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Assessing the Effectiveness of Using Simulation on Nursing Students' Education and Competencies about Cardiopulmonary Resuscitation

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ABSTRACT

High fidelity simulation (HFS) has emerged as a crucial tool in healthcare education due to its ability to facilitate the implementation of realistic clinical scenarios. Proficiency in Cardiopulmonary Resuscitation (CPR) is imperative for nursing professionals. This study aims to explore previous literature that investigates the effects of HFS on the acquisition and retention of CPR knowledge and skills, comparing two teaching methods: (1) traditional CPR lecture accompanied by static manikin training, and (2) CPR lecture combined with high fidelity simulation training. Although high fidelity simulators have been widely utilized in various aspects of clinical nursing, their impact on the acquisition and retention of CPR knowledge and skills in nursing education remains understudied.

To bridge this research gap, this study seeks to assess the effectiveness of traditional training program and high-fidelity simulation training program in enhancing the acquisition and retention of CPR knowledge and skills among nursing students.

The findings of this study will contribute to the expanding body of literature on the efficacy of HFS in nursing education, offering evidence-based recommendations for the integration of HFS into CPR training programs. Ultimately, this research aims to enhance the quality of CPR education and ensure that nursing students develop the necessary competence in this vital clinical skill.

KEYWORDS: Cardiopulmonary Resuscitation CPR, Training, Simulation, Traditional, Nursing Education, Nursing Students, Competencies

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INTRODUCTION

Cardiopulmonary resuscitation (CPR) is a critical skill that nursing students need to learn to become competent and confident healthcare professionals. Traditionally, CPR training has relied on didactic lectures, written materials, and low-fidelity simulations. However, these methods may not provide students with the necessary skills and knowledge to perform CPR effectively in real-life situations. High-fidelity simulation (HFS) has emerged as a promising approach to enhance nursing students' CPR training. HFS allows students to practice and master essential CPR skills in a controlled and safe environment that closely resembles real-life scenarios. The use of HFS in nursing education has increased significantly in recent years, but its effectiveness in improving CPR outcomes remains a topic of debate. This review article aims to synthesize the available evidence on the effects of HFS on nursing students' outcomes during the CPR experience. By critically analyzing and interpreting the current literature, this review will provide valuable insights into the potential benefits and limitations of HFS in nursing education and practice.

High-fidelity simulation (HFS) is a new trend that has been introduced into the nursing community (Jeffries, 2005; Nehring & Lashley, 2004). According to Jeffries (2005), traditional teaching using a lecture format relies on memory rather than a deep understanding of content.

Also, HFS enables educators to implement clinical scenarios that allow students to practice critical situations such as cardiac arrest without risk to patients (Alinier, 2010). Furthermore, high-fidelity simulation enhances experimental

learning to enable students to practice skills in a safe environment, demonstrate clinical decision-making ability, observe other students, and learn from feedback during debriefing sessions (Brannan, White, & Bezanson, 2008; Jeffries, 2005)

Rizzolo et al. (2011) described simulation as "a training device that closely represents reality but in which the complexity of events can be controlled. Many simulators are being used in the nursing education field, ranging from low to high fidelity. Fidelity refers to how the simulator replicates reality" (Alessi, 2000; Bearnson & Wiker, 2005). Low-fidelity simulation refers to static manikins without any interactive features, and high-fidelity simulation refers to interactive manikins capable of realistic physiological responses (Alessi, 2000).

Moreover, using simulation in education helps practice necessary skills in a safe environment and increasing knowledge and skills retention (Ziv, Wolpe, Small, & Glick, 2003; Hertel & Millis, 2002). However, the effect of the simulation teaching method on retaining knowledge and skills is still questionable among nursing educators (Lasater, 2007). Moreover, acceptance of clinical simulators is not expected to be a possible way to enhance clinical competencies for nurses practicing at the bedside (Decker, Sportsman, Puetz, & Billings, 2008). The American Heart Association (AHA) (2015) has indicated a need for continuing research into teaching methods that may improve the retention of CPR knowledge and skills to increase survival rate and quality of care for patients with cardiac arrest. Thus, further research is needed to explore ways to increase the retention of CPR knowledge and skills with various teaching approaches, such as high-fidelity simulators.

