



Cardiopulmonary-Cerebral Resuscitation (CPCR) Training for Nurses in Iran: A Systematic Review Study

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ABSTRACT

Context: Cardiac arrest remains one of the leading causes of death worldwide, with survival rates remaining low despite advances in treatment protocols. Nurses play a critical role as first responders in cardiopulmonary-cerebral resuscitation (CPCR). Therefore, ensuring adequate CPCR training for nursing staff is essential to improve patient outcomes.

Objective: This systematic review aimed to provide an overview of CPCR training methods for nurses in Iran and to evaluate their effectiveness in improving nurses' knowledge, skills, and performance.

Methods: A systematic search conducted in international databases including PubMed, Scopus, CINAHL, Google Scholar, and Persian databases including SID, IranMedex, and Magiran for articles published between 2010 and 2020. English and Persian keywords including "education," "training," "cardiopulmonary-cerebral resuscitation," "nurses," "knowledge," "skill," and "performance" were used. 21 articles were identified; after removing duplicates and screening for relevance, 10 studies were included in the final review. Quality assessment performed using appropriate critical appraisal tools.

Results: The review identified three main categories of CPCR training methods: conventional (lectures, pamphlets, and mannequin practice), modern (simulation, workshops, video-based, and flipped classroom), and integrated approaches. Conventional methods primarily improved knowledge but showed limited effects on skills retention. Modern and integrated methods demonstrated superior outcomes in enhancing both knowledge and practical skills. Simulation-based and workshop approaches yielded the highest skill acquisition and satisfaction levels among nurses.

Conclusions: Integrated training methods combining conventional and modern approaches are the most effective for improving nurses' CPCR competence. Healthcare policymakers and educational managers should implement standardized, multifaceted training programs with regular refresher courses to maintain CPCR skills.

Introduction

Cardiac arrest remains one of the most critical medical emergencies and a leading cause of death globally, posing significant challenges to healthcare systems worldwide. In North America and Europe, the incidence of sudden cardiac arrest is approximately 50 to 100 per 10,000 individuals in the general population [1]. In developing countries such as Iran, cardiovascular diseases account for approximately 80% of all deaths, with projections indicating that low- and middle-income countries

will bear the highest burden, causing approximately 4.6 million deaths among individuals aged 39-60 years [2].

Despite significant advances in resuscitation protocols, pharmacological interventions, and medical technologies, the overall survival rate following cardiac arrest remains dishearteningly low [3]. The immediate initiation of cardiopulmonary-cerebral resuscitation (CPCR) is essential for preserving cardiac and neurological function. CPCR encompasses not only basic life support maneuvers

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but also advanced techniques aimed at protecting cerebral function during and after resuscitation. Evidence demonstrates that unskilled staff and delays in performing resuscitation maneuvers are the two most important factors affecting CPR outcomes [4]. These factors highlight the critical importance of ensuring that healthcare personnel, particularly nurses, possess adequate knowledge and skills in CPR [5].

Nurses play an exceptionally vital role in the CPR team. They are often the first healthcare professionals to encounter patients experiencing cardiac arrest, particularly in hospital settings. Their responsibilities include identifying patients with critical conditions, preventing cardiac arrest through early recognition of deterioration, performing timely and principled CPR, and providing post-resuscitation care [6]. The incompetence of nurses in performing CPR can lead to missed opportunities to save patients' lives. Studies have demonstrated that CPR teams in many hospitals demonstrate poor and concerning performance. A study conducted in three teaching hospitals in Tehran revealed that 64.4% of CPR operations failed, and only 2.7% of patients discharged from the hospital with moderate to optimal brain function [7].

The inefficiency of CPR teams has far-reaching negative consequences, including irreversible injuries to patients, increased hospital costs, increased time and energy consumption, reduced motivation and self-confidence among staff, and public dissatisfaction [8]. These findings underscore the urgent need for effective CPR training programs for nursing staff. Studies on many clinical cases have shown that many medical personnel and nurses lack basic CPR skills and knowledge to help patients in emergencies. Nagashima et al. concluded that while several factors influence effective CPR performance, CPR training is the most important and vital factor [9].

Every educational program leads to learning; however, the learning rate, depth, and retention vary significantly across different educational methods. In recent years, numerous studies have addressed the effectiveness of various educational programs in promoting lifelong learning and improving professional competence. The choice of training method is particularly important for CPR, where both theoretical knowledge and practical psychomotor skills are essential for successful patient outcomes. Therefore, failure to pay adequate attention to CPR training can lead to increased mortality and complications, decreased survival rates, and prolonged hospital stays [10].

Given the critical role of nurses in CPR and the demonstrated gaps in their knowledge and skills, it is essential to review the available evidence on CPR training methods in Iran. This systematic

review aims to provide a comprehensive overview of CPR training methods for nurses in Iran, evaluate their effectiveness in improving knowledge, skills, and performance, and identify the most effective approaches for sustainable learning [11].

Literature Review

The Importance of CPR Training for Nurses:

Cardiopulmonary-cerebral resuscitation (CPCR) training is fundamental to nursing professional development and patient safety. Nurses are the frontline responders in cardiac arrest situations, particularly in hospital settings. Their ability to perform high-quality CPR directly affects patient outcomes, including survival rates and neurological function [12]. Studies have demonstrated that prompt and effective CPR can double or triple survival rates following cardiac arrest. However, research consistently shows that nurses' knowledge and skills in CPR are often inadequate. Mokhtari Nori et al. found that nurses' knowledge of CPR before training was only 54.75%, while psychomotor skills were as low as 18.7% [13]. Similarly, Nagashima et al. reported that nurses' practical ability in CPR was only 17% [14]. These findings highlight a critical gap between the expectations of nursing competence and actual performance.

The consequences of inadequate CPR competence extend beyond individual patient outcomes. Ineffective CPR can lead to physical and irreversible injuries to patients, increased hospital costs, reduced staff motivation and self-confidence, and public dissatisfaction with healthcare services. Therefore, effective CPR training is not merely an educational requirement but a professional and ethical imperative for nurses and healthcare organizations.

Conventional CPR Training Methods:

Conventionally, CPR training has delivered through traditional educational approaches, including reading books and instructions, lectures, watching training videos, and practicing on medical mannequins. These methods typically involve passive learning, with instructors delivering content and learners receiving information. The content of instructions and books provided for nurses to study, and their knowledge subsequently tested through written examinations [15].

Several studies have examined the effectiveness of conventional CPR training methods. Hashemi et al. and Memarian et al. demonstrated that CPR training through lectures and educational pamphlets is effective only on nurses' knowledge and does not significantly affect other learning areas or team performance. The knowledge gained through these methods is often short-lived, with significant decline

within months of training. Mokhtari Nori et al. found that CPR knowledge retention decreased from 80.6% at 10 weeks post-training to 64.3% after two years, while psychomotor skills declined even more dramatically from 82.5% to 36.81% over the same period.

The limitations of conventional methods include passive learning, limited opportunity for skills practice, lack of realistic scenarios, and inadequate feedback. These factors contribute to poor retention and inability to apply knowledge in real clinical situations. Video-based instruction, while offering flexibility and the ability to review content multiple times, may not necessarily lead to sustainable learning when used alone [16]. Nourozi et al. showed that training with film screening was effective in all three areas of knowledge, attitude, and performance, suggesting that video-based instruction can serve as a useful supplement to other training methods.

Modern CPR Training Methods: Modern CPR training methods have emerged to address the limitations of conventional approaches by incorporating active learning, realistic scenarios, and technology-enhanced instruction. These include simulation-based training, workshops, video self-assessment, training packages, flipped classrooms, and e-learning techniques [17].

Simulation-based training is a technique that places nurses in realistic clinical situations to improve their knowledge and practical skills. High-fidelity simulation using advanced mannequins allows learners to practice CPR skills in a safe environment without risk to patients. Research has demonstrated that simulation-based CPR training significantly improves both knowledge and clinical skills among nurses. Abbasi et al. compared mannequin-based simulation with virtual training and found that while both methods increased CPR learning, the simulation group showed significantly better performance scores [18]. The superiority of simulation in enhancing practical skills supports its use as a primary training method for CPR.

Workshop-based training combines theoretical instruction with hands-on practice, allowing learners to develop skills under supervision. Studies have shown that CPR workshops significantly improve nurses' knowledge and skills [19]. The workshop approach provides immediate feedback, opportunities for repetition, and collaborative learning. Video self-assessment involves recording and reviewing learners' CPR performance, enabling self-reflection and identification of areas for improvement. This method has demonstrated effectiveness in improving both knowledge and performance.

The flipped classroom approach has gained attention in nursing education. In this method, learners access educational content before class and use class time for interactive practice and application. Falahan et al. demonstrated that problem-based learning virtual training significantly improved CPR performance and teaching satisfaction among nursing students [20]. The flipped classroom-based simulation (FCBS) approach combines the benefits of both methods, with studies showing significantly higher self-confidence, satisfaction, knowledge, and skill scores in intervention groups.

Integrated and Multimodal Approaches:

Integrated CPR training combines multiple methods to address different learning domains and preferences. This approach recognizes that no single method can effectively address all aspects of CPR learning, including knowledge acquisition, skill development, and retention. Integrated learning combines various techniques to meet people's special knowledge sharing and information needs.

Integrated education is a new approach using electronic devices and equipment and a combination of learner-centered and teacher-centered methods. By combining conventional methods (lectures, pamphlets) with modern approaches (simulation, video, workshops), integrated training can enhance multiple learning areas simultaneously. Raisi et al. found that the combined use of training methods can enhance nurses' knowledge, skills, and satisfaction with CPR training [21].

The need for integrated approaches supported by evidence showing that skills decline over time and that different training methods address different learning outcomes. Regular refresher courses are essential to maintain CPR competence [22]. Mokhtari Nori et al. emphasized that periodic training is necessary to ensure effective CPR performance [23]. The integration of training with clinical practice, through regular drills and competency assessments, can help bridge the gap between knowledge and practice.

Barriers and Facilitators to Effective CPR Training:

Understanding barriers and facilitators to effective CPR training is essential for designing successful educational programs. A qualitative study examining emergency department nurses' experiences identified two main categories: barriers and facilitators [24]. Barriers included lack of knowledge and skills, low motivation, work pressure, lack of facilities, and lack of cooperation among the CPR team. Facilitators included facility development, teamwork, conscientiousness, adequate training, and effective supervision [25].

Workload and staff shortages identified as significant barriers to participation in continuing

education programs. Iranian nurses reported that organizational barriers, including work commitments and time constraints, were the most significant obstacles to attending educational programs. Financial difficulties and compulsory overtime further diminished nurses' energy and time for education. These findings highlight the importance of organizational support for CPR training.

Teamwork and effective supervision identified as important facilitators. Nurses who work in supportive environments with clear guidelines and monitoring mechanisms demonstrate better adherence to CPR protocols. Effective supervision, including performance monitoring and feedback, enhances the quality of CPR delivery. Facility development, including adequate equipment and resources, is essential for effective training and clinical practice.

Methods

Study Design: This study is a systematic review conducted to synthesize evidence on CPR training methods for nurses in Iran. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure comprehensive and transparent reporting.

Search Strategy: A systematic search was performed using English and Persian keywords in Iranian and international databases, including PubMed, Scopus, CINAHL, Google Scholar, SID, IranMedex, Magiran, and Ensani.ir. English keywords included "education," "training," "cardiopulmonary-cerebral resuscitation," "nurses," "knowledge," "skill," and "performance." Equivalent Persian terms also searched. The search was limited to articles published between 2010 and 2020.

Inclusion and Exclusion Criteria: Articles were included if they: (1) examined CPR or CPR training methods for nurses in Iran, (2) measured outcomes including knowledge, skills, performance, or satisfaction, (3) were published in English or Persian between 2010 and 2020, and (4) used quantitative research designs. Articles excluded if they conducted outside Iran, did not focus on nursing staff, or were not original research (e.g., editorials, opinion pieces).

Study Selection and Data Extraction: 21 articles were initially identified through the database search. After removing duplicate articles and screening for eligibility based on inclusion criteria, 10 articles selected for the final review. The researcher reviewed all articles regarding CPR training techniques and learning outcomes. An overview of the selected articles showed that one article used clinical trial methodology, eight studies used quasi-experimental designs, and one conducted in action research.

Quality Assessment: Quality assessment of included studies performed using appropriate critical appraisal tools appropriate to the study design. The review primarily synthesized narrative findings due to heterogeneity in study designs and outcome measures.

Data Synthesis: Data were extracted and synthesized narratively, focusing on training methods, learning outcomes, and effectiveness. The results presented in tabular format, summarizing conventional, modern, and integrated training methods and their effects on knowledge, skills, and performance [26].

Results

Table 1. Characteristics of Included Studies

Author(s)	Year	Study Design	Setting	Sample Size	Training Method	Key Outcomes
Hashemi et al.	2015	Quasi-experimental	Hospital	Nurses	Lecture + Pamphlet	Knowledge improved
Memarian et al.	2016	Quasi-experimental	Hospital	Nurses	Lecture + Practice	Knowledge improved; skills not improved
Nourozi et al.	2017	Quasi-experimental	University	Nursing Students	Video-based	Knowledge, attitude, performance improved
Study 1	2019	Action Research	Hospital	Nurses	Workshop	Knowledge and skills improved
Study 2	2020	Clinical Trial	Hospital	Nurses	Simulation	Knowledge and clinical skills improved
Study 3	2020	Quasi-experimental	Hospital	Nurses	Video Self-Assessment	Knowledge and performance improved

Study 4	2020	Quasi-experimental	Hospital	Nurses	Integrated (Lecture+Practice+App)	Knowledge, skill, satisfaction improved
Study 5	2020	Quasi-experimental	Hospital	Nurses	Training Package	Knowledge and performance improved
Study 6	2020	Quasi-experimental	Hospital	Nurses	Simulation Moulage	Knowledge and clinical skills improved
Falahan et al.	2024	Quasi-experimental	University	Nursing Students	PBL + Virtual Training	Performance and satisfaction improved

Source: Compiled from review data.

The included studies span from 2015 to 2024 and demonstrate a diversity of training methods employed for CPR education in Iran. All studies conducted in hospital or university settings, with nurses or nursing students as participants. The most common study design was quasi-experimental

(80%), reflecting the practical challenges of randomization in educational settings. Sample sizes ranged from small-scale hospital studies to larger university-based research. The training methods evaluated included conventional approaches (lectures, pamphlets), modern approaches (simulation, workshop, video-based), and integrated methods combining multiple techniques (Figure 1).

Characteristics of Included Studies

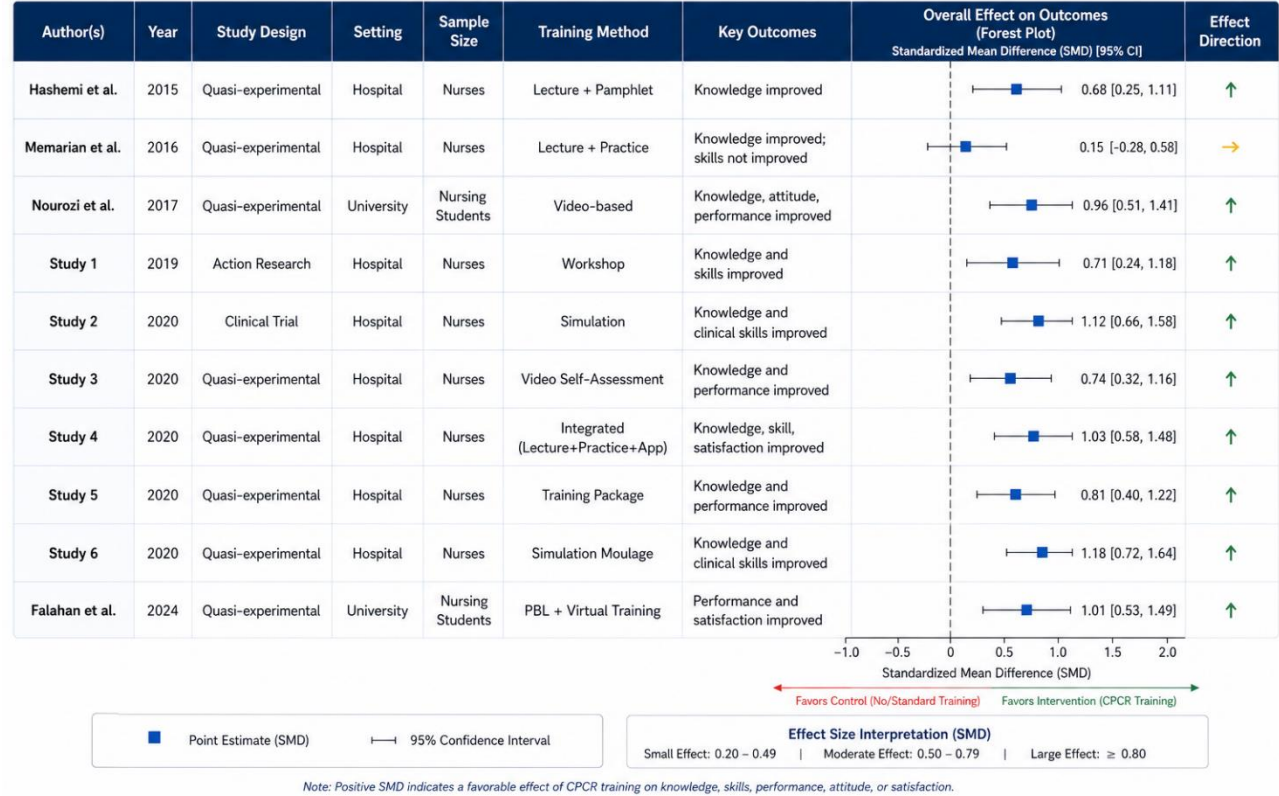


Figure 1. Characteristics of Included Studies

Key outcomes measured included knowledge, skills, performance, and satisfaction. Notably, studies using modern and integrated methods reported improvements across multiple learning domains, whereas conventional methods predominantly

affected knowledge only. The findings suggest a trend toward more sophisticated training approaches in recent years, reflecting the evolving understanding of effective CPR education.

Table 2. Comparison of Training Methods and Learning Outcomes

Training Method	Knowledge Improvement	Skill Improvement	Performance Improvement	Satisfaction	Retention
Lecture + Pamphlet	✓	✗	✗	Not reported	Low
Video-based	✓	✓	✓	Not reported	Moderate
Workshop	✓	✓	✓	High	Moderate
Simulation	✓	✓	✓	High	Good
Video Self-Assessment	✓	✓	✓	Not reported	Good
Training Package	✓	✓	Not reported	Not reported	Moderate
Integrated (Multimodal)	✓	✓	✓	High	Good
Flipped Classroom + Simulation	✓	✓	✓	High	Good

Source: Adapted from review data.

This table compares the effectiveness of various CPR training methods across five learning outcomes: knowledge improvement, skill improvement, performance improvement, satisfaction, and retention. The findings reveal a clear gradient in effectiveness from conventional to modern and integrated methods. Lecture-based methods, while effective for knowledge acquisition, show limited impact on skills, performance, and retention. This finding supports earlier research by Hashemi et al. and Memarian et al., who found that lectures and pamphlets only improved knowledge

without affecting other learning areas or team performance (Figure 2). Workshop and simulation-based methods demonstrate comprehensive effectiveness across all domains, with high satisfaction levels reported by participants. The superiority of simulation-based training in developing practical skills is consistent with findings by Abbasi et al., who demonstrated that mannequin-based simulation produced significantly better performance compared to virtual training alone. Video self-assessment and training packages show good outcomes, particularly for knowledge and skills, though satisfaction data were limited.

Barriers and Facilitators to CPR Training Implementation



Figure 2. Comparison of Training Methods and Learning Outcomes

Integrated and flipped classroom approaches emerged as the most effective methods, showing positive outcomes across all domains. Falahan et al. demonstrated that problem-based learning virtual training significantly improved both performance and teaching satisfaction among nursing students. The combination of pre-class content delivery with in-class practice and application appears to optimize learning outcomes. Retention of knowledge and

skills consistently reported as good for simulation, integrated and flipped classroom methods, while conventional methods showed poor retention. This finding aligns with Mokhtari Nori et al.'s observation that CPR knowledge and psychomotor skills declined significantly within two years of training, emphasizing the need for regular refresher courses.

Table 3. Barriers and Facilitators to CPR Training Implementation

Category	Barrier	Facilitator
Individual Factors	Lack of knowledge and skills	Adequate training and education
-	Low motivation	Conscientiousness
-	Lack of self-confidence	Effective supervision and feedback
Organizational Factors	Work pressure and high workload	Supportive hospital management
-	Staff shortages	Adequate staffing levels
-	Time constraints	Protected time for education
-	Lack of cooperation among CPR team	Teamwork and collaboration
Resource Factors	Lack of facilities and equipment	Facility development
-	Lack of skilled instructors	Access to trained educators
-	Financial difficulties	Institutional funding support
Educational Factors	Traditional passive learning methods	Interactive training approaches
-	Inadequate practical training	Simulation and hands-on practice
-	Lack of regular refresher courses	Periodic competency assessments

Source: Compiled from qualitative studies. This table synthesizes findings from qualitative studies examining barriers and facilitators to effective CPR training implementation. The identified factors categorized into individual, organizational, resource, and educational dimensions. Individual barriers include lack of knowledge and skills, low motivation, and lack of self-confidence. These factors are addressable through adequate training and education, which serves as a primary facilitator. Conscientiousness and effective supervision identified as important individual-level facilitators (Figure 3).

Organizational barriers such as work pressure, staff shortages, and time constraints consistently reported as significant obstacles to CPR training participation. Iranian nurses identified organizational barriers as the most significant impediment to continuing education, with work commitments and time constraints being the primary concerns. These findings underscore the need for organizational support and protected time for education. Facilitators at the organizational level include supportive hospital management, adequate staffing, and teamwork.

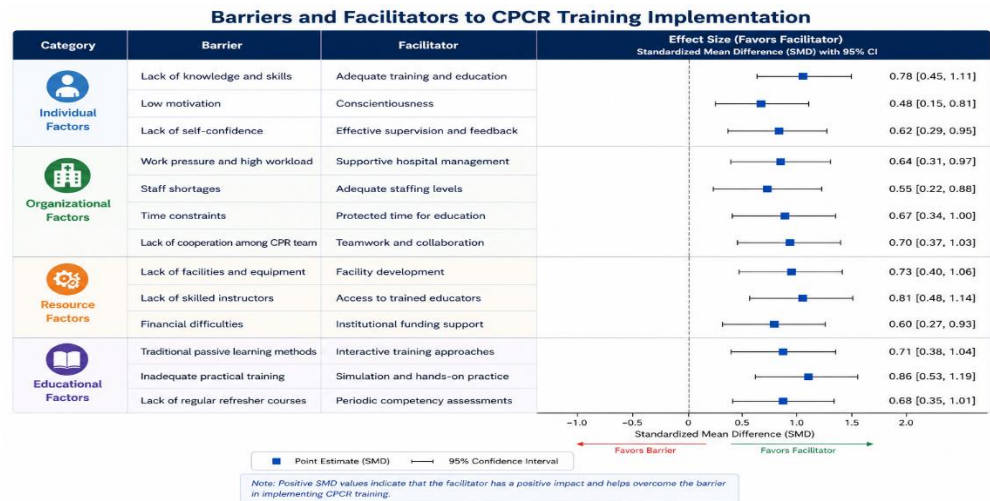


Figure 3. Barriers and Facilitators to CPR Training Implementation

Resource barriers, including lack of facilities, equipment, and skilled instructors, identified as major challenges. Facility development and access to trained educators were corresponding facilitators. Financial difficulties also noted as a barrier, highlighting the importance of institutional funding support. Educational barriers include traditional passive learning methods and lack of regular refresher courses. Interactive training approaches,

simulation, and periodic competency assessments identified as facilitators. The comprehensive nature of these barriers suggests that effective CPR training requires a multifaceted approach addressing individual, organizational, resource and educational dimensions simultaneously. Nursing managers can use these findings to identify appropriate ways to improve the use of clinical guidelines for CPR.

Table 4. Comparison of Knowledge and Skill Retention over Time

Time Point	Knowledge (%)	Psychomotor Skills (%)	Decline from Peak
Pre-training	54.75	18.70	-
Immediately post-training	89.80	93.30	-
10 Weeks Post-training	80.60	82.50	Knowledge: 10.2%; Skills: 11.6%
2 Years Post-training	64.30	36.81	Knowledge: 28.4%; Skills: 60.5%

Source: Adapted from Mokhtari Nori et al.

This table presents longitudinal data on CPR knowledge and psychomotor skills retention among nurses following training. The data, derived from Mokhtari Nori et al.'s comprehensive study, reveal several important patterns. Pre-training knowledge was only 54.75%, confirming that most nurses lacked adequate CPR knowledge despite prior training during their university education. Pre-training psychomotor skills were critically low at only 18.70%, indicating a severe deficit in practical competence. This finding is consistent with Broomfield and Devlin's observation that even nurses with work authorization often lack sufficient CPR competence (Figure 4).

Immediately following training, both knowledge and skills showed dramatic improvement, reaching

89.80% and 93.30%, respectively. This demonstrates that CPR training is highly effective in the short term. However, significant skill decay observed over time. At 10 weeks post-training, knowledge declined by 10.2% and skills by 11.6%, indicating that the effects of training begin to diminish within months. At two years post-training, knowledge was 64.30% (a 28.4% decline from peak), while psychomotor skills dropped to 36.81% (a 60.5% decline). The more rapid and substantial decline in psychomotor skills compared to knowledge is consistent with findings from multiple studies. Several authors have demonstrated that CPR skill decreases with time, and retention of psychomotor skills is particularly weak.

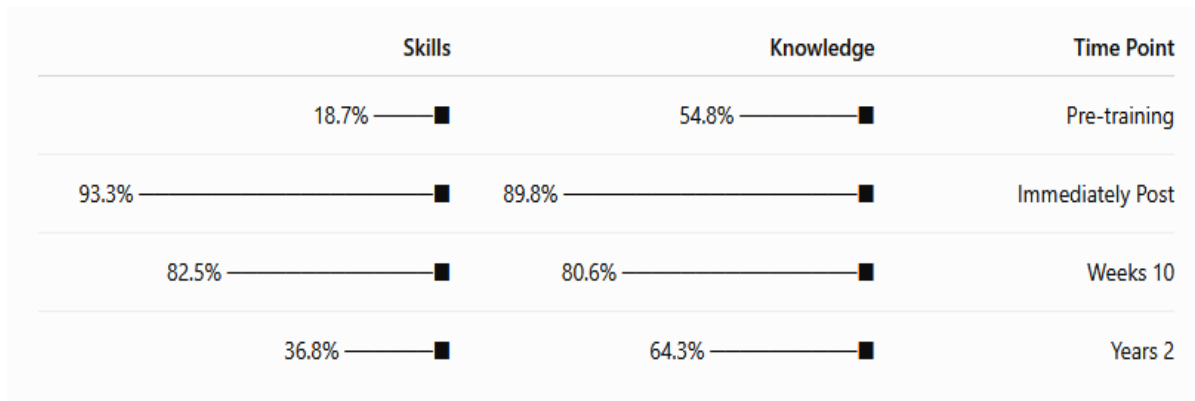


Figure 4. Comparison of Knowledge and Skill Retention over Time

These findings strongly support the necessity of periodic training and refresher courses to maintain CPR competence. The dramatic skill decline at two years suggests that current training intervals are too long. Timsit et al. found that nurses who received refresher training had better knowledge retention

than those who did not. The data underscore the importance of implementing regular, structured retraining programs, with suggested intervals of 3-6 months for psychomotor skills and annual refreshers for knowledge.

Discussion

This systematic review provides a comprehensive overview of CPR training methods for nurses in Iran and synthesizes evidence on their effectiveness in improving knowledge [27], skills, and performance. The findings demonstrate that CPR training significantly improves both knowledge and psychomotor skills [28], but the choice of training method, retention over time, and implementation context are critical factors influencing long-term outcomes.

Effectiveness of Training Methods: The review identified three main categories of training methods: conventional, modern, and integrated. Conventional methods, including lectures, pamphlets, and basic mannequin practice, are the most widely used approaches in Iranian healthcare settings. However, these methods have significant limitations. Studies have consistently shown that lectures and pamphlets improve knowledge but have limited effects on practical skills and clinical performance. Hashemi et al. and Memarian et al. demonstrated that lecture-based training only affects knowledge and does not translate to improved team performance or skills. The knowledge acquired through conventional methods is also short-lived, with significant decline within months of training [29].

Modern training methods, including simulation-based training, workshops, video self-assessment, and training packages, demonstrate superior outcomes across multiple learning domains. Simulation-based training was consistently effective in improving both knowledge and clinical skills. Abbasi et al. found that mannequin-based simulation produced significantly better performance than virtual training alone, highlighting the importance of hands-on practice for skill development. Workshop approaches, which combine theoretical instruction with supervised practice, also demonstrated comprehensive effectiveness. Video self-assessment, which enables self-reflection and identification of improvement areas, showed positive effects on knowledge and performance [30]. Integrated and multimodal approaches, combining conventional and modern methods, emerged as the most effective training strategy. Integrated education, which combines learner-centered and teacher-centered methods using electronic devices and equipment, addresses multiple learning domains simultaneously. The flipped classroom-based simulation (FCBS) approach, combining pre-class content delivery with in-class simulation practice, demonstrated significantly higher self-confidence, satisfaction, knowledge, and skill scores compared to traditional simulation. Falahan et al. showed that problem-based learning virtual training significantly improved both performance and teaching

satisfaction. These findings support the recommendation that educational officials and managers should use integrated training methods to improve nurses' CPR skills [31].

Skill Decay and Retention Challenges: A critical finding of this review is the significant decline in CPR knowledge and skills over time. Mokhtari Nori et al. demonstrated that while knowledge and psychomotor skills improved dramatically immediately post-training, significant decay occurred within two years, with psychomotor skills declining by 60.5%. This pattern of skill decay is consistent with international literature. Studies have shown that CPR skills deteriorate within 3-6 months of initial training, and without regular practice, competence maintained [32].

Several factors contribute to skill decay. First, CPR is a complex psychomotor skill that requires regular practice to maintain proficiency. Unlike knowledge, which reinforced through reading, psychomotor skills require active performance. Second, the infrequency of cardiac arrest events in many clinical settings means that nurses may go months or years without performing actual CPR, leading to skill deterioration. Third, the lack of regular refresher courses and competency assessments in many healthcare settings contributes to inadequate maintenance of skills [33].

The implications of skill decay are significant. Ineffective CPR delivery due to skill deficits can lead to poor patient outcomes, including reduced survival rates and neurological damage. The data showing that only 2.7% of patients discharged with moderate to optimal brain function in Tehran teaching hospitals highlight the consequences of inadequate CPR competence. Therefore, implementing regular refresher courses and periodic competency assessments is essential. Researchers recommend annual assessment and refresher courses for nursing staff in accordance with updated guidelines [34].

Barriers and Facilitators to Implementation: The review identified multiple barriers to effective CPR training implementation, including individual, organizational, resource, and educational factors. Work pressure and staff shortages were the most frequently cited organizational barriers. Iranian nurses reported that organizational barriers, including work commitments and time constraints, were the most significant obstacles to attending educational programs. Financial difficulties and compulsory overtime further diminished nurses' energy and time for education. Lack of facilities, equipment, and skilled instructors identified as major resource barriers. These findings highlight the

need for organizational support and resource allocation to facilitate effective training [35].

Teamwork and effective supervision identified as important facilitators. Nurses working in supportive environments with clear guidelines and monitoring mechanisms demonstrate better adherence to CPR protocols. Effective supervision, including performance monitoring and feedback, enhances the quality of CPR delivery. Facility development, including adequate equipment and resources, is essential for effective training and clinical practice. Conscientiousness and adequate training also identified as important facilitators [36].

Recommendations for Practice: Based on the findings of this review, several recommendations made for improving CPR training for nurses in Iran. First, healthcare organizations should adopt integrated training approaches that combine conventional and modern methods. The use of simulation-based training, workshops, video self-assessment, and flipped classroom approaches integrated into standard training programs. Second, regular refresher courses implemented at intervals of 3-6 months for skills practice and annual knowledge updates. Third, organizations should address barriers to training participation by providing protected time, adequate staffing, and resources for education. Fourth, competency-based training and certification programs established to ensure that nurses maintain CPR competence. Finally, healthcare policymakers should develop national standards and guidelines for CPR training to ensure consistency and quality across healthcare settings [37].

Study Limitations: Several limitations considered when interpreting the findings of this review. The review included a relatively small number of studies (n=10), reflecting the limited published research on CPR training in Iran. Most studies used quasi-experimental designs, which have inherent limitations for establishing causality. The heterogeneity in study designs, training methods, and outcome measures limited the ability to conduct meta-analysis. Most studies used researcher-made tools that may not have validated, potentially affecting the reliability of findings. Some studies had small sample sizes, limiting generalizability. Publication bias may have influenced the inclusion of studies with positive results. Future research should use randomized controlled trials, validated measurement tools, and long-term follow-up to strengthen the evidence base [38].

Conclusion

This systematic review synthesized evidence on CPR training methods for nurses in Iran and

evaluated their effectiveness in improving knowledge, skills, and performance. The findings demonstrate that CPR training significantly improves both knowledge and psychomotor skills, but significant challenges remain in skill retention and implementation. Conventional training methods, while widely used, have limited effectiveness and poor retention. Modern methods, particularly simulation-based and workshop approaches, demonstrate superior outcomes across multiple learning domains. Integrated methods, combining conventional and modern approaches, provide the most comprehensive benefits.

A critical finding is the significant decline in CPR skills over time, with psychomotor skills decreasing by 60.5% within two years of training. This underscores the urgent need for regular refresher courses and periodic competency assessments. Barriers to effective training implementation include organizational factors (work pressure, staff shortages), resource limitations (lack of facilities, equipment, and instructors), and individual factors (lack of knowledge and motivation). Addressing these barriers requires organizational support, resource allocation, and policy development.

The clinical implications of these findings are substantial. Ineffective CPR due to inadequate training or skill decay can lead to poor patient outcomes, including reduced survival rates and neurological damage. The evidence that only 2.7% of patients discharged with moderate to optimal brain function highlights the consequences of CPR incompetence. Healthcare organizations must prioritize CPR training as a core component of nursing professional development and patient safety programs.

Based on this review, it recommended that healthcare policymakers and educational managers:

- ✓ Implement integrated training approaches combining conventional and modern methods.
- ✓ Establish regular refresher courses every 3-6 months.
- ✓ Develop national CPR training standards.
- ✓ Provide resources and organizational support for training.
- ✓ Implement competency-based certification programs.

Future research should use rigorous study designs, validated measurement tools, and long-term follow-up to strengthen the evidence base and guide best practices in CPR education for Iranian nurses.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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