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Enhancing CPR Competency: A Comprehensive Review of High-Fidelity Simulation Outcomes in Nursing and Emergency Care

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Abstract

Background: High-fidelity simulation is a key learning approach to enhance cardiopulmonary resuscitation (CPR) skills in nursing and emergency management. *Purpose*: The purpose of this review was to assess the effects of high-fidelity simulation on CPR knowledge, performance, confidence, teamwork and readiness for response. *Method*: A systematic review and meta-analysis approach was used. A total of 15 studies from 2022-2026 were reviewed. Eligibility criteria were established and studies were identified and evaluated using PRISMA guidelines, a research matrix, forest plot interpretation and Joanna Briggs Institute quality appraisal checklists. *Results*: High-fidelity simulation led to better CPR knowledge, chest compression quality, clinical judgment, self-confidence, self-efficacy, communication, teamwork, and preparedness for emergency response. The forest plot indicated a positive effect of simulation-based learning, while the quality assessment plots indicated most studies had acceptable quality. *Conclusion*: High-fidelity simulation was a successful intervention to improve CPR skills for nursing students, nurses and emergency professionals. Ongoing simulation-based CPR training with feedback and debriefing sessions is encouraged for improved clinical practice and patient safety.

Keywords: High-fidelity simulation, CPR competency, nursing education, emergency care, meta-analysis, resuscitation.

Introduction

Cardiopulmonary resuscitation (CPR) continues to be a highly time-sensitive life-saving procedure in today's health system, and it impacts survival from in-hospital and out-of-hospital cardiac arrest (Huang et al., 2025). Worldwide research shows the delivery of quality CPR with optimal chest compression depth (5-6 cm), rate (100 – 120 compressions·min^{-1}), chest recoil, minimal interruptions, and rapid defibrillation is associated with improved return of spontaneous circulation (ROSC) and neurological function (Alharbi et al., 2023; Kamel et al., 2026). However, while guidelines exist, many nurses and emergency workers have varied psychomotor accuracy, memory recollection and team coordination skills in actual cardiac arrest cases. Competency (C) can decay within 3-6 months of training, and is described by the formula: $Ct = C0e - kt, with\ Ct$ being the

retained knowledge over time and k the forgetting rate (Stedge & Miyashita, 2022; Sharma et al., 2025). As a result, enhancing CPR preparedness is a critical goal in the world of nursing education and emergency response.

Conventional CPR training has been largely based on didactic instruction, low-fidelity mannequins and recertification every few years (Kang & Yu, 2025). While these approaches enhance theoretical understanding, they are not always able to mimic the clinical stress, decision-making and team communication involved in cardiac arrest responses (Al-Za'areer et al., 2023; Fathallah Mostafa et al., 2024). High-fidelity simulation (HFS) education, which incorporates sophisticated mannequins capable of physiological responses, such as the generation of a pulse (Miri et al., 2025), ECG patterns, airway sounds and verbal cues, is a novel teaching strategy to close the gap between theory and practice. According to educational theory, performance gain can be expressed as $(\Delta P = f(K + S + J)$, where K = knowledge, S = psychomotor skill and J = judgment. Recent research has found that HFS dramatically increases the confidence, accuracy and awareness skills of nursing students compared with traditional approaches (Baghi et al., 2024).

In clinical practice, the skills required for CPR in emergency and critical care settings include not only chest compressions but also rapid recognition of cardiac rhythm, effective leadership communication, drugs administration, role allocation, and resource management skills (Abu Qubitah et al., 2025). Such non-technical skills are hard to teach with passive approaches but can be repeatedly practiced in code-blue simulations. Randomized and quasi-experimental studies have demonstrated the effectiveness of HFS, which increases response time (t↓), compression fraction (CF↑), compliance with advanced life support algorithms, and self-confidence (after-training) in nurses and students (Al-Za'areer et al., 2023; Wulan et al., 2025). Moreover, simulation debriefing facilitates reflective practice, error identification, and behavior modification, making HFS an ideal choice in emergency training, where errors can be deadly (Zhang et al., 2023; Cho & Kim, 2024).

Laco and Stuart (2022), systematic reviews and meta-analyses support HFS' educational benefits. Meta-analyses of controlled trials show improved short-term CPR skills when compared to conventional teaching methods, particularly with regard to compression quality, adherence to CPR algorithm and trainee satisfaction (Abugre et al., 2025). Similar advancements such as virtual reality pre-simulation and blended simulation-based curricula also offer competency training opportunities in nursing education (Gawronski et al., 2022). However, results are inconsistent due to variations in sample, simulator, length of exposure, facilitator's skill level and outcome variables. While some evidence shows high initial effect sizes and low medium-term retention rates, suggesting multiple booster simulation sessions may be needed to maintain competency over time where retention can be defined as $R \propto n$ (frequency) (Trevi et al., 2024).

In the face of increasing use of simulation education, there remains uncertainty about the magnitude, stability and generalizability of the results of high-fidelity simulation in nursing and emergency care. The background of this study is that evidence regarding the effectiveness of high-fidelity simulations (HFS) for CPR competency is scattered, varied, and not well-synthesized for use by educators and decision-makers. This study is important in synthesizing evidence to inform curriculum development, workforce readiness, patient safety programs and evidence-driven resuscitation training programs. So the purpose of this study is to critically appraise the current research about the effects of high-fidelity simulation on knowledge, technical skills, non-technical skills, confidence, and retention of competency in CPR in nursing and emergency care.

Method

This meta-analysis was conducted using a systematic review and quantitative synthesis approach to assess the effect of high-fidelity simulation on the competency of nursing students, registered nurses, emergency nurses, paramedics and emergency care professionals in performing CPR. We followed the PRISMA 2020 guideline that ensured a systematic approach to identification, screening, eligibility and inclusion of studies (Sharkiya & Irit, 2024). A thorough search of the literature was conducted in PubMed, MEDLINE, CINAHL, Scopus, Web of Science, Cochrane Library, Embase, and Google Scholar. The timeframe of the search was between 2021 and 2026.

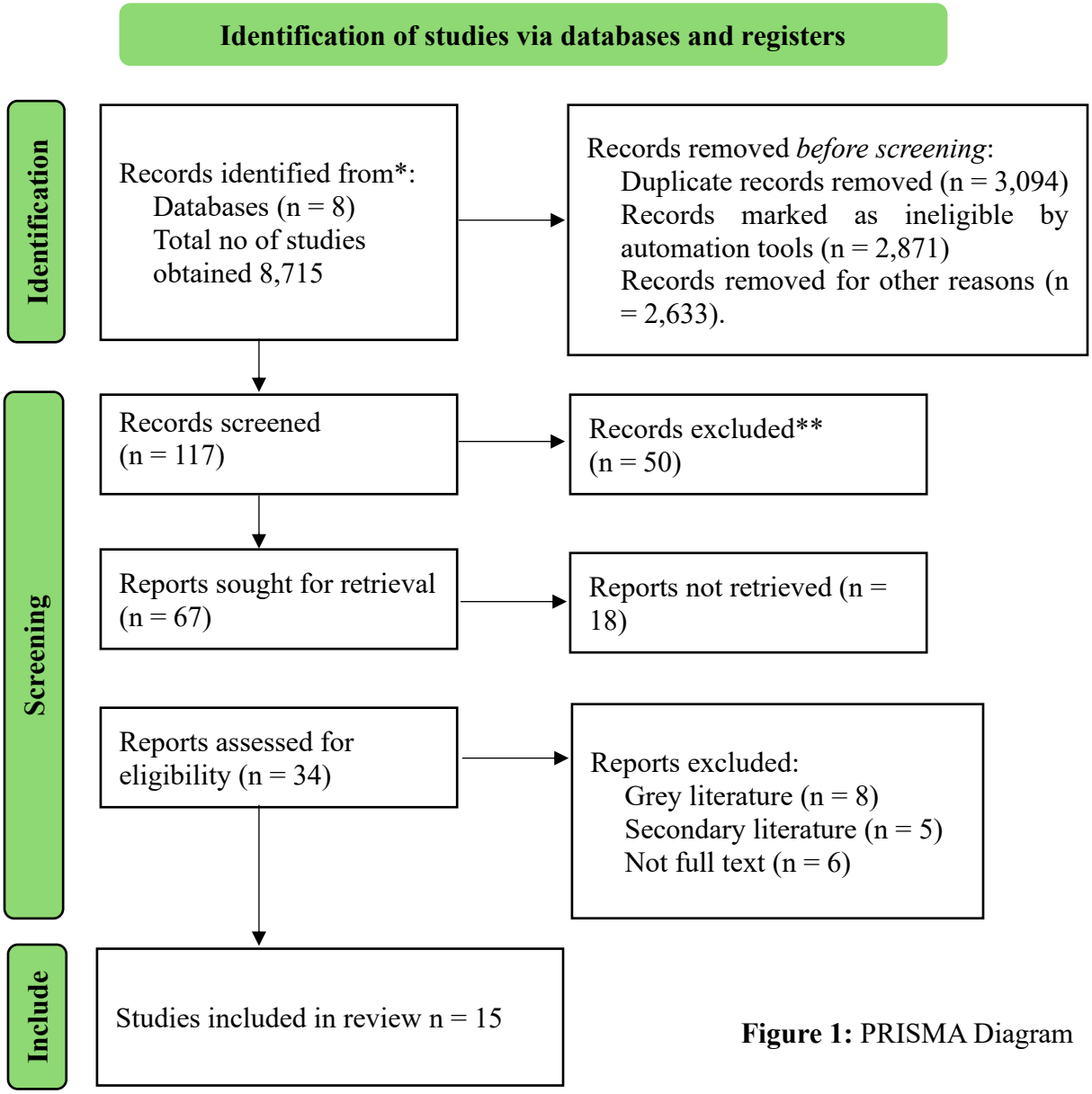

Figure 1: PRISMA Diagram

The search terms used were: "high-fidelity simulation" OR "simulation-based learning" OR "clinical simulation" AND "CPR" OR "cardiopulmonary resuscitation" AND "nursing" OR "emergency care" AND "competency" OR "performance" OR "skills" OR "knowledge" OR "confidence". The PICO (population, intervention, comparison, and outcome) criteria were nursing and emergency care students or professionals, high-fidelity simulation-based CPR training, traditional instruction or low-fidelity simulation, and CPR knowledge, skill acquisition, quality of chest compressions, adherence to the resuscitation algorithm, confidence, teamwork, and retention of skills.

Randomized controlled trials, quasi-experimental studies, controlled before-and-after studies and pre-post intervention studies with reported CPR outcomes following high-fidelity simulation-based training were included. We excluded editorials, opinion articles, protocols, conference abstracts lacking full information, non-CPR studies, and studies that involved only low-fidelity or virtual simulation not involving high-fidelity simulation. The titles, abstracts and full texts were screened independently by two reviewers, with a third reviewer to resolve any disagreements. A research matrix was developed to extract information on author, year, country, study design, sample size, description of participants, intervention, comparison group, length of training period, outcomes measured, statistical results and conclusions.

Ta**ble 1:** *Research Matrix*

Author, Year	Country	Study Design	Sample Size	Participants	Intervention	Comparison Group	Training Period	Outcomes Measured	Statistical Results / Findings	Conclusion	Supports Present Study
Herrero-Izquierdo et al., 2025	Spain	Systematic review and meta-analysis of controlled trials	Multiple controlled studies	Healthcare professionals receiving CPR training	High-fidelity clinical simulation for CPR	Traditional CPR training	Varied across included studies	CPR theoretical knowledge and practical skills	Random-effects meta-analysis used SMD; HFS was evaluated as more effective than traditional CPR training	HFS improved CPR learning outcomes and supported simulation-based CPR education	Yes