Cardiopulmonary resuscitation (CPR) has been a concern for years (Bullock, 2000; Hamilton, 2005; Madden, 2006). Unfortunately, we do not have the exact number of cardiac arrests in Saudi Arabia; approximately 300,000 out-of-hospital cardiac arrests were reported each year in the United States (AHA, 2015). There is only a 10% survival rate after CPR because of the public and healthcare providers' poor quality of performance (Alspach, 2005; Abella et al., 2005). Studies have documented that nurses' and nursing students' quality of CPR performance is poor due to inadequate initial training, leading to poor CPR knowledge and skills (Abella et al., 2005; Dine et al., 2008; Kardong-Edgren & Adamson, 2009). Other studies have shown that cardiopulmonary resuscitation knowledge and skills decline rapidly, often within weeks of completing a course (Wayne et al., 2006; Hamilton, 2005; Madden, 2006). Many nursing colleges have used different teaching methods to improve students' CPR knowledge and skills (Hamilton, 2005). Childs and Sepples (2006) found that adding simulation as a teaching method in nursing education provided valuable experiences for learning psychomotor skills and developing critical thinking. As the demand for the quality level of nursing students has increased, evaluating the effectiveness of current teaching methods and the search for alternative teaching methods are needed (Jeffries, 2005).

In Saudi Arabia, an increasing number of nursing colleges are integrating high-fidelity simulation in the educational process to improve students' competencies. A study by Akhu-Zaheya, Gharaibeh, and Alostaz (2013) was conducted to observe the effects of high-fidelity BLS simulation on knowledge acquisition, knowledge retention, and self-efficacy nursing students. This study revealed no significant differences in knowledge acquisition and retention between the traditional method and HFS groups. On the other hand, another study was conducted by Al Hadid and Suleiman (2012) to measure the effects of boost training sessions supported by simulation on the retention of CPR knowledge and skills of nursing students. The result revealed that the boost session supported by simulation had improved the student's CPR knowledge and skills.

Although the Faculty of Nursing at King Abdulaziz University has introduced many high-fidelity simulators in the nursing laboratories, there has been little research to date measuring the learning outcomes of using HFS as a teaching method alongside traditional teaching methods among nursing students in Saudi Arabia.

To conclude, students who can participate in active learning with HFS may acquire and retain CPR knowledge and skills, which promotes the quality of patient care. Researchers support positive learning outcomes in knowledge acquisition and retention (Brannan, White, & Bezanson, 2008; Jeffries, 2005; Childs & Sepples, 2006**)**.

1.1 Purposes of the study

Improving nursing care and patient outcomes relies heavily on the acquisition and retention of CPR knowledge and skills. Therefore, this study aims to assess the effectiveness of using High Fidelity Simulation (HFS) as a teaching and learning tool to enhance nursing students' CPR knowledge and skills. The poor acquisition and retention of CPR knowledge and skills necessitate the evaluation of different teaching methods (Saraç & Ok, 2010). Thus, the objective of this study is to review previous literature that focuses on the impact of simulation on the acquisition and retention of CPR knowledge and skills, employing two teaching approaches: (1) traditional didactic CPR lecture combined with static manikin training, and (2) didactic CPR lecture accompanied by high-fidelity simulation training

The Effect of simulation on nursing practice

Enhancing patient safety is a global concern, as highlighted by Wall's (2000) report to the Institute of Medicine (IOM), which emphasizes the use of simulation training as a strategy to prevent errors in clinical settings. The acquisition and retention of CPR knowledge and skills are crucial for nurses to respond promptly and effectively during cardiopulmonary arrests, ultimately improving patient outcomes (Hamilton,

2005). In Saudi Arabia and across the world, various methods are employed to teach CPR skills. Therefore, it is imperative to investigate and identify the most appropriate teaching approach that ensures the acquisition and retention of CPR knowledge and skills, aiming to uphold patient safety and enhance the overall quality of care.

