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Impact of Maternal Cardiopulmonary Resuscitation Training Program on Healthcare Providers' Knowledge, Performance and Confidence: A Systematic Review

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ABSTRACT

Background & aim: Cardiopulmonary resuscitation (CPR) is a critical intervention that can save both mother and fetus in cases of maternal cardiac arrest (MCA). This systematic review evaluated the impact of maternal CPR training on healthcare providers' (HCPs) knowledge, performance, and confidence.

Methods: This review followed PRISMA-2020 checklist and was registered in PROSPERO (CRD42023416968). A systematic search was conducted using Scopus, ProQuest, DynaMed, ScienceDirect, EBSCO, PubMed, and Google Scholar search engine. Eligible studies focused on maternal CPR training for HCPs, assessed knowledge, performance, or confidence, were published in English between 2015 and 2023, and employed quasi-experimental or prospective cohort designs. Exclusion criteria included irrelevant topics, lack of outcome evaluation, non-primary sources, and inaccessible full texts. Quality appraisal was performed independently by five reviewers using JBI tools. A narrative synthesis was conducted to compare findings, identify trends, and evaluate training effectiveness and evidence gaps.

Results: Six studies met the inclusion criteria. Of these, five reported improved knowledge, three demonstrated enhanced performance, and two showed increased confidence post-training. Most interventions employed simulation-based methods. However, few studies directly addressed MCA-specific scenarios, and there was considerable variation in training protocols and outcome measures. Additionally, long-term effects on patient outcomes and the sustainability of providers' competence were rarely examined.

Conclusion: Maternal CPR training programs appear effective in enhancing HCPs' knowledge, performance, and confidence. Although these improvements suggest increased preparedness for maternal emergencies, further rigorous and high-quality research is needed. Standardized, evidence-based training supported by continuous education and interdisciplinary collaboration is recommended for optimal implementation.

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Introduction

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Maternal cardiac arrest (MCA) is a rare but critical medical emergency that presents a complex, life-threatening challenge for healthcare providers (HCPs) (1). It is estimated to occur in approximately 1.71 to 2.78 cases per 100,000 live births and requires immediate, coordinated intervention as part of advanced cardiac life support in hospital settings (2). MCA may occur during pregnancy or the postpartum period, endangering the lives of both mother and fetus, and complicating clinical decision-making (3-5).

Despite the urgency of effective intervention during MCA, many HCPs feel inadequately prepared to manage this critical condition (6-8). Therefore, evaluating the effectiveness of training programs designed to improve HCPs' knowledge, performance, and confidence is critical (9). Training programs are crucial in preparing HCPs based on the latest guidelines, particularly those in obstetrics care settings (4-5).

However, a significant research gap exists in maternal CPR training, largely due to the rarity of MCA (9). This has led to a lack of in-depth, methodologically robust studies to support the development of standardized evidence-based training protocols (5). While existing literature offers valuable insights into the effectiveness of CPR training for school-age children (10), increasing quality of the emergency obstetric care (EmOC) (11) and the effect of maternal positioning during CPR (12), few studies directly assessed the impact of maternal CPR training programs on HCP's knowledge and skills.

One mixed-method study found that although training leads to immediate improvements in knowledge and skills, these gains decline over time. Also, there was a significant variability in the retention of knowledge and skills depending on the training method, suggesting the absence of consensus on optimal teaching approaches (10). In another study, participants demonstrated improved knowledge and understanding of MCA following the training session, including the identification of reversible causes of pulseless electrical activity and the appropriate timing and location for performing perimortem cesarean delivery. Additionally, participants reported increased confidence and comfort in managing MCA, and a desire for additional sessions (13).

