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Development and implementation of a nursing students' simulation program for the initial assessment of trauma patients

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Abstract

This study aimed to develop and implement a simulation-based training program designed to enhance nursing students' competency in the initial assessment of trauma patients while providing a controlled and safe learning environment. The simulation program was structured based on the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model, incorporating multiple levels of fidelity into the simulation design. A traffic accident scenario was selected to simulate realistic trauma patient assessments. The program was developed between October 2022 and February 2023 and was subsequently implemented on June 23–24, 2023, with 21 nursing students from a university in Seoul. The program's effectiveness was assessed through the evaluation of changes in confidence levels, engagement in practice, and participation experiences. Statistical analyses were conducted using SPSS 24.0. Confidence levels before and after the program were compared using the Wilcoxon signed-rank test, and engagement in practice was analyzed using descriptive statistics, including means and standard deviations. Qualitative content analysis was employed to examine participation experiences. The results demonstrated a significant improvement in confidence levels following program completion ($Z = -3.92$, $p < .05$). The highest engagement in simulation practice was reported in autotelic experiences. The qualitative analysis identified key themes, including "disorientation in trauma patient situations," "approaching collaborative nursing," and "enhanced motivation for learning." Scenario-based education incorporating varying levels of fidelity was found to be an effective pedagogical approach for improving nursing students' competencies in trauma patient assessment and facilitating rapid clinical decision-making in high-pressure environments. These findings underscore the value of integrating simulation-based education into nursing curricula to enhance students' clinical preparedness and confidence in managing trauma cases. Future research should explore the integration of real-world clinical experiences with simulation-based training to further optimize educational outcomes and bridge the gap between theoretical knowledge and practical application.

Keywords: Initial assessment nursing students, Simulation, Trauma.

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1. Introduction

In the contemporary healthcare landscape, nurses encounter multifaceted challenges arising from the rapid evolution of society and advancements in medical technology [1]. Nurses are continually required to acquire the knowledge and skills necessary to meet the demands of professional practice [2]. In life-threatening emergencies, timely interventions and life-saving measures are essential [3]. Nurses play a pivotal role not only in managing trauma patients affected by accidents, incidents, natural disasters, and human-induced events but also in influencing the quality of the services provided [4]. The active involvement of nursing personnel during the initial resuscitation phase of trauma patients is critical to ensuring effective and seamless trauma care management [5].

1.1. Related Works

Nurses' responsibilities include assessing trauma patients, promptly identifying their problems, and implementing appropriate management strategies to enhance the quality of care [6]. It is essential to provide nurses with education on the importance of patient safety and training in the skills required for managing trauma patients [7]. Trauma nursing competencies, including rapid initial assessment that considers the mechanism of injury and specialized trauma nursing skills, are crucial [8]. Therefore, effective clinical experiences during nursing education are necessary for developing these competencies [9].

Medical students with limited experience in managing critically injured trauma patients often encounter challenges in learning the processes involved in the initial evaluation and treatment of such patients [10]. Similarly, after graduation, nursing students require diverse educational strategies to build their confidence as professional caregivers in clinical settings [11]. As initial trauma assessment involves numerous procedural skills, training in a realistic environment is regarded as the most effective approach and simulation-based education has been adopted for this purpose [12]. Simulation training provides nursing students with a safe environment to practice nursing skills without harming patients [13]. It also enhances their confidence and focus on nursing care while fostering their motivation for self-directed learning and improving problem-solving abilities [14].

To enable nursing students to confidently perform initial trauma assessments and effectively fulfill their roles as nurses in clinical settings, providing opportunities for initial trauma evaluation and training in various nursing skills is essential. However, it is difficult for nursing students to practice in life-threatening situations. Clinical practicums are predominantly observation-based, offering limited opportunities for active participation. Therefore, this study developed a simulation program that accurately replicates clinical scenarios, providing nursing students with a safe environment to practice initial trauma assessments. Additionally, the study aimed to confirm the program's validity by specifically examining nursing students' confidence in performing trauma nursing, their level of engagement during the practicum, and their experiences participating in the simulation program.

2. Research Methods

2.1. Design

This is a descriptive study outlining the process of developing and implementing a nursing students' simulation program for the initial assessment of trauma patients.

