

The impact of simulation based learning on nurse knowledge and skills in intubation and intravenous catheters; Systematic review

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World Journal of Advanced Research and Reviews, 2021, 11(02), 410–417

Publication history: Received on 28 May 2021; revised on 26 August 2021; accepted on 29 August 2021

Article DOI: <https://doi.org/10.30574/wjarr.2021.11.2.0309>

Abstract

Background: One of the primary problems in nursing education is the mismatch between theory and practice. Applying academic knowledge to practice presents obstacles for nurses, a problem that is seen around the world. Our systematic research set out to find out how nurses' competency with intravenous catheters and intubation methods was impacted by simulation-based learning.

Method: PRISMA statement (8) was followed in the course of this investigation. For studies evaluating the effects of simulation-based training for nurses to be accepted for inclusion in the systematic review, they must be randomized controlled trials. The trials' primary objectives were to gain information or skills. The studies were eligible for inclusion if they were written in English. A comprehensive search was conducted of the Cochrane and PubMed databases. Limits the content of search results to articles published between 2015 and 2021.

Results and conclusion: In this systematic review, five randomized controlled studies were incorporated. Research focused on hospital ward nurses, surgical unit staff, and critical care and pediatric unit staff. The influence of simulation-based learning on nurses' knowledge and abilities was the outcome of interest. Our results from this systematic analysis of 5 included studies suggest that simulation-based training is useful in improving nurses' skills when compared to other learning approaches. But it's unclear what the results are due to the poor documentation. With reference to the other comparisons, we are unable to draw any conclusions about registered nurses.

Keywords: Simulation based learning; Knowledge; Skills; Intubation; Intravenous line

1. Introduction

The disarray between theory and practice in nursing education is one of the main issues. Nurses have challenges when applying their academic knowledge in practice, a problem that is observed globally (1). The gap that is established between theory and practice makes learning more difficult, and a nurse ability to integrate professionally is impacted when they don't grasp nursing words and ideas (2). This is accomplished by having a solid grasp of healthcare science, where nursing theory and practical abilities coexist peacefully. Simulation is one training method that supports this approach.

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The definition of simulation is "the process by which we are trying to achieve results that as closely approximate clinical practice as possible." It is a method of supplementing or finishing real-life experiences with guided encounters that are a fully interactive, accurate replica of the actual world (3). It's a teaching strategy that helps nurse integrate into the healthcare industry more rapidly by having them experience the real aspects of their future professional duties through a predetermined scenario (4).

Simulation is utilized in nursing science to educate theoretical and clinical skills, with an emphasis on encouraging nurse critical thinking (5). Even before they begin working as professionals, simulation helps nurse obtain healthcare and nursing experiences by putting them in a setting that is quite similar to a hospital. The nurses are able to apply what they have learned, handle challenges and issues, and even make errors without hurting anyone—all of this while working in a secure setting where there is absolutely no risk to the patients (6). Lack of instructors and clinical structures for nurses training, along with the higher caliber of instruction offered by this approach, have all contributed to an increase in the use of simulation (7).

The purpose of our systematic review was to investigate how simulation-based learning affected nurses' proficiency with intravenous catheters and intubation techniques.

2. Method

This study was conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (8). Studies assessing the impact of simulation-based training for nurses have to be randomized controlled trials (RCTs) in order to be deemed appropriate for inclusion in the systematic review. The main goals of the trials were to be knowledge or skills. If the studies were written in English, they qualified for inclusion.

The Cochrane and PubMed databases were thoroughly searched. Focuses search results on articles released between 2015 and 2021. The following search phrases were used: skills, nurse, computer-based, computer-enhanced, and simulation. For pertinent references, previously identified systematic reviews and primary investigations were searched. We reached out to subject-matter experts for other published or unpublished studies. Lastly, to find unpublished or continuing trials, the text term "simulation" was used to search Clinical Trials.

Each of the four authors separately reviewed each title and abstract. To test the selection process, the first sixty titles and abstracts were reviewed in order to gauge comprehension of the inclusion and exclusion criteria. All studies that did not clearly fit the inclusion criteria had their full-text publications collected. For final inclusion, all full-text papers were read by the same four writers. All disagreements were resolved through conversation until an agreement was achieved.

A form for the pre-defined extraction of data was created. All authors extracted the data from the included studies, and verified its quality. The following information was extracted: citation, number of participants, interventions, main findings, and effect measures.

3. Result and discussion

We included 5 randomized controlled trials (Fig 1) in this systematic review. Studies targeted intensive care unit, surgical unit, pediatric intensive care unit and hospital ward nurses. The outcome of interest was the effect of simulation based learning in nurse's knowledge and skills. When compared to alternative learning methodologies, simulation-based training appears to be beneficial in enhancing nurses' abilities, according to our findings from this systematic review of 5 included research. But because of the inadequate documentation, these outcomes are unclear. We are unable to make any inferences for registered nurses based on the other comparisons. According to Huang et al., 2021 (9) study, when compared to controls, nurses who got the two-week induction program reported significantly higher ratings for knowledge and competence. Higher knowledge and proficiency were associated with more frequent use of the mobile app. Main findings and interventions utilized in the included studies were presented in (Table 1).

Just one study (10) found that high-fidelity simulation significantly improved nurses' competence as compared to other learning methodologies. Furthermore, when compared to other simulation tactics, there appears to be a tendency toward computer-based simulation as the most effective strategy on nurses' knowledge; nonetheless, the outcomes are ambiguous and non-conclusive. These comparisons also provide a poor score to the evidence's quality. Still, using simulation-based training to apply new guidelines or government mandates might not be the best course of action. Workshops and clinical audits are often employed tactics to enhance healthcare personnel' compliance with

recommendations. When employed alone, these tactics have demonstrated a negligible to modest impact (11,12). Evidence, however, suggests that quality improvement initiatives must to be customized for the environment in which they are applied (13).

According to Jansson et al., 2016 study (14), both groups' ability ratings increased over time, but the difference in progress between the research groups was statistically significant only after six months. The intervention group's average skill and median delta skill scores only grew by 12 percentage points during the course of the research. Interestingly, only 33.3% of the intervention group reached a mean score of 50% in the baseline measurement. Ninety percent of them succeeded in the post intervention assessment at the end. Adherence has to be at least 95% before ventilator associated pneumonia incidence will decline. Various estimates suggest that aggressive infection control strategies might prevent around 55% of ventilator associated pneumonia cases (15).

