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Abstract

Background Basic life support (BLS) competency is essential for nurses, who are often the first healthcare professionals to recognize and respond to cardiac arrest in hospital settings. Maintaining up-to-date resuscitation knowledge and skills through continuing education is critical for improving patient outcomes. Method This prospective educational intervention study evaluated the impact of a standardized BLS training program on nurses' knowledge and cardiopulmonary resuscitation (CPR) performance. A total of 321 nurses participated in a 45-minute training session based on European Resuscitation Council guidelines. Knowledge was assessed using a 10-item questionnaire administered before and after training. CPR performance was evaluated using a simulation-based cardiac arrest scenario and a structured 10-item checklist. Results Post-training knowledge scores increased significantly (2.9 ± 1.6 vs 4.2 ± 1.1, $p < 0.001$; Cohen's $d = 0.97$). Successful CPR performance was observed in 81.3% of participants. Higher post-training knowledge scores were independently associated with CPR success (OR = 1.56, 95% CI: 1.13–2.16, $p = 0.007$). Knowledge scores demonstrated modest predictive ability for CPR success (AUC = 0.62). Conclusion Integrating structured BLS training with simulation-based assessment may strengthen nurses' preparedness for cardiac arrest situations. Integrating simulation-based resuscitation training into continuing nursing education programs may strengthen nurses' preparedness for cardiac arrest situations.

Keywords: resuscitation; education; nurse

Introduction

Cardiac arrest remains a major cause of morbidity and mortality worldwide, and early initiation of cardiopulmonary resuscitation (CPR) is a key determinant of survival according to the European Resuscitation Council (ERC) guidelines [1]. Nurses are often among the first healthcare professionals to recognize clinical deterioration and initiate resuscitation in hospital settings. Therefore, maintaining adequate knowledge and competence in basic life support (BLS) is essential for timely and effective resuscitation.

Previous studies have shown that CPR knowledge and skills may decline over time after initial training [2–4]. Without regular reinforcement, healthcare professionals may experience reduced confidence and decreased performance during resuscitation events. For this reason, continuing education programs play an important role in maintaining nurses' competence in life-saving skills and supporting patient safety in clinical settings.

Simulation-based training has increasingly been used in nursing education to improve the acquisition and retention of clinical skills.(5,6,2025). Simulation provides a safe environment in which nurses can practice resuscitation techniques and receive feedback on their performance. Evaluating both knowledge and practical performance following training programs is important to determine the effectiveness of educational interventions and to guide the development of continuing professional education strategies.

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Therefore, this study aimed to evaluate the effect of a basic life support (BLS) training program on nurses' knowledge and CPR performance and to examine whether post-training knowledge levels were associated with successful CPR performance in a simulation-based assessment.

Materials and Methods

Study Design and Setting

This prospective educational intervention study evaluated the effect of basic life support (BLS) training on nurses' knowledge and cardiopulmonary resuscitation (CPR) performance. The study was conducted at a large tertiary care hospital between July 1, 2025, and January 1, 2026. The training session lasted approximately 45 minutes and included both theoretical and practical components.

Participants

Participants were recruited from nurses attending the hospital's annual in-service education program. The BLS training session was part of the institutional continuing education activities for nursing staff. All nurses attending the training were informed about the study, and participation in the research component was voluntary. Only nurses who provided informed consent were included.

A total of 321 nurses working in different clinical units participated. Demographic data including age, gender, education level, working unit, and duration of professional experience were collected. Participants were also asked about previous experience with critical patient management, CPR performance, and prior BLS training.

Ethical approval was obtained from the Non-Interventional Ethics Committee (Approval No: 2025/298).

Training Procedure

Participants attended a standardized 45-minute BLS training session conducted by a certified instructor according to European Resuscitation Council (ERC) 2021 guidelines. The training included recognition of cardiac arrest, activation of the emergency response system, use of an automated external defibrillator (AED), and correct chest compression and ventilation techniques.

Following the theoretical component, the instructor demonstrated CPR techniques on a training manikin (AmbuMan® Basic CPR training manikin). The procedure was first demonstrated without explanation and then repeated with step-by-step instruction. Participants subsequently performed CPR individually on the manikin as part of a simulation-based assessment.

Knowledge Assessment

Theoretical knowledge was assessed using a 10-item questionnaire administered before and after training. The questionnaire was developed based on ERC 2021 resuscitation guidelines and previously published literature. Content validity was reviewed by three ERC-certified instructors.

Each correct answer was scored as 1 point, with total scores ranging from 0 to 10. For additional analysis, knowledge scores were categorized as low (0–4), moderate (5–7), and high (8–10).

CPR Skill Assessment

CPR skills were evaluated immediately after training using a simulation-based cardiac arrest scenario performed on an AmbuMan® Basic CPR training manikin equipped with a compression depth indicator.

Each participant managed the first two minutes of the simulated cardiac arrest scenario individually. Performance was assessed by two certified instructors using a structured 10-item checklist covering key BLS steps, including scene safety assessment, responsiveness check, breathing assessment using the look–listen–feel method, calling for help, requesting an AED, correct hand

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placement, appropriate compression rate (100–120/min), adequate compression depth (5–6 cm), full chest recoil, continuous compressions, and effective ventilation.

Compression depth was assessed using the manikin's built-in indicator and compression rate was monitored using a metronome. Each correctly performed step was scored as 1 point (range: 0–10). In case of scoring disagreement, the final score was determined by consensus. Scores ≥8 were classified as successful CPR performance.

The study followed the STROBE guidelines for reporting observational studies.

Statistical Analysis

Statistical analyses were performed using SPSS software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and categorical variables as number and percentage. Pre- and post-training knowledge scores were compared using the paired samples t-test, and effect size was calculated using Cohen's d.

Associations between categorical variables were analyzed using the chi-square test, and relationships between continuous variables were assessed using Pearson correlation analysis. Factors associated with successful CPR performance were evaluated using binary logistic regression, with results presented as odds ratios (OR) and 95% confidence intervals (CI). Receiver operating characteristic (ROC) analysis was performed to assess the predictive ability of post-training knowledge scores for CPR success. A $p < 0.05$ was considered statistically significant.

Results

Participant Characteristics

A total of 321 nurses participated in the study. The mean age was 27.8 ± 4.3 years, and most participants were female (82.6%). The mean professional experience was 44.7 ± 50 months. Most participants worked in adult inpatient wards (67.6%). Approximately one-third had never performed CPR (34.3%), and 28.7% reported no previous BLS training. Additional participant characteristics are presented in Tables 1 and 2.

Table 1. Demographic Characteristics of Participants (n = 321).

Variable	n (%) / Mean ± SD
Age (Years)	27.8 ±4.3
Gender n (%)	
Female	265 (82.6)
Male	56 (17.4)
Education Level	
High school	20 (6.2)
Bachelor's degree	272 (84.7)
Master's degree	28 (8.7)
Professional experience (months)	44.7 ±50
Working Unit	
Adult inpatient ward	217 (67.6)
Adult intensive care unit	46 (14.3)
Pediatric inpatient ward	24 (7.5)
Pediatric intensive care unit	46 (14.3)
Emergency department	3 (0.9)
Operating room	6 (1.9)
Palliative care unit	2 (0.6)
Other	6 (1.9)

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Continuous variables are presented as mean ± standard deviation (SD), and categorical variables are presented as number and percentage

Table 2. Previous Clinical Experience and BLS Training.

Variable	n (%)
Previous experience managing critically ill patients	
Never	51 (15.9)
At least once per year	116 (36.1)
At least once per month	83 (25.9)
At least once per week	34 (10.6)
Other	37 (11.5)
Previous CPR performance	
Never	110 (34.3)
At least once per year	101 (31.5)
At least once per month	49 (15.3)
At least once per week	33 (10.3)
Other	28 (8.7)
Previous BLS simulation training	
None	92 (28.7)
Yes, within the last 6 months	12 (3.7)
Yes, 6–12 months ago	4 (1.2)
Yes, more than 1 year ago	97 (30.2)

Values are presented as number (percentage). CPR = cardiopulmonary resuscitation; BLS = basic life support.

Effect of Training on Knowledge

The mean knowledge score increased significantly after training (2.9 ± 1.6 vs. 4.2 ± 1.1, $p < 0.001$), with a large effect size (Cohen's d = 0.97) (Table 3).

Table 3. Pre- and Post-Training Knowledge Scores.

Variable	Mean ± SD	p value	Effect Size
Pre-training knowledge score	2.9 ± 1.6	< 0.001	Cohen's d = 0.97
Post-training knowledge score	4.2 ± 1.1		

Values are presented as mean ± standard deviation (SD). Pre- and post-training knowledge scores were compared using the paired samples t-test. Effect size was calculated using Cohen's d.

CPR Performance and Knowledge Association

Overall, 81.3% of participants achieved successful CPR performance (≥8 points). The proportion of successful CPR increased with higher knowledge levels ($\chi^2 = 6.77$, $p = 0.034$). Post-training knowledge scores were weakly but significantly correlated with CPR success ($r = 0.179$, $p = 0.001$). Professional experience was not associated with CPR success ($p = 0.917$).

Multivariable and ROC Analysis

Participants who achieved successful CPR had significantly higher post-training knowledge scores (4.39 ± 1.14 vs. 3.87 ± 1.03, $p = 0.001$). Logistic regression analysis identified post-training knowledge score as an independent predictor of CPR success (OR = 1.56, 95% CI: 1.13–2.16, $p = 0.007$). Working unit and previous manikin-based training were also significant predictors (Table 5). ROC analysis showed that post-training knowledge score had a modest predictive ability for CPR success (AUC = 0.62, 95% CI: 0.54–0.70, $p = 0.002$).

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Table 5. Multivariable Logistic Regression Analysis of CPR Success.

Variable	OR (Exp(B))	95% CI	p value
Age	1.041	0.917–1.182	0.537
Gender	0.695	0.324–1.490	0.350
Professional experience (months)	0.998	0.988–1.009	0.764
Working unit	1.272	1.044–1.550	0.017
Previous manikin-based training	0.674	0.470–0.966	0.032
Pre-training knowledge score	1.005	0.796–1.268	0.969
Post-training knowledge score	1.562	1.128–2.163	0.007

Multivariable logistic regression analysis was performed to identify factors associated with successful CPR performance. Results are presented as odds ratios (OR) with 95% confidence intervals (CI). A p-value < 0.05 was considered statistically significant.

Discussion

The present study evaluated the impact of a basic life support (BLS) training program on nurses' knowledge and cardiopulmonary resuscitation (CPR) performance using a simulation-based assessment. The findings demonstrated that the training program significantly improved participants' theoretical knowledge. In addition, higher post-training knowledge scores were associated with a greater likelihood of successful CPR performance during the simulation scenario. These results suggest that structured BLS training can contribute to both knowledge acquisition and practical resuscitation competence among nurses. Understanding the relationship between theoretical knowledge and CPR performance may provide valuable insights for the development of effective continuing education strategies in clinical practice.

Education and regular training are considered essential components of effective resuscitation systems. The European Resuscitation Council (ERC) education guidelines emphasize that nurses and other healthcare professionals who care for patients at risk of cardiac arrest should receive structured resuscitation training [7]. Participation in accredited life support courses is recommended for healthcare providers responsible for advanced resuscitation care. In particular, nurses involved in adult cardiac arrest management are encouraged to attend accredited Advanced Life Support (ALS) courses. Evidence also indicates that participation in accredited resuscitation training programs among healthcare professionals is associated with improved patient outcomes, including increased survival after cardiac arrest [8,9]. In line with these recommendations, evaluating the effectiveness of resuscitation training programs and their impact on both knowledge acquisition and practical resuscitation performance remains an important area of investigation.

Another important finding of this study was the significant association between post-training knowledge scores and CPR performance. Participants with higher theoretical knowledge scores were more likely to perform successful CPR during the simulation scenario. This finding suggests that cognitive understanding of the BLS algorithm may play a critical role in the correct execution of resuscitation steps. Although CPR is primarily considered a psychomotor skill, adequate theoretical knowledge may facilitate correct decision-making, proper sequencing of interventions, and adherence to guideline-based resuscitation practices during cardiac arrest situations. Previous studies have also suggested that healthcare professionals with higher levels of resuscitation knowledge demonstrate better adherence to recommended CPR techniques and algorithms [5,10]. Therefore, strengthening theoretical knowledge through structured educational programs may contribute to improved practical resuscitation performance among nurses.

Interestingly, previous clinical experience variables were not significantly associated with CPR success in this study. Age, professional experience, previous exposure to critically ill patients, and prior CPR performance did not significantly influence participants' performance during the simulation-based assessment. One possible explanation for this finding is that all participants received the same standardized training immediately before the evaluation, which may have reduced potential differences related to clinical background and allowed participants with varying levels of experience to perform the resuscitation steps according to the same algorithm-based approach. Clinical exposure alone may not necessarily translate into correct adherence to resuscitation guidelines, as healthcare professionals may encounter cardiac arrest situations in clinical practice but may not consistently follow guideline-recommended practices without structured and updated training. Therefore, standardized educational interventions may play a more important role than prior clinical exposure in ensuring consistent CPR performance.