Patients wish to receive high-quality CPR in the event of cardiopulmonary arrest. If CPR is not performed correctly or in a timely fashion, the patient's chance of survival is limited. The AHA (2015) has determined that patient survival rates can double or even triple with immediate and adequate CPR and defibrillation. Investigating the effect of teaching methods, in particular, HFS versus traditional teaching methods on retention of CPR knowledge and skills for nursing students, is significant for nurses and educational institutions, as there is only a 10% survival rate after CPR because of poor performance by healthcare providers (Alspach, 2005**)**.

Importance of Cardiopulmonary Resuscitation (CPR) Training for Nursing Students

Cardiopulmonary resuscitation (CPR) includes chest compression, ventilation, and the use of a conventional or Automated External Defibrillator (AHA, 2015). Jacobs and Nadkarni (2004) found that the outcome of CPR is mainly dependent on early defibrillation, effective chest compressions, and assisted ventilation. It was also stated that the most critical determinant of survival from sudden cardiac arrest is the presence of a rescuer who is trained, willing, able, and equipped to act in an emergency. Nursing students are expected to perform CPR maneuvers because they may care for patients at risk of developing cardiac arrest during their clinical training (Gombotz, Weh, Mitterndorfer, & Rehak, 2006). The American Heart Association (2015) implemented significant CPR guidelines based on the increasing evidence of poor CPR outcomes. Furthermore, the trainer should implement high-quality CPR, good compression rate, adequate depth, allowing complete chest recoil after each compression, and minimizing pauses in compressions (Hazinski et al., 2015). The sequence of CPR skills, according to AHA (2015) recommendations are:(1) Assess responsiveness; (2) activate the emergency response system (or send a second rescuer); (3) get the Automatic Electronic Defibrillator (AED); (4) check pulse and other signs of circulation; (5) if no pulse start CPR (30 compressions at a rate of at least 100, fast and deep); (6) opens the victim's airway; (7) check breathing; (8) if breathing is absent or inadequate provide two breaths (must cause the chest to rise); (9) when AED arrives: power on the AED; (10) attach electrode pads to patient's bare chest in the proper location with adequate skin contact and no overlap of pads; (11) clear victim before analyze, and shock; (12) push shock button to attempt defibrillation; (13) check to breathe and signs of circulation after no shock indicated message; (14) Rescuer should be prepared to continue CPR if the non-shockable rhythm is present (AHA, 2015). Cardiopulmonary resuscitation guidelines are essential to provide adequate blood flow to vital organs during CPR (AHA, 2015). It is necessary to train nursing students on CPR before starting clinical experiences with patients to maintain knowledge and skills by finding effective and efficient methods of CPR instruction and training (Fredriksson, Herlitz, & Nichol, 2003).

Acquiring and Maintaining CPR Knowledge and Skill

studies have demonstrated a decline in CPR knowledge and skills shortly after training (Hamilton, 2005; Ackerman, 2009). For instance, Madden (2006) found a rapid decline in CPR knowledge and skills among Irish nursing students after training. Jabbour, Osmand, and Klassea (2017) reported deficiencies in CPR retention when traditional passive instruction methods were used. However, refreshing CPR courses improved retention, emphasizing the need for engaging classes to sustain CPR knowledge and skills in nursing students. a study by Madden (2006), undergraduate nursing students underwent a refreshment CPR course to assess knowledge and skills acquisition and retention. The results showed an increase in CPR knowledge and skills after the course, indicating positive training effects. However, there was a significant decrease in retention after ten weeks, the importance of regular training. Additionally, Ackermann (2009) investigated the effectiveness of high-fidelity simulation on nursing students' CPR knowledge and skills. The experimental group that received simulation training demonstrated significantly higher knowledge scores and skill performance compared to the control group.

Hamilton (2005) conducted a literature review to explore nurses' CPR knowledge and skill retention after resuscitation training and identify factors that contribute to knowledge and skill retention during and after CPR training. Hamilton discovered that there is a discrepancy in the rate at which CPR skills and knowledge deteriorate. Skills tend to decline more rapidly than knowledge, with reductions observed as early as two weeks after training and persisting up to 1-2 years later. Furthermore, Hamilton found that the use of computer-based mannequins and diverse teaching methods enhances CPR knowledge and retention. The majority of studies reviewed by Hamilton focused on CPR among community lay rescuers, anesthesia staff, and military personnel, with limited research investigating nursing and nursing students. Therefore, further research is needed to explore the CPR knowledge and skills of the nursing population, specifically nursing students.

In another study, Ackermann (2009) assessed the effectiveness of high-fidelity simulation in enhancing CPR knowledge and skill acquisition and retention among nursing students. The study involved a sample of 68 subjects, with 49 participants completing the retention test. The subjects were randomly assigned to either a control group or an intervention

group. Following standard CPR training, a cardiopulmonary knowledge test was administered using multiple-choice questions. The intervention group received additional training using a high-fidelity simulator, while the control group received no further intervention. All participants underwent posttests to evaluate their knowledge and skill performance and were subsequently retested three months later. Ackermann observed that during the initial post-testing, the intervention group exhibited significantly higher knowledge scores ($p = 0.015$) and skill performance ($p < 0.001$) compared to the control group.Ackermann concluded that high-fidelity simulation had a positive impact on CPR knowledge and skill acquisition and retention. However, determining whether the significant difference in results was attributed to the simulation training or the additional training time provided to the experimental group proved challenging.

Akhu-Zaheya, Gharaibeh, and Alostaz (2013) conducted a study to explore the impact of high-fidelity BLS simulation on knowledge acquisition, knowledge retention, and self-efficacy among nursing students in Saudi Arabia. The study involved two groups of students as the sample. The first group (n=52) received training using traditional teaching methods alongside high-fidelity BLS simulation, while the second group (the control group, n=58) received instruction solely through traditional methods. The findings revealed that there were no significant differences in knowledge acquisition and knowledge retention between the two groups.

Similarly, Al Hadid and Suleiman (2012) conducted a study with a sample of 40 nursing students from a university in Saudi Arabia to assess the effects of boost training sessions supported by simulation on the retention of CPR knowledge and skills. Throughout the study, the students underwent three tests: a pretest, posttest I, and posttest II, which evaluated their knowledge and skills acquisition. The results indicated that the boost session, combined with simulation, resulted in improved CPR knowledge and skills among the subjects.

On the other hand, Broomfield's study (1996) reported a significant reduction in both knowledge and skills after ten weeks of standard CPR training. However, this study is outdated considering changes in international CPR guidelines. Akhu-Zaheya, Gharaibeh, and Alostaz (2013) found no significant differences in knowledge acquisition and retention between traditional teaching methods and high-fidelity BLS simulation in nursing students. Similarly, Al Hadid and Suleiman (2012) concluded that boost training sessions supported by simulation improved CPR knowledge and skills among nursing students.

Nicholson et al. (2009) compared three teaching methods and found no significant differences in knowledge gain, but retention performance was higher with high-fidelity simulation and mutual discussions. Curran et al. (2004) evaluated neonatal resuscitation skills and found that simulation training was as effective as video review for knowledge and performance. Creutzfeldt et al. (2009) studied the retention of CPR knowledge and skills using virtual simulation training, showing a drop in both groups over time. Andresen et al. (2008) investigated CPR and AED retention and recommended a two-hour CPR class with re-evaluation after six months. Spooner et al. (2007) and Woollard et al. (2004) reported poor retention of CPR skills after several weeks or months.

Overall, these studies indicate the need for alternative teaching methods, such as high-fidelity simulation, to enhance the retention of CPR knowledge and skills. Regular refreshment courses, engaging classes, and frequent re-evaluation are crucial to maintaining CPR competency and confidence in responding to cardiac arrest victims. Further research is required to explore the effectiveness of simulation training and other innovative approaches in improving CPR retention.

Role and Benefits of High-Fidelity Simulators in Nursing Education

High-fidelity simulators have demonstrated their value in various aspects of clinical nursing education. Studies have shown positive outcomes when using simulation as a teaching method in nursing programs. For instance, Bearnson and Wiker (2005) found that simulation was beneficial in postoperative pain management education for nursing students. Similarly, Bremner et al. (2006) reported that novice nursing students highly valued simulation as a learning tool, emphasizing its importance in the curriculum.