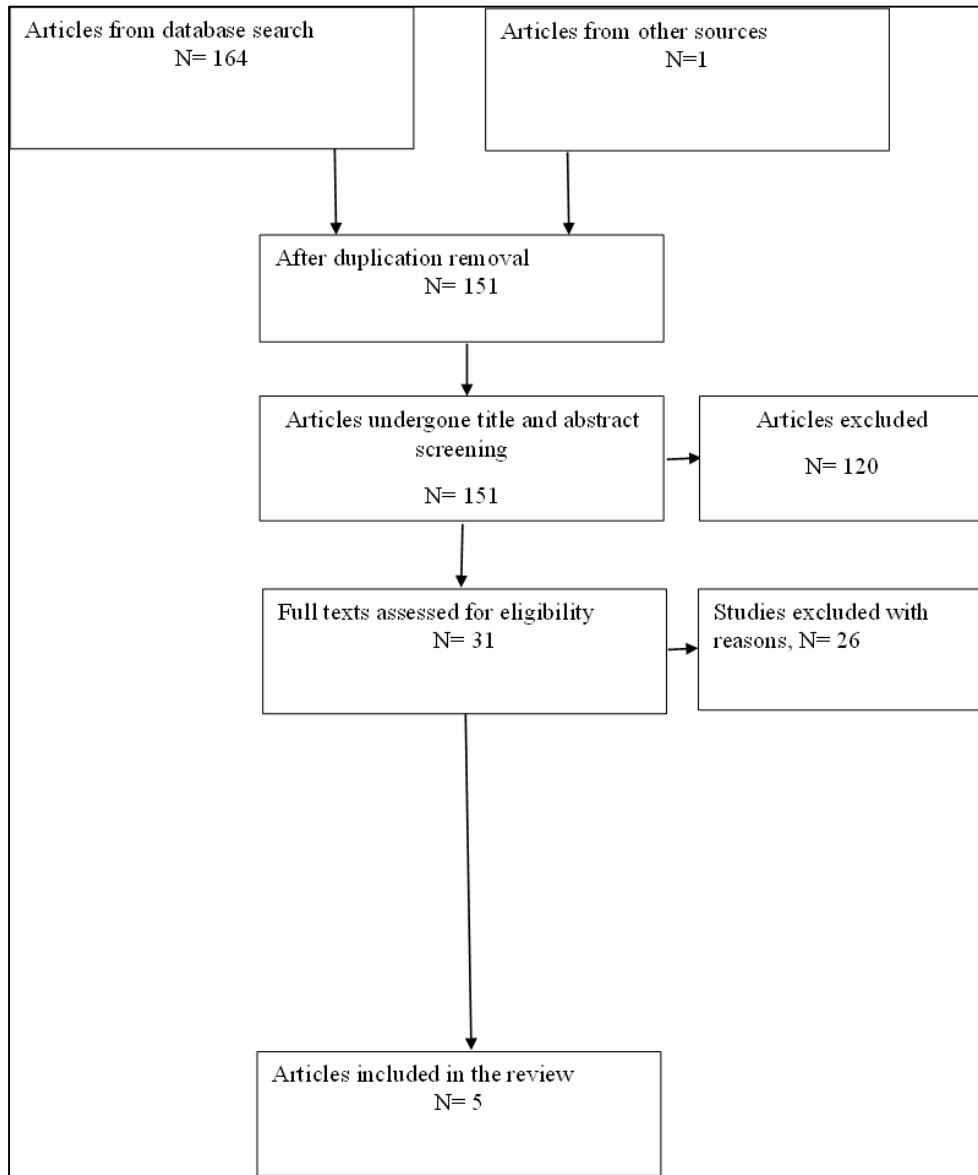


Figure 1 PRISMA consort chart of selection process

Depending on the situation, subject, and approach, simulation education may offer various benefits over other teaching strategies (16,17). Prior research has shown that learning and clinical outcomes improve more permanently following routinely spaced education sessions. These findings suggest that these approaches would yield more durable benefits than a single verbal debriefing without the retraining opportunities employed in this trial (18,19). The inconsistent results across the published research may be the consequence of a deficiency in solid evidence and a common approach to measuring outcomes. Unlike traditional teaching methods, concrete experimentation's components—audiovisual,

feedback, immediate expert constructive, debriefing, and retraining opportunities—are based on the principles of experimental learning. These methods are especially well-suited to continuing education for nurses, where the ongoing integration of theory and practice is crucial (20). It should be mentioned that the absence of solid data and a common approach to outcome evaluation makes it challenging to evaluate the efficacy of simulation education in comparison to other education-based initiatives.

One of the core nursing skills that is still primarily acquired in the clinical context after graduation is the placement of peripheral intravenous catheters (21). To guarantee ongoing clinical competency with this ability, health care institutions need to implement rigorous training and reinforcement programs. In addition to being frequently utilized to supplement clinical rotations for nursing students, simulation-based learning may also be advantageous for PIVC insertion. Indeed, research using blended learning methodologies that include didactic and simulation tools have found decreased patient complication rates and fewer intravenous insertion attempts per patient (22,23). These studies did, however, have several limitations that could affect how the results are interpreted.

For PIVC insertion to be effective, one must be knowledgeable about the anatomical and physiological elements of peripheral vascular access (24). A complicated cognitive process underlies the retention, retrieval, and application of newly acquired knowledge and abilities from long-term memory. The research participants in Jansson et al. (14) showed significant increases in knowledge as soon as the training program was over. Similar findings were found in a prior study that examined the effects of a blended learning continuing education course on nurses' knowledge, competence, and confidence (22).

The results of Wilfong et al.'s study (23), which found a significant decrease in the attempts number per patient for nurses attended simulation training compared with those who did not, and which aligned with the findings of Lyons et al. study (22), which found a non-significant improvement in first attempt success, are likely due to variations in data collection and sampling. The study conducted by Keleekai et al. found no significant changes in the procedural time for PIVC insertion procedure or the proportion of first attempt success during the simulation (21).

Table 1 Characteristics, interventions, and main findings of the included studies

Citation	Study setting	Study design	Participants	Outcome	Intervention	Main findings
Huang et al., 2021 (9)	Teaching hospital wards and ICU	RCT	79 graduated nurses	Knowledge and skills on central venous catheter	Attended a presentation on central venous catheter examination during a two-week induction program.	Nurses who received the intervention reported substantially higher knowledge and competence ratings as compared to controls. Use of the mobile app more frequently was linked to increased knowledge and proficiency.
Keleekai et al., 2016 (21)	Surgical units	RCT	59 RNs	Knowledge and skills	Eight hours session, simulation-based PIVC instruction are followed by an online learning course.	Both groups' baselines for knowledge and abilities were comparable. After the training program, the intervention group's knowledge and competence ratings were considerably higher than those of the wait-list group. Following crossover, the wait-list group outperformed the intervention group in terms of knowledge and competence ratings. The wait-list group had

						improvements in knowledge and skills of 28% and 24%, respectively, during the immediate pre-intervention and post-intervention periods, whereas the intervention group saw improvements in knowledge and abilities of 31% and 24%, respectively.
Liaw et al., 2015 (25)	Hospital wards	RCT	67 RNs	Measurement of Skill	A high-fidelity simulation scenario. Simulation session lasted for 15 min. Three-hour web-based simulation.	Following the Web-based simulation, the experimental group's clinical performance posttest scores showed a substantial improvement over the pretest results. Furthermore, after correcting for pretest scores, the experimental group's clinical performance posttest ratings were considerably higher than those of the control group. The experimental group's members rated the Web-based simulation highly and expressed satisfaction with their educational experience. The responses about the Web-based simulation's most beneficial features reveal themes including problem-solving encouragement, teaching tactics, and relevance to practice.
Jansson et al., 2016 (14)	Intensive care unit	RCT	17 ICU nurses	Skill in intubated patients	A 20-minute training and a 10-minute high-fidelity simulation exercise centered on intubated patients' adherence to a ventilator-bundle. The experimental group engaged in a systematic 60-minute debriefing and got verbal comments.	In the final post-intervention assessment, the average skills score rose from 46.8% to 58.8% of the overall score following simulation teaching. There was no discernible shift in the group average knowledge scores. Only at the 6-month assessment did the average between-group disparity in skills scores reach statistical significance.

Hebbar et al., 2015 (10)	Pediatric ICU	RCT	76 RNs	Central venous catheter skills	Training methods using a central venous line every three, six, and twelve months with an instructor through low-fidelity simulation on a basic manikin.	Improved compliance with central venous catheter maintenance bundle practice is linked to bedside simulation-based training in central venous catheter dressing changes. Improved central venous catheter maintenance bundle procedures may help lower the incidence of bloodstream infections.
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Abbreviations

- PIVC, peripheral intravenous catheter insertion
- RN, registered nurse

4. Conclusion

When compared to alternative learning strategies, our findings from the systematic analysis of the included RCTs indicate that simulation-based training is helpful in enhancing nurses' skills and knowledge.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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