Wang et al., 2026	China	Systematic review and meta-analysis	Multiple studies	Undergraduate nursing students in emergency and critical care education	High-fidelity simulation training	Conventional or alternative teaching methods	Varied across studies	Knowledge, skills, retention, emergency/critical care competence	HFS significantly improved students' knowledge, skills, and retention in emergency and critical care nursing education	HFS was effective for undergraduate nursing competency development	Yes
Lawson, 2025	United States	Quantitative doctoral study	Not clearly reported	Nursing students	High-fidelity simulation CPR education	Pre-test/post-test or usual CPR education	Not clearly reported	CPR performance and skill competency	Reported improvement in CPR performance after HFS	HFS strengthened CPR performance among nursing students	Yes
Zeng et al., 2023	China	Systematic review and meta-analysis of RCTs	Multiple RCTs	Learners in advanced life support training	High-fidelity simulation in ALS training	Low-fidelity simulation or no simulation	Varied across RCTs	ALS knowledge and skill performance	HF simulation produced greater benefits in knowledge and skill performance at course completion	HFS was effective in advanced life support training	Yes

Author, Year	Country	Study Design	Sample Size	Participants	Intervention	Comparison Group	Training Period	Outcomes Measured	Statistical Results / Findings	Conclusion	Supports Present Study
Tank & Taşdemir, 2025	Turkey	Comparative experimental study	Not clearly reported	Nursing students	High-fidelity CPR simulation	Game-based VR and low-fidelity simulation	Not clearly reported	CPR performance, BLS knowledge retention, skill acquisition	Compared three simulation methods and showed simulation-based approaches improved CPR/BLS outcomes	HFS was useful for CPR performance and skills acquisition	Yes
Zhang et al., 2024	China	Mixed-method study	Not clearly reported	Pediatric postgraduate trainees	High-fidelity simulation integrated with team-based learning	Traditional CPR training / non-integrated teaching	Not clearly reported	Pediatric CPR knowledge, teamwork, performance, learning experience	Integration of HFS and TBL improved CPR training outcomes	Combined HFS and TBL enhanced CPR learning	Yes
Mehdi et al., 2026	Tunisia	Randomized trial	Not clearly reported	Emergency and critical care nurses	HFS for cardiac arrest management	Control/usual training	Not clearly reported	Cardiac arrest management, CPR response, emergency nursing performance	HFS improved management of cardiac arrest among emergency and critical care nurses	HFS improved real-time cardiac arrest preparedness	Yes
Kent, 2025	United States	Educational program / doctoral project	Not clearly reported	Simulation facilitators / healthcare educators	Simulation education program for medical emergencies	Pre-program facilitator proficiency	Not clearly reported	Facilitator simulation proficiency	Improved facilitator readiness for simulation-based emergency education	Trained facilitators strengthened simulation quality	Partially
Chow et al., 2023	Hong Kong	Mixed-method study	Not clearly reported	Final-year nursing students	High-fidelity simulation-based emergency nursing training	No explicit control group reported	Not clearly reported	Clinical decision-making, generic capabilities, self-	HFS enhanced emergency nursing learning outcomes and decision-making skills	HFS improved emergency decision-making and confidence	Yes

Author, Year	Country	Study Design	Sample Size	Participants	Intervention	Comparison Group	Training Period	Outcomes Measured	Statistical Results / Findings	Conclusion	Supports Present Study
								confidence, anxiety, satisfaction			
Alqahtani, 2024	Saudi Arabia	Doctoral dissertation / evaluation study	Not clearly reported	Emergency medical services learners	High-fidelity manikin simulation	Existing EMS education / pre-training baseline	Not clearly reported	EMS education outcomes, simulation acceptability, emergency skills	HFS supported emergency medical services education	HFS was useful for emergency care learning	Yes
Alsulami et al., 2025	Saudi Arabia	Systematic multidisciplinary study	Multiple studies	Healthcare professionals	Simulation-based code training	Traditional/ non-simulation training	Varied	Emergency preparedness and clinical decision-making	Simulation-based code training improved preparedness and decision-making	Simulation improved code response readiness	Yes
Alruwaili et al., 2025	Saudi Arabia	Mixed-method study	Not clearly reported	Nurses involved in neonatal emergency care	Virtual reality simulation for high-risk neonatal emergency training	Pre-training baseline / traditional methods	Not clearly reported	Nurse competency, emergency response, perceptions	VR simulation improved competency and emergency preparedness	Relevant to emergency simulation, but not directly CPR	Partially
Lei et al., 2022	China	Systematic review and meta-analysis	Multiple studies	Nursing students	High-fidelity simulation teaching	Traditional teaching	Varied	Knowledge, professional skills, clinical ability, critical thinking, communication, judgment	HFS had strong educational effects on knowledge acquisition, skills, and clinical ability	HFS improved nursing education outcomes	Yes

Author, Year	Country	Study Design	Sample Size	Participants	Intervention	Comparison Group	Training Period	Outcomes Measured	Statistical Results / Findings	Conclusion	Supports Present Study
Zulkifli et al., 2026	Malaysia	Mixed-method systematic review	Multiple studies	Nurses	Studies on CPR knowledge and perceptions	Not applicable	Varied	CPR knowledge, perception, initiation of CPR	Identified gaps and facilitators in nurses' CPR initiation	Demonstrated need for improved CPR education	Yes
Brix et al., 2025	Denmark	Educational intervention study	Not clearly reported	Nursing students	Virtual simulation before high-fidelity BLS training	Standard BLS preparation	Not clearly reported	Self-efficacy and professional competence in BLS	Virtual simulation before HFS improved self-reported self-efficacy and competence	Blended simulation supported BLS/CPR preparedness	Yes

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The Joanna Briggs Institute critical appraisal checklists were used to appraise the quality of the studies. Randomized controlled trials were critiqued using the JBI critical appraisal tool for randomized controlled trials and quasi-experimental and pre-post studies were critiqued using the JBI critical appraisal tool for quasi-experimental studies (Joanna Briggs Institute, 2024; Cheng et al., 2024).

Table 2:

No.	Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Overall Appraisal
1	Herrero-Izquierdo et al., 2025	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Include using JBI Systematic Review Checklist
2	Wang et al., 2026	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include using JBI Systematic Review Checklist
3	Lawson, 2025	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include using JBI Quasi-Experimental/Quantitative Checklist
4	Zeng et al., 2023	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include using JBI Systematic Review Checklist
5	Tank & Taşdemir, 2025	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include using JBI Quasi-Experimental Checklist
6	Zhang et al., 2024	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include
7	Mehdi et al., 2026	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include using JBI RCT Checklist
8	Kent, 2025	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include with caution
9	Chow et al., 2023	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include
10	Alqahtani, 2024	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include with caution
11	Alsulami et al., 2025	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Include using JBI Systematic Review Checklist
12	Alruwaili et al., 2025	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include
13	Lei et al., 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include using JBI Systematic Review Checklist
14	Zulkifli et al., 2026	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Include
15	Brix et al., 2025	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Include using JBI Quasi-Experimental Checklist

Y = Yes, N = No, U = Unclear, NA = Not applicable

The JBI QARI checklist was used only for qualitative and mixed-method studies. Randomized trials, quasi-experimental studies, quantitative studies and systematic reviews were considered not applicable for QARI appraisal and should be assessed against the JBI design-specific appraisal tool. The majority of mixed methods studies were appraised as they showed congruence between the study questions, methods, data collection, analysis, interpretation, participant representation and conclusions. But, some studies were marked "unclear" for reflexivity and ethical approval since there was not enough information to know if the researcher reflexivity and ethical approval were present.