2.2. Procedure

Development of a Nursing Students' Simulation Program for the Initial Assessment of Trauma Patients: In this study, the development of a simulation program for the initial assessment of trauma patients followed the ADDIE Model [15], a systematic instructional design and learning development framework comprising five stages: analysis, design, development, implementation, and evaluation. In the analysis phase, case scenarios were selected in collaboration with three clinical practitioners with over ten years of experience in the emergency field. Statistical trends in common injury types [16] and the mechanisms and conditions of trauma patients visiting trauma centers in Gyeonggi Province, South Korea, as of 2020, were analyzed. Based on the analysis, the scenario focused on a frequently occurring case: "a multiply injured patient involved in a vehicle accident." The appropriateness of learning objectives and essential patient assessment skills [17] was verified through discussions with the three clinical practitioners and one nursing professor, forming the basis for scenario development. The developed scenario underwent a pilot simulation involving five clinical nurses. Adjustments were made to ensure alignment with the learning objectives and to keep the scenario's duration within the expected time frame. Procedures typically performed by physicians, such as Focused Assessment with Sonography for Trauma (FAST), were excluded from the nursing activities to maintain a focus on nursing-specific objectives. The scenario development process was carried out between October 2022 and February 2023. The scenario was designed to integrate fidelity levels appropriate for simulation [14]. Preparations included confirming the type of simulation equipment, the availability of practice rooms, training materials, human resources, and consumables. The simulation program was conducted as part of a co-curricular program at a nursing university in Seoul and spanned two days. Participants were nursing students who had completed basic training in nursing skills and had experience in clinical practicum settings. This structured and systematic approach ensured

the development and implementation of a realistic simulation program, providing nursing students with an opportunity to enhance their competence and confidence in performing initial trauma assessments.

The Effects of Implementing the Nursing Students' Simulation Program for the Initial Assessment of Trauma Patients: To examine the effects of the nursing students' simulation program for the initial assessment of trauma patients, confidence levels in trauma nursing performance were measured before participation. Following participation, confidence levels, engagement during practice, and experiences with the simulation program were evaluated.

2.3. Data Collection and Analysis

The simulation program was conducted from June 23 to 24, 2023, targeting third- and fourth-year nursing students enrolled at a nursing university in Seoul. Participants were recruited via a university bulletin board one month prior to the program, resulting in 24 volunteering nursing students. Of these participants, three withdrew due to absences, leaving 21 students to complete the program. Before the simulation, participants completed a questionnaire to assess their confidence in trauma nursing performance. To evaluate their experiences with the program, participants were instructed to write a three-page reflective essay in response to the prompt, "Describe your thoughts and feelings after conducting an initial trauma patient assessment." Following the simulation, participants recorded their confidence levels, engagement during practice, and reflections in a self-reflection journal.

Confidence in trauma nursing performance was measured using a 10-point scale, with higher scores indicating higher confidence levels. Engagement in practice was assessed using Ko's Simulation Learning Engagement Scale [18] which comprises four factors—cognitive assimilation, presence, attention focus, and self-directed experience—across 16 items. The original reliability of the instrument had a Cronbach's α value of .89, and in this study, it had a Cronbach's α value of .92. Confidence levels in trauma nursing performance were analyzed using data obtained from 20 participants, excluding one who did not complete the survey. The SPSS 24.0 software was used for analysis. The basic characteristics of the participants and their engagement in practice were analyzed using means and standard deviations. To compare confidence levels before and after the program, the Shapiro-Wilk test was conducted to verify normality. As the pre-education data did not follow a normal distribution, the Wilcoxon signed-rank test was applied. Descriptive statistics were used to conduct the means and standard deviations for engagement in practice.

Participants' experiences in the simulation program for the initial assessment of trauma patients were analyzed using qualitative content analysis. The self-reflection journals written by the participants were reviewed line by line to identify meaningful statements, resulting in 68 open codes. These open codes were examined to determine whether they shared similar meanings or conveyed different ones and were subsequently organized into 24 subcategories, from which three main themes were extracted. To ensure the quality of the analysis, credibility, consistency, neutrality, and applicability were addressed [19]. Credibility was verified by meeting with two participants to ensure that their simulation experiences were accurately represented in the analysis. Consistency was maintained through consensus between the two researchers involved in the study. The researchers made efforts to maintain objectivity, thereby ensuring neutrality. Applicability was restricted to nursing students who participated in the simulation for the initial assessment of trauma patients.

2.4. Ethical Considerations

Participants were informed that the study aimed to evaluate the effects of a simulation program by assessing their subjective confidence and experiences in trauma nursing. The study's procedures were also explained to the participants. They were assured that their participation, refusal, or withdrawal would not impact their academic evaluation, as the program was part of a co-curricular initiative. Participants provided informed consent before data collection.

3. Research Validation

3.1. Development of a Nursing Students' Simulation Program for the Initial Assessment of Trauma Patients

The development of a simulation program for the initial assessment of trauma patients was conducted in accordance with the ADDIE Model [15]. During the analysis phase, trauma patient cases were reviewed to identify frequently occurring scenarios, with traffic accident cases selected as the most common encounters faced by nurses. In the design phase, learning objectives were established to guide the training of nurses in the essential tasks required for the initial assessment of trauma. In the development phase, scenarios were created to facilitate the operation of the simulation program for the initial assessment of trauma patients. The structure of the simulation program was developed to incorporate various levels of fidelity Figure 1, with scenarios designed for the use of medium- and high-fidelity simulators. In the implementation phase, the simulation program was conducted with nursing students, and in the evaluation phase, the participants' confidence in trauma nursing performance, their level of engagement in the simulation, and their overall experiences were assessed.

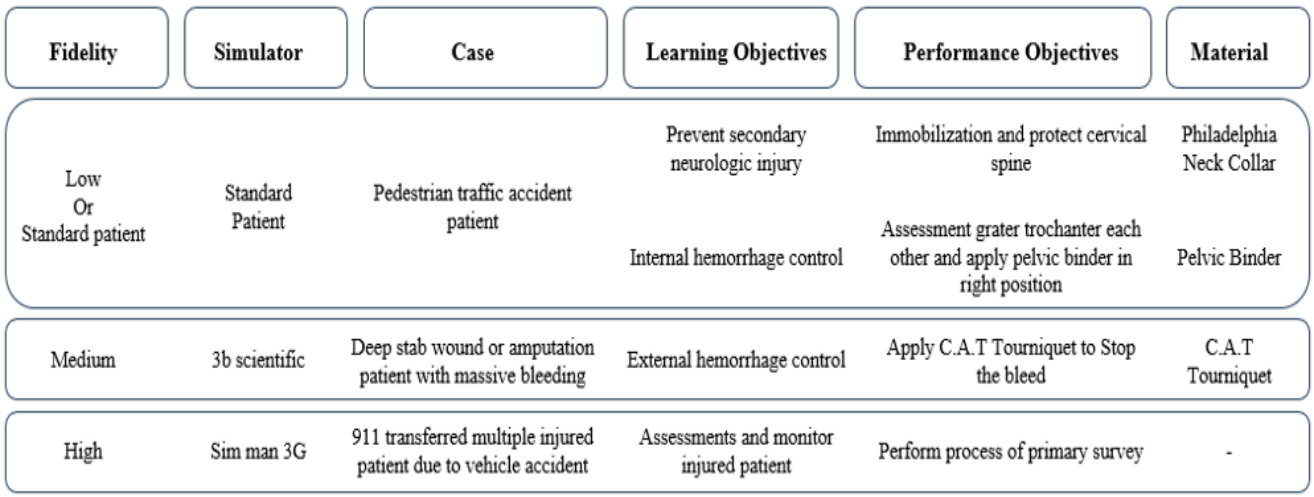

Figure 1.
Structure of the simulation program.

The simulation program was structured to integrate different levels of simulator fidelity, combining low-, medium-, and high-fidelity simulators to provide comprehensive training for nursing students. Low-fidelity simulators were utilized to train cervical spine stabilization and pelvic stabilization techniques. Medium-fidelity simulators were employed to practice the application of tourniquets for external hemorrhage control and patient assessment. High-fidelity simulators, such as SimMan, were used to simulate the initial assessment of a patient experiencing loss of consciousness due to a traffic accident.

The scenario for utilizing the high-fidelity simulator was designed to reflect the nursing tasks performed by nursing students in response to patient situations and changes in circumstances. This scenario was developed to ensure that, as nursing students conduct initial patient assessments, the patient's condition changes in a way that facilitates the provision of appropriate medical care through proper initial assessment. Basic information was provided to guide the process. At the stage before the patient's arrival, nursing students were instructed to prepare by donning appropriate personal protective equipment and getting ready to receive the patient. They proceeded by confirming airway clearance, and cervical spine stabilization, and sequentially assessing breathing and circulation. As the patient's vital signs began to deteriorate, the attending physician intervened with a focused assessment using ultrasound to check for hemorrhagic shock. Ultimately, the scenario concluded when the attending physician shared with the team that a hemoperitoneum was confirmed and directed the nurse to prepare for emergency surgery.

