the least common  
235 and highlights the necessity to focus more on teaching nursing students the  
236 importance of patient engagement to enhance safety. Treating patients as partners  
237 is essential for improving patient safety by fostering collaborative relationships  
238 between patients and healthcare providers, promoting effective communication, and  
239 enabling patients to play an active role in their care.<sup>26,27</sup>

240 The instruments used to assess the effectiveness of the interventions were  
241 numerous, and information regarding their validity and reliability was not consistent.  
242 According to previous research, creating trustworthy and accurate tools for  
243 measuring safety competencies is difficult,<sup>28</sup> and previous reviews have identified  
244 the absence of a reliable and valid tool that covers all patient safety domains.<sup>29,30</sup>

245 Most of the studies were graded as having a moderate risk of bias and denoting a  
246 lack of a control group and multiple assessments before and after the intervention.  
247 Additionally, significant heterogeneity was presented across the studies and was  
248 related to variations in course design, teaching methods and contents, and  
249 outcomes assessment, which made the meta-analysis unfeasible. These results are  
250 similar to those of previous systematic reviews conducted among medical students  
251 and trainee physicians.<sup>31,32</sup>

252 The findings highlighted above may have contributed to the inconsistent and mixed  
253 results about the effectiveness of educational interventions in the 36 studies  
254 reviewed. It also reflects the variability and complexity of educational interventions  
255 and their impact on patient safety competencies in undergraduate nursing students.  
256 Moreover, it has raised concerns regarding patient safety education in nursing and  
257 the necessity for more effective approaches. This is in accordance with other studies  
258 showing that patient safety education for undergraduate nursing students is  
259 inconsistent<sup>9,33</sup> and more evidence is required regarding the most effective practices  
260 for educating pre-registration nursing students and the methods that should be  
261 utilized for optimal results.<sup>11,34</sup>

262 High-quality research is needed to identify effective strategies for developing  
263 nursing students' patient safety competencies. Studies with control groups can

264 better assess changes before and after interventions, while longitudinal studies can  
265 track their impact over time. Additionally, validated instruments that can reliably  
266 evaluate these competencies should be employed.

267

## 268 *Limitations*

269 The studies showed significant heterogeneity in methodology, interventions,  
270 outcome measures, and reporting, which precluded meta-analysis and did not allow  
271 the calculation of standardized effect sizes. Additionally, owing to the time and  
272 limitations of translation services, excluding languages other than English, Spanish,  
273 and Portuguese may have omitted otherwise eligible studies.

274

## 275 **Conclusion**

276 This systematic review found significant differences in how patient safety education  
277 is delivered to undergraduate nursing students in terms of course design, content,  
278 the stage at which it is introduced into the curriculum, the evaluation process, and  
279 the assessment tools and outcomes in the included studies. Educational  
280 frameworks for patient safety can support nursing education, providing evidence-  
281 based materials to help in curriculum development.

282 The interventions described in this review may help to guide new strategies for  
283 enhancing patient safety knowledge, skills, behaviors, and attitudes in  
284 undergraduate nursing students. It is paramount for researchers and educators to

285 continue developing patient safety curricula and examine the effects of educational  
286 interventions using more robust research methodologies.

287

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