In the field of obstetrics and midwifery, Nehring et al. (2001) conducted a study to assess the effectiveness of simulation training on eclampsia. Although there was no significant difference in scores between groups, the overall mean score increased after simulation training. This suggests that simulation can contribute to knowledge enhancement. However, Nehring and Lashley (2004) highlighted the underdevelopment of simulation use in nursing education programs, indicating the need for further research in this area.

Benner et al. (2012) emphasized the importance of clinical practice and real-life emergency situations in building students' ability to respond effectively. However, since opportunities for such experiences may be limited, simulations provide a controlled environment for students to practice and receive immediate feedback. Alinar et al. (2006) conducted a study demonstrating the positive impact of scenario-based simulation on nursing students' competence and confidence, with the experimental group showing significant improvement compared to the control group.

Simulation also allows nursing students to learn and master clinical skills while achieving clinical competency in a safe environment (Luctkar-Flude, Wilson-Keates, & Larocque, 2012). Reflective learning can occur through simulations, providing opportunities for students to evaluate their performance and identify areas for improvement. Additionally, HFS provides models of real-life clinical

situations that enhance knowledge acquisition and retention (Hertel & Millis, 2002).

In summary, high-fidelity simulators offer valuable benefits in nursing education, including improved learning outcomes, enhanced competency, and opportunities for reflective learning. As nursing educators continue to develop and refine simulation programs, the integration of HFS can support and reinforce classroom knowledge, ultimately preparing students for real-world clinical practice.

The Significance of Simulation Debriefing

Simulation debriefing is a critical element of the teaching-learning process, as emphasized by Decker et al. (2008). Cantrell (2008) conducted a qualitative research study to evaluate the advantages of a structured debriefing session on student learning after participating in three pediatric simulation scenarios. Eleven senior-level students, whose performances were recorded during each simulation with their consent, took part in the study. Immediate oral debriefing sessions were conducted after the simulations, followed by a structured debriefing session two weeks later, utilizing the video recordings as feedback on the students' performance. To determine the effectiveness of the debriefing methods, two one-hour qualitative focus group interviews were conducted. The findings revealed that the oral debriefing session immediately after the simulation had a greater impact on student learning compared to the structured debriefing session held two weeks later. The oral debriefing session was more beneficial because the experience was still fresh in the students' minds.

Similarly, Savoldelli et al. (2006) investigated the value of debriefing in simulation by comparing the non-technical performance improvements of anesthesia residents who received different forms of feedback. The study included three groups: no feedback, oral feedback, and verbal feedback with the assistance of a videotape during the debriefing session. All groups completed pretests and posttests and participated in a second scenario, which was also recorded. The performances were later assessed using a validated scoring system. The results indicated no improvement in the control group (no feedback), while significant differences were observed in the scores of the other two groups (oral feedback and video-assisted feedback). These findings underscore the significance of debriefing following simulation, as simulation without debriefing proved to be significantly less beneficial for the learners.

In summary, both studies highlight the importance of simulation debriefing in enhancing student learning outcomes. Immediate oral debriefing sessions after the simulation have shown to be particularly valuable, as they capitalize on the fresh experience in students' minds. Furthermore, providing feedback, either orally or with the aid of video recordings, during debriefing sessions has proven to be instrumental in improving non-technical performance. These findings emphasize the crucial role of debriefing in maximizing the educational benefits of simulation-based training

CONCLUSION

Nursing students undergo CPR training before commencing their clinical rotations; however, their CPR knowledge and skills tend to decline rapidly over time. As nursing students are often the first to encounter and respond to cardiac arrest cases during their clinical rotations, the quality of their response significantly impacts the outcomes for the victims. Enhancing the CPR competency of nursing students is therefore crucial to achieve better patient outcomes. High-fidelity simulation, with its immersive features, offers a promising approach to maintaining and retaining CPR knowledge and skills. In light of this, the present study aimed to assess the effectiveness of high-fidelity simulation (HFS) as a CPR training method compared to static manikin training in terms of CPR knowledge and skills acquisition and retention. By evaluating the impact of HFS on nursing students' CPR proficiency, this study seeks to contribute to the development of effective CPR training programs in nursing education.

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