3.2. The Effects of Implementing the Nursing Students' Simulation Program for the Initial Assessment of Trauma Patients

Confidence in Trauma Nursing Performance among Nursing Students Before and After the Program: This study compared the confidence levels in trauma nursing performance before and after the educational program Table 1. The average confidence score for trauma nursing performance increased from 3.25±2.86 before the program to 6.45±1.86 after the program. A comparison of pre-and post-simulation scores revealed a statistically significant difference (z=-3.92, p<.05).

Table 1.
Comparison of nursing students' confidence before and after participation (N=20).

Variable	Pre-education	Post-education	Z	p-value
	M±SD	M±SD		
Confidence	3.25±2.86	6.45±1.06	-3.92	< .05

Measuring Nursing Students' Engagement in the Simulation Program: Engagement in the simulation program was assessed using the factors of "cognitive absorption," "presence," "attention," and "autotelic experience." The "cognitive absorption" factor, which evaluated how smoothly the simulation was conducted, the participants' clear understanding of their roles, and the alignment of the provided information with their existing knowledge, indicated the lowest average score of 3.95. The "presence" factor, assessing how realistic the educational situation felt, scored at 4.05. The "attention" factor, which measured the participants' immersion and focus during the simulation, indicated an average score of 4.3. The "autotelic experience" factor, indicating how much participants enjoyed the simulation and found the experience meaningful, had the highest average score of 4.75, suggesting that the participants had a positive experience with the simulation. Table 2.

Table 2.
Measuring nursing students' engagement in simulation (N=20).

Variable	Min.	Max.	Sum	M	SD
Cognitive absorption	3.00	5.00	78.71	3.95	0.56
Presence	2.00	5.00	81.00	4.05	0.84
Attention	3.00	5.00	86	4.30	0.70
Autotelic experience	3.67	5.00	94	4.70	0.39

Experiences of Nursing Students Participating in the Simulation Program for the Initial Assessment of Trauma Patients: In this study, the nursing students participating in the simulation program for the initial assessment of trauma patients experienced "disorientation in trauma patient situations," "approaching collaborative nursing," and "enhanced motivation for learning."

Disorientation in Trauma Patient Situations: During the simulation, nursing students expressed feeling confused and uncertain about how to respond as the patient's condition changed and deteriorated. They found that the initial patient assessment and management were more challenging in practice than they had anticipated.

"I panicked a bit and was scared as the patient was in continuous pain. I felt clueless about how to perform nursing interventions. I missed checking for wounds on the back, which was disappointing. I learned that theory and practice are different. Although I knew what needed to be done in my head, I struggled to execute it in real-time." (Case 18) "I did not check for back injuries. I was trying to catch the rapidly changing patient conditions and provide the necessary treatment, but I struggled to find equipment and felt overwhelmed while answering the phone, which I regretted." (Case 19)

Approaching Collaborative Nursing: Participating in the simulation allowed nursing students to better understand the care involved in the initial assessment of trauma patients and the importance of communication and teamwork within trauma teams. They also learned the value of maintaining a calm attitude and considering the patient's perspective during emergencies.

"While learning the sequence and methods of initial assessment, I understood the interventions necessary in critical situations. I also learned to think independently about what actions to take according to changes in vital signs. Collaborating with classmates and assigning roles was meaningful and helped build teamwork skills." (Case 1) "I realized the importance of communication during an emergency. Monitoring the patient's status and notifying the doctor immediately if abnormalities were detected for orders was crucial. Team members learned the importance of quickly informing others of their observations and assessment findings." (Case 4)

Enhanced Motivation for Learning: Nursing students recognized that performing initial trauma patient assessments required practice to master basic nursing skills and that continuous studying was necessary to understand patients' conditions and provide appropriate care.

"I must study more to understand the appropriate responses and meanings of symptoms. I must learn more about a patient's condition based on their symptoms." (Case 2) "I realized I must learn how to prioritize care based on a patient's needs. I was disappointed with my indecision, so I want to lay a foundation for providing immediate care through more thorough studying and preparation." (Case 14).