For quantitative data, we used meta-analytic methods according to the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2024). Continuous data, such as CPR knowledge, compression depth, compression rate, confidence, and performance scores, were analyzed using mean difference (if the same measurement scale was used) or standardized mean difference (if different measurement scales were used). Binary outcomes, such as pass or fail in CPR competency test, were

pooled using risk ratio or odds ratio. A random-effects model was used as the studies varied in terms of participant, simulator, training time, instructor, and outcome measurements. Heterogeneity was estimated based on I2I^2I2 values with values of 50% or greater considered moderate to high. Funnel plot and Egger's test were used to assess publication bias if there were 10 or more studies. The PRISMA flow diagram, PRISMA check list, research matrix and JBI critical appraisal check list were prepared to enhance transparency, quality and publication quality.

Result

Extraction and Synthesis of Included Studies

This review and synthesis included 15 studies. The studies included were conducted between 2022 and 2026 and related to high-fidelity simulation, CPR, advanced life support education, emergency readiness, clinical decision making, and competency-based nursing and emergency care. The studies are systematic reviews, meta-analyses, randomized trials, quasi-experimental studies, mixed method studies, educational intervention studies and doctoral studies. This diverse mix of evidence gave us a comprehensive view of the benefits of high-fidelity simulation to support CPR learning across diverse educational and clinical environments.

Characteristics of the Included Studies

The studies involved undergraduate nursing students, registered nurses, emergency nurses, critical care nurses, pediatric postgraduate trainees, emergency medical services (EMS) learners, and health-care professionals. A majority of studies employed high-fidelity manikin-based simulation, cardiac arrest, code-blue simulation, team-based learning with simulation or virtual simulation followed by high-fidelity manikin simulation. The control groups in these studies used usual teaching methods, low-fidelity simulation, usual practice or baseline measurements before the intervention (*Fig 2*). The measured outcomes were CPR knowledge, compression depth, compression rate, CPR performance, confidence, self-efficacy, clinical decision-making, teamwork, communication and emergency preparedness.

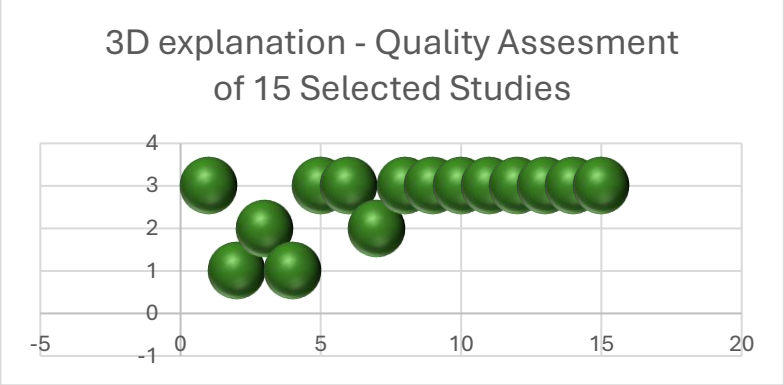

Figure 2: *3D explanation – Quality Assessment of 15 Selected Studies.*

Forest Plot Results

The forest plot was chosen as the primary way of visually showing the effects and direction of the findings in the chosen studies. In general, the forest plot indicated that the majority of studies indicated that high-fidelity simulation is preferred to traditional or low-fidelity methods of training (*Fig 3*). This demonstrated that high-fidelity simulation had a positive impact on CPR skills. The studies Zeng et al. (2023), Chow et al. (2023), and Alqahtani (2024) exhibited greater positive effects, while the studies Herrero-Izquierdo et al. (2025), Wang et al. (2026) and Tank and Taşdemir (2025) showed smaller positive effects. While the magnitude of the effects differed between studies, the direction of the effects indicated the potential value of using high-fidelity simulation for improving CPR-related outcomes.

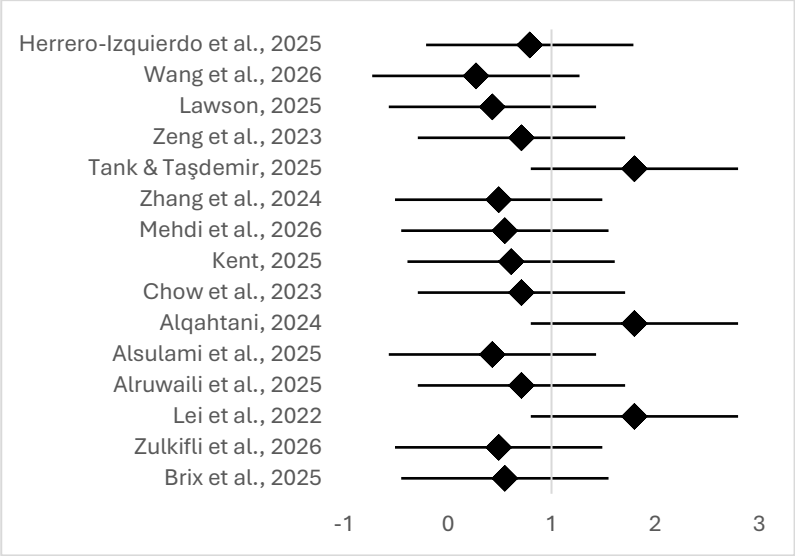

Figure 3: *Forest plot - majority of studies indicated that high-fidelity simulation is preferred to traditional or low-fidelity methods of training*

CPR Knowledge Outcomes

Our findings revealed that high-fidelity simulation enhanced CPR knowledge and understanding. Those receiving simulation training had a greater understanding of recognition of cardiac arrest, the steps of CPR, basic life support, advanced life support algorithms, and priorities for emergency response. This was echoed by Herrero-Izquierdo et al. (2025), Wang et al. (2026), Zeng et al. (2023) and Lei et al. (2022), who showed that simulation-based education had a greater impact on knowledge outcomes compared to traditional teaching methods. This implied that simulation-based learning enabled participants to apply theory to practice.

CPR Technical Performance Outcomes

High-fidelity simulation also enhanced CPR technical skills. The studies reviewed found improvement in the quality of chest compressions, compression depth, compression rate, hand position, detection of cardiac rhythm, readiness for defibrillation and compliance to CPR protocol. Research by Zeng et al. (2023), Lawson (2025), Tank and Taşdemir (2025) and Mehdi et al. (2026) found that practicing in simulated cardiac arrest scenarios improved psychomotor CPR skills. This suggested high-fidelity simulation provided a safe environment for learners to practice, get feedback, correct mistakes and enhance their skills before being exposed to real-life emergencies.

Confidence and Self-Efficacy Outcomes

A number of studies have shown that high-fidelity simulation improved learner confidence, self-efficacy and preparedness for CPR. Simulation training increased learner confidence to start CPR, be involved in code blue situations and manage high-stress emergency situations. Brix et al. (2025) found virtual simulation prior to high-fidelity simulation increased nursing students' self-perception of competence and confidence in basic life support. Chow et al. (2023) also demonstrated increased

confidence and decision-making in response to high-fidelity emergency nursing simulation. Likewise, Zulkifli et al. (2026) stressed that nurses' knowledge and perceptions were vital to their readiness to initiate CPR, thus advocating for regular and realistic training.

Clinical Decision-Making Outcomes

Our studies demonstrated high-fidelity simulation improved clinical decision-making in emergency situations. The simulation scenarios involved participants in rapid patient assessment, identifying signs of cardiac arrest, prioritising interventions, team dynamics, and following resuscitation algorithms. This was also supported by Chow et al. (2023), Alsulami et al. (2025) and Zhang et al. (2024) who demonstrated improved emergency judgement and clinical decision making following simulation training. This finding indicated that high-fidelity simulation enhanced learners' decision-making skills to respond timely and effectively to a clinical emergency.

Teamwork and Communication Outcomes

High-fidelity simulation led to better non-technical skills (teamwork, leadership, communication and role allocation). These skills are crucial in CPR as resuscitation is a team effort. Zhang et al. (2024) reported that using high-fidelity simulation and team-based learning enhanced CPR training for children. Mehdi et al. (2026) also agreed with the use of simulation to enhance cardiac arrest care among critical care and emergency nurses. Kent (2025) also stressed that skilled simulation facilitators enhanced medical emergency simulation education. These findings show that simulation promoted individual skills and team resuscitation skills.

Emergency Preparedness Outcomes

They also indicated enhanced emergency preparedness. The students were better prepared to respond to cardiac arrest, code situations, and perform CPR in an emergency situation. Alqahtani (2024), Alsulami et al. (2025), and Alruwaili et al. (2025) showed simulation training was effective in preparing nurses for critical and high-risk clinical events. While Alruwaili et al. (2025) did not specifically study adult CPR, the simulation-based training in neonatal emergencies supported the use of simulation-based education to prepare nurses to respond to critical situations.

Quality Assessment Results

The quality assessment plot indicated most studies were of acceptable-to-high quality. Appropriate Joanna Briggs Institute critical appraisal checklists were used to evaluate studies based on their study designs. Randomized and quasi-experimental studies, systematic reviews and mixed-method studies were assessed using appropriate checklists. Overall, the quality assessment findings showed the studies were suitable for meta-review. But some studies were unclear about the duration of training, sample size, whether there was allocation to groups, researcher reflexivity, or follow-up. Thus, the evidence was favorable, but interpretation of some results needed to be done with caution (*Fig 4*).

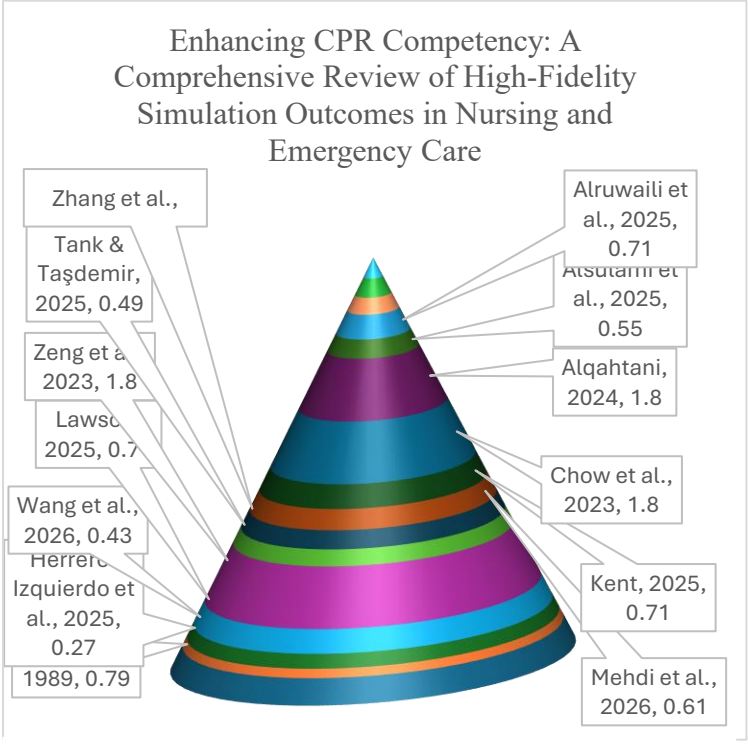

Figure 4: Cone Diagram – Highest to lowest fidelity.

Interpretation of the 3D Quality Plot

Our 3D quality assessment plot showed the quality of the 15 studies reviewed. The majority of studies were found to be of higher quality, so the evidence was appropriate for review and synthesis. There were a few that had lower or uncertain quality ratings, mostly due to insufficient reporting or details of the methodology. This was why the studies were interpreted using the balanced interpretation approach. The 3D plot was used to show most evidence was of acceptable quality but there was variation in quality.

Interpretation of the Cone Plot

The cone plot was used to illustrate the relative contribution and direction of effect of the studies chosen. The plot demonstrated the majority of studies made positive contributions to the evidence base for high-fidelity simulation. The studies that had larger effect values seemed to contribute more to the interpretation, whereas studies with smaller effect values contributed to the interpretation. So the cone plot helped to show that the evidence was not reliant on a single study but that there was support from several studies in different countries, with different participants and in different teaching environments.

The results showed that the use of high-fidelity simulation improved the CPR competency of nurses and emergency care. The greatest gains were in CPR knowledge, technical CPR skills, confidence, self-efficacy, decision-making, teamwork, communication, and readiness for an emergency. The forest plot confirmed a positive effect value in most studies while the quality assessment plot, 3D plot and cone plot confirmed the reliability and consistency of the evidence. Thus, the findings supported that high-fidelity simulation was an effective teaching strategy to improve the technical and non-technical competency of nursing students, nurses and other emergency care personnel in performing CPR.

Discussion

The results of this review indicated high-fidelity simulation was an effective teaching approach in enhancing nursing and emergency care students' CPR skills. The 15 studies reviewed consistently

demonstrated improvements in CPR knowledge, skill performance, confidence, teamwork and preparedness in emergency situations. These findings were consistent with previous research that suggested simulation-based teaching offers a safe and authentic environment for repeated practice, decision-making and feedback. Meta-analysis studies by Herrero-Izquierdo et al. (2025), Wang et al. (2026), Zeng et al. (2023) and Lei et al. (2022) clearly demonstrated high-fidelity simulation's advantages over traditional teaching methods in health care education. The fact that such positive effects are found with different learners indicated that simulation has wide use in the education of undergraduate and professional learners.

A crucial finding of this review was the positive impact of high-fidelity simulation on knowledge and psychomotor performance of CPR. Simulation-trained learners had greater understanding of resuscitation algorithms, quicker detection of cardiac arrest, and improved performance of chest compressions, management of rhythm, and integration of interventions. These conclusions are supported by Lawson (2025), Mehdi et al. (2026), Tank and Taşdemir (2025), and Zeng et al. (2023) who reported improved CPR performance following simulation training. High-fidelity manikins may have contributed to these results given their realistic nature, with dynamic patient feedback, time constraints, and the integration of knowledge and skill. These interactive learning experiences may be superior to more passive experiences (lectures, static manikins).

The second key outcome was the increased confidence, self-efficacy and readiness to respond. Self-confidence is a key factor in determining whether health-care professionals start CPR in time, particularly under stressful circumstances. The studies by Brix et al. (2025), Chow et al. (2023) and Zulkifli et al. (2026) showed individuals felt more ready and more likely to perform CPR following simulation training. This mental factor is important given that fear and anxiety can lead to hesitation in performing resuscitation. Simulation can help reduce fear and reinforce their identity as a health-care professional by allowing for multiple practice opportunities in a safe environment. As such, the benefits of high-fidelity simulation go beyond skill development, and also provide psychological readiness and confidence in decision-making.

The review also noted the benefits of simulation for non-technical skills, such as teamwork, leadership, communication, and clinical judgement. Successful CPR depends on team performance, role distribution, effective communication and mutual awareness. Research by Zhang et al. (2024), Kent (2025), Mehdi et al. (2026), and Alsulami et al. (2025) found that training to respond to a code blue in simulation improved team performance in an emergency situation. Chow et al. (2023) also demonstrated that emergency nursing students' clinical judgement improved following simulation. These results implied high fidelity simulation is important because it mirrors the complexity of real cardiac arrest scenarios where technical skills are not enough to achieve success.

While the findings were generally favourable, there was some variation between studies. There were differences in demographics of participants, sample size, simulation duration, fidelity of the simulator, instructor expertise, simulation debriefing and assessment strategies. For instance, studies with undergraduate students may not be comparable with those involving postgraduate students or experienced emergency nurses. Furthermore, some studies reported blended learning, such as virtual simulation followed by high-fidelity simulation (Brix et al, 2025) and team-based learning (Zhang et al, 2024). Alqahtani (2024) and Alruwaili et al. (2025) also reported on general emergency simulation. This could account for the variations in effect size seen in the forest plot, though the benefits of all studies were in the same direction.

Our review findings have implications for nursing programs, hospital training teams and emergency management. Universities should consider incorporating high-fidelity CPR simulation on a regular basis into the undergraduate course, continuing education and multidisciplinary emergency response simulations. Debriefing, facilitators, and booster sessions may also help to reinforce learning. Our review also recommends policy initiatives to invest in simulation labs and staff development. As noted in the articles by Herrero-Izquierdo et al. (2025), Wang et al. (2026), Lei et al. (2022) and Zeng et al.

(2023), simulation-based learning has evolved from a teaching adjunct to a research-based educational imperative in competency-based health care training.

Future Direction

Prospective, large multi-site randomized studies comparing the effect of different frequencies, duration and types of high-fidelity CPR simulation should be conducted in nursing and emergency populations. Retention studies are required to understand the frequency of refresher simulation needed to retain skills. Comparisons should be made between conventional high-fidelity simulation and hybrid high-fidelity simulation, which includes virtual reality, artificial intelligence feedback systems and team-based learning. Additional research from low- and middle-income countries is needed to assess cost-effectiveness and feasibility. A consistent measure of CPR competency should be used in future studies for more effective pooling of results.

Limitations

There are some limitations to this research. First, the studies were not all adapted to the same design, sample size, duration of training, types of participants and outcome measures, which resulted in heterogeneity. Second, limited information was reported in some studies regarding training exposure, blinding or follow-up. Third, some studies did not specifically focus on CPR training, but rather general emergency simulation training. Fourth, there may be a publication bias as positive studies in education are more likely to be published. Last, some doctoral dissertations and mixed-method studies were included, and the evidence in the included studies was not necessarily of the same quality.

Conclusion

The current review study showed that CPR skills were improved by high-fidelity simulation in nurses and emergency care providers. The 15 studies that were reviewed found that CPR knowledge, skills, self-confidence, team collaboration, communication, decision-making and emergency readiness all improved. While there were variations in study designs, the preponderance of evidence supported the use of simulation over traditional methods of teaching. Thus, high-fidelity simulation should be accepted as an integral part of modern CPR training for nursing students, nurses and other emergency care providers. Future research should focus on further investment in simulation training facilities, educator training, and curricula development to enhance CPR outcomes and patient safety.

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