The simulation-based nature of the assessment may also have contributed to minimizing differences related to previous experience. Simulation provides a controlled and safe learning environment in which healthcare professionals can practice resuscitation skills without risk to patients. In addition to improving technical skills, simulation-based training allows participants to apply theoretical knowledge in a structured scenario that closely resembles real clinical situations. Using structured checklists and objective indicators such as compression depth and rate enables standardized evaluation of CPR performance and facilitates assessment of adherence to resuscitation guidelines. For these reasons, simulation-based training and assessment may be valuable tools for evaluating the effectiveness of educational interventions aimed at improving resuscitation competence among healthcare professionals.

In the present study, participants who had received BLS training within the previous 6–12 months appeared to demonstrate slightly higher CPR success rates compared with other groups. However, the number of participants in this subgroup was very small, which limits the ability to draw firm conclusions from this observation. The optimal interval for resuscitation retraining remains an area of ongoing discussion in the literature, as several studies have shown that both knowledge and psychomotor CPR skills may decline over time after initial training [2]. The European Resuscitation Council (ERC) guidelines emphasize that maintaining resuscitation competence should not rely solely on infrequent large-scale training sessions. Instead, the guidelines recommend the use of spaced learning strategies consisting of shorter and more frequent training activities to reinforce knowledge and skills over time [7]. Such approaches may help healthcare professionals maintain resuscitation readiness and prevent skill deterioration between formal training sessions. Therefore, future educational programs may benefit from incorporating spaced learning models in addition to traditional training courses.

This study has several limitations that should be considered when interpreting the findings. First, the study was conducted in a single tertiary care hospital, which may limit the generalizability of the results to other healthcare settings. Second, CPR performance was evaluated in a simulation-based environment rather than during real clinical cardiac arrest events. Although simulation allows standardized and safe assessment of resuscitation skills, it may not fully reflect the complexity and stress of real-life resuscitation situations. Third, the study assessed knowledge and skills immediately after the training session; therefore, long-term retention of knowledge and CPR performance could not be evaluated. Finally, some subgroups included a small number of participants, particularly those who had received recent BLS training within the previous 6–12 months, which limits the strength of conclusions regarding the influence of training intervals.

The findings of this study have important implications for continuing nursing education and professional development programs. As nurses are often the first healthcare professionals to recognize and respond to cardiac arrest in hospital settings, maintaining both theoretical knowledge and practical resuscitation skills is essential. The results suggest that structured BLS training programs combined with simulation-based practice may enhance nurses' preparedness for cardiac arrest situations. Incorporating regular refresher training and spaced learning strategies into continuing professional development programs may help maintain resuscitation competence over time and support improved patient outcomes.

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Conclusions

In conclusion, the findings of this study demonstrate that basic life support training significantly improves nurses' theoretical knowledge and is associated with better CPR performance in a simulation-based assessment. These results highlight the critical role of structured educational programs in maintaining resuscitation competence among nurses. As nurses are often the first healthcare professionals to recognize and respond to cardiac arrest in hospital settings, ensuring that they possess up-to-date knowledge and practical resuscitation skills is essential for patient survival. Regular and structured continuing education programs, supported by simulation-based practice, may help strengthen nurses' preparedness for cardiac arrest situations and ultimately contribute to improved resuscitation outcomes and increased survival rates.

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Table 4. Factors Associated with CPR Success.

	Successful	Unsuccessful	p value
Age (years)	27.83 ± 4.49	27.72 ± 3.89	0.855
Professional experience (months)	44.57 ± 51.24	45.32 ± 44.59	0.917
Pre-training knowledge score	2.99 ± 1.66	2.58 ± 1.45	0.082
Post-training knowledge score	4.39 ± 1.14	3.87 ± 1.03	**0.001**
Gender			0.563
Female	217 (81.9)	48 (18.1)	
Male	44 (78.6)	12 (21.4)	
Education level			0.738
High school	222 (81.6)	50 (18.4)	
Bachelor's degree or higher	39 (79.6)	10 (20.4)	
Previous BLS training			0.312
No	78 (84.8)	14 (15.2)	
Yes	183 (79.9)	46 (20.1)	
Previous CPR experience			0.866
No	90 (81.8)	20 (18.2)	
Yes	171 (81.0)	40 (19.0)	
Previous critical patient management			0.835
No	42 (82.4)	9 (17.6)	
Yes	219 (81.1)	51 (18.9)	

Continuous variables are presented as mean ± standard deviation and were compared using the independent samples t-test. Categorical variables are presented as number (percentage) and were compared using the chi-square test. A $p < 0.05$ was considered statistically significant.

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