4. Results and Discussion

This study developed a simulation program for nursing students to enhance their capability in performing initial trauma assessments and evaluated the program's effectiveness. The ADDIE Model was utilized during the development stage, providing a structured framework that facilitated step-by-step implementation from analysis to evaluation. This systematic approach ensured a thorough assessment of learner needs and ongoing evaluation throughout the program.

Trauma mechanisms vary widely, and while injuries from stab and gunshot wounds make up 5–10% of trauma cases in many countries, South Korea's incidence is relatively low at 1.7% [20]. In contrast, traffic accidents are the leading cause of severe trauma in South Korea, accounting for 54.9% of cases as of 2021 [16]. Given that nursing graduates are likely to encounter traffic accident victims in clinical settings, this study was designed to focus on common trauma cases found in Korea. Repeated training with the developed simulation program is expected to enable students to apply their skills effectively in clinical practice post-graduation. Considering the increasing frequency of trauma cases, developing comprehensive training programs for nurses and healthcare professionals is essential. The scenarios developed in this study were designed to replicate real-life trauma situations, providing nursing students with training in environments that closely resemble actual field conditions. The simulation program was structured using a multi-stage evaluation model [14], which helped students understand detailed scenarios and practice targeted skills. This approach included providing varied levels of fidelity to challenge and enhance students' learning and skill development. Consistent with the results of previous studies linking simulation fidelity to training outcomes [21], the integration of low, medium, and high-fidelity simulators in this study enabled students to engage in comprehensive simulations, boosting their confidence in clinical tasks. Research has shown that complex and varied scenarios improve learners' problem-solving abilities [22]. This study incorporated cases involving different trauma types, such as blunt-force and penetrating injuries, and multiple hemorrhage control techniques. Such case-based learning is vital, given that preventable deaths resulting from untreated hemorrhage remain significant in South Korea. However, the preventable mortality rate decreased from 30.5% in 2015 to 15.7% in 2019 [23, 24]. These findings emphasize the importance of timely hemorrhage management during the "golden hour" and support the results of previous research highlighting the benefits of case-based learning for trauma care [21, 22].

The participants in this study demonstrated high levels of immersion in the simulation, which contributed to an increase in their confidence in handling trauma situations. This finding aligns with those of previous studies showing the positive outcomes of simulation-based training on student confidence [25]. Effective communication and teamwork are vital for ensuring patient safety, especially when multiple medical resources are involved. Previous studies have shown that nurses who maintain strong relationships and receive peer support in critical care settings are better equipped to manage trauma patients [24]. In this study, students recognized the importance of teamwork and communication, which is consistent with previous literature on their significance in trauma nursing [24, 26].

Trauma nurses require competencies that include clinical judgment, situational management, and understanding medications, treatments, and potential complications, requiring a combination of practical experience, skills, and knowledge

[27, 28]. Participants in this study reported an increase in learning motivation, suggesting that simulation training can encourage students to acquire essential professional knowledge and skills. New nurses often experience high-stress levels and psychological burdens when adapting to trauma patient care [29]. Similarly, the nursing students in this study initially felt disoriented. However, through peer observation, communication, and participation in debriefing sessions, they developed critical thinking skills and learning motivation. These findings reinforce the positive impact of simulation-based education on building student confidence and enhancing their capabilities, aligning with the findings of previous studies on the effectiveness of simulation training [25].

5. Conclusion

This study focused on developing and evaluating the effectiveness of a simulation program for nursing students aimed at the initial assessment of trauma patients. The program enabled nursing students to become highly engaged with trauma scenarios and enhanced their confidence in performing initial assessments for trauma patients. Simulation-based education provides an effective opportunity for nursing students to train in making rapid and accurate judgments during various trauma situations. This approach is expected to prepare such students to perform proficiently in clinical practice after graduation as skilled nurses.

Future research should focus on developing scenarios that reflect various mechanisms of injury and multiple types of traumas. Additionally, creating interprofessional education programs involving multidisciplinary teams (e.g., doctors, nurses, paramedics, radiologic technologists) to enhance learning across different healthcare roles is essential. It is also suggested that incorporating actual clinical experiences with advanced simulation technology, such as virtual reality (VR) and augmented reality (AR), could provide more immersive training experiences. These combined efforts will lead to greater engagement and improved proficiency, thereby enabling nursing students to develop more specialized skills in trauma patient care. Further expansion of simulation training for initial trauma assessment to a larger number of nursing students is needed, and follow-up studies to track their adaptation to clinical trauma assessments post-graduation are recommended.

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