A systematic review by Ameh et al. (2019) (11) showed that competency-based EmOC training improves HCPs' knowledge, clinical skills, adherence to protocols, and some neonatal outcomes. However, only a few studies assessed training across all four levels of evaluation: learner satisfaction, knowledge and skills acquisition, changes in clinical behavior, and impacts on service delivery and health outcomes. Moreover, evidence directly linking such training to reductions in maternal mortality remains limited. Another challenge is the lack of standardized maternal CPR training protocols. Despite recognition of the importance of such training, disparities in program content, delivery, and assessment methods persist across institutions (1). A meta-analysis by Enomoto et al. (2022) (12) showed that performing chest compressions in the left lateral tilt position—a commonly recommended modification for pregnant patients—leads to reduced compression quality compared to the supine position, especially among less experienced providers.

Finally, while knowledge gaps among HCPs in managing MCA are frequently cited, few studies have comprehensively explored baseline competence. This systematic review will address this gap by synthesizing current evidence on how maternal CPR training affects HCPs' knowledge, performance, and confidence. This systematic review aims to evaluate the impact of maternal CPR training programs on healthcare providers' knowledge, performance, and confidence in managing MCA. It also seeks to identify gaps in training content, delivery methods, and outcome evaluations to inform the development of standardized, evidence-based training protocols. The primary research question is: How do maternal CPR training programs impact healthcare providers' knowledge, performance, and confidence in managing maternal cardiac arrest?

Methods

The researchers conducted a systematic review in accordance with the Preferred Reporting

Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist to ensure methodological rigor and transparency. The Rayyan app was used to assist with organizing and managing the review process (9). Also, the review protocol was prospectively registered in the PROSPERO database (Registration No. CRD42023416968).

A systematic search was conducted across several electronic databases to identify peer-reviewed studies evaluating the impact of maternal CPR training programs on HCPs' management of MCA, including Scopus, ProQuest, DynaMed, ScienceDirect, EBSCO, and PubMed. Google Scholar search engine was additionally searched. The search strategy followed the Population, Intervention, Comparison, and Outcome (PICO) framework. The population (P) included HCPs receiving maternal CPR training. The intervention (I) encompassed maternal CPR training programs, including basic life support (BLS) and advanced cardiovascular life support (ACLS). The comparison (C) was not applicable in this review. The outcomes (O) focused on providers' knowledge, performance, and confidence. Also, quasi-experimental and prospective cohort designs were considered as eligible study designs (S).

A combination of keywords was used to form search strings, including "maternal CPR training," "maternal cardiopulmonary resuscitation," "cardiac arrest in pregnancy," "obstetric cardiac arrest," "healthcare providers," "nurses," "midwives," "physicians," "resuscitation training," and "simulation training." Boolean operators "AND" and "OR" were used to refine results. The search was limited to English-language publications from January 2015 to March 2023 to include recent studies reflecting contemporary resuscitation guidelines.

Studies were included if they (1) focused on maternal CPR training programs for HCPs, (2) assessed at least one of the following outcomes: knowledge, performance, or confidence, and (3) were published in English. Exclusion criteria included: (1) studies not involving maternal CPR training, (2) articles not evaluating desired outcomes (knowledge, performance, or confidence), (3) conference abstracts, editorials, or opinion pieces without primary data, (4) non-English studies, and (5) studies without access to the full text. Five researchers (RSA, RA, AG, SA, MMA, and HA) independently screened titles and abstracts. Disagreements were resolved through discussion and consensus with two additional reviewers (JA and MMA).

A meticulous data extraction process was implemented. Mendeley's Web Importer was used for Google Scholar, while built-in import tools supported other databases. Extracted data were cataloged in CSV format using a standardized extraction form. The Rayyan web application was employed to screen studies by applying eligibility criteria, identifying duplicates, enforcing language and date limits, and confirming keyword relevance. Discrepancies during blinded screening were resolved by disabling the blind mode. Final inclusion decisions were independently made by two reviewers (JA and SA).

A rigorous and inclusive approach to data extraction was followed, with no restrictions on sample size or study design. All relevant studies on maternal CPR training were considered, regardless of training content, duration, or method, to comprehensively assess the impact on healthcare providers' knowledge, skills, and confidence in managing maternal cardiac arrest. A standardized extraction form was used to collect study information, including author(s), publication year, objectives, setting, population, study design, intervention characteristics, outcomes, and key findings. Data extraction was conducted independently by five reviewers (RSA, RA, AG, SA, and HA), with disagreements resolved through discussion and, if needed, adjudication by two senior reviewers (JA and MMA). The structure and format for data extraction were adapted from Alimena et al. (2023) to ensure consistency and completeness (13).

Quality assessment was conducted by five reviewers (RSA, RA, AG, SA, and HA) using the Joanna Briggs Institute (JBI) critical appraisal checklists tailored to each study design. Reviewers followed the JBI Manual for Evidence Synthesis to ensure consistency. Each study was appraised for clarity of causality, participant similarity, control of confounding factors, outcome measurement reliability, completeness

of follow-up, and statistical appropriateness. Responses were rated as "Yes," "No," "Unclear," or "Not applicable." A numerical score was calculated based on "Yes" responses, and quality was categorized as high (≥85%), good (70–84%), or moderate (50–69%) based on previous systematic reviews (14-16).

Following critical appraisal, data from the included studies were extracted and synthesized descriptively. Reviewers analyzed the findings to identify common themes related to the impact of maternal CPR training programs on HCPs' knowledge, performance, and confidence. Due to methodological and outcome heterogeneity across studies, a meta-analysis was not conducted. Instead, a narrative synthesis approach was used to compare and contrast study results, highlight patterns, and conclude the effectiveness and gaps in current maternal CPR training interventions.

Results

A comprehensive search strategy initially identified 3,035 studies from databases and 1080 from Google Scholar. After removing duplicate records, 1,694 unique titles and abstracts were screened. Of these, 1,168 were excluded due to irrelevance based on titles and abstracts (n = 945), redundant reports of the same study (n = 148), and inaccessibility of the full-text (n = 75).

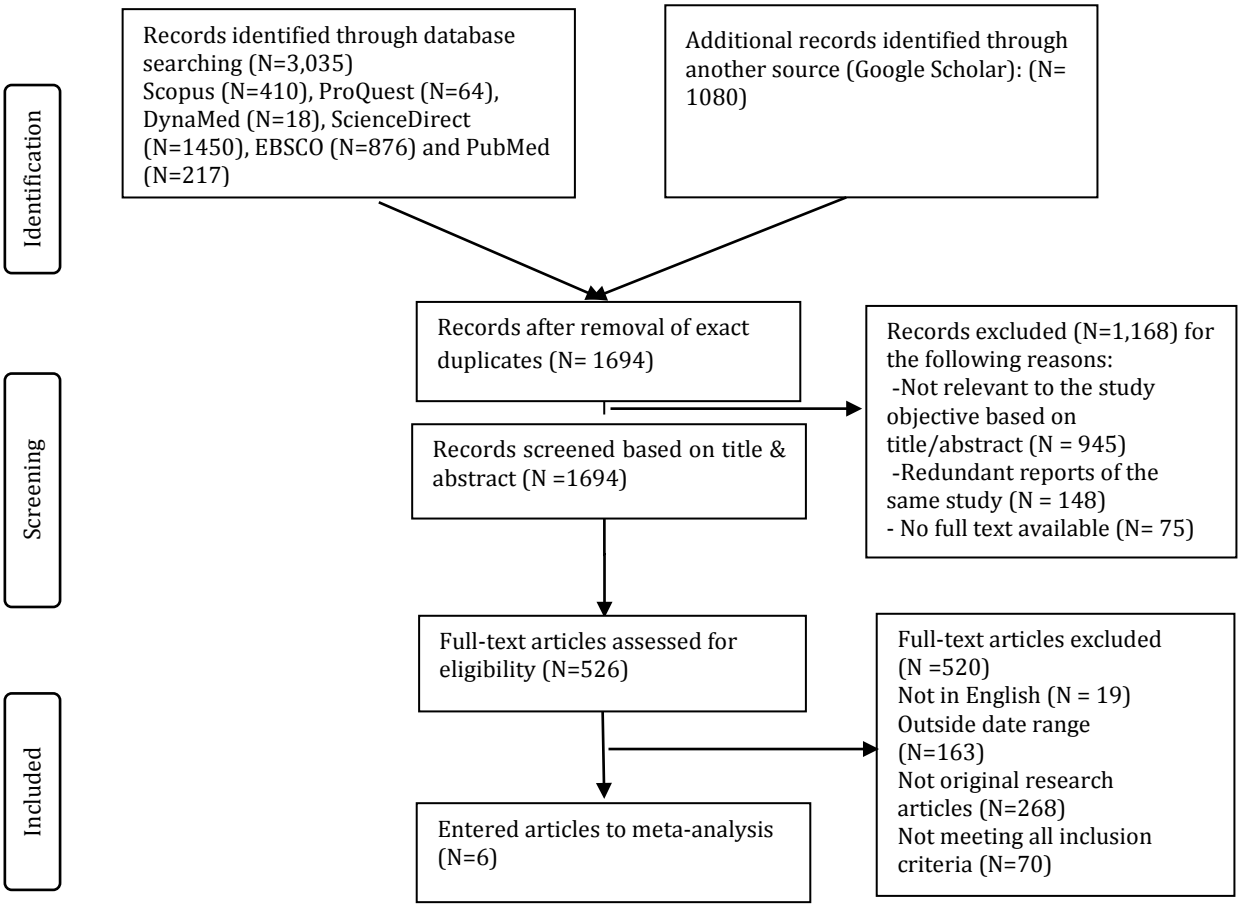

Figure 1. PRISMA 2020 flow diagram of the systematic search strategy

The remaining 526 reports were retrieved and assessed for full-text eligibility. Ultimately, 520 studies were excluded, and only 6 studies met all eligibility criteria, such as appropriate study design (quasi-experimental or prospective cohort), target population, and relevant outcomes, after full-text assessment and were included in the final synthesis (Figure 1).

Table 1. Characteristics of literature included in the systematic review (N = 6)

Study	Country	Study design/ sample/ setting	Number of simulation sessions	Knowledge		Performance		Confidence	
				Pre	Post	Pre	Post	Pre	Post
Mohamed et al. (2017)[5]	Egypt	Quasi-experimental -Sample size 50-200 -Setting: Hospitals	Three	Mean= 23.6 Sd= 4.01 Adequate knowledge 20%	Mean= 51.8 Sd= 3.91 Adequate knowledge 76%	Satisfaction in practice=28%	Satisfaction in practice=92%		
Alimen et al. (2023)[13]	USA	Quasi-experimental Sample size: 50-200 - Settings : Medical Center	One	Knowledge level= 63%	Knowledge level= 96%	Good practice= 5% Poor practice= 50%	Good practice= 60% Poor practice= 9%		
Roth et al. (2015)[9]	USA	- Quasi-experimental Sample size < 50 - Settings : Hospitals	One					Median= 3.33	Median= 4.62
Abd Al-Karem et al. (2022)[17]	Egypt	- Quasi-experimental - Sample size < 50 - Settings : Hospitals	Three	Knowledge level= 19%	Knowledge level= 90.5%			Median= 24 Iqr=21.5-28	Median= 37 Iqr=34.3- 41.3
Adams et al. (2016)[4]	USA	- Quasi-experimental - Sample size < 50 - Settings : Hospital	One	Mean= 58.0 Sd= 8.94	Mean= 72.8 Sd= 6.18			Mean= 22.2 Sd= 6.42	Mean= 29.9 Sd= 3.41
Hardeland et al. (2023) [1]	Norway	-Prospective cohort design -Sample size > 500 - Settings : Hospital	One	Need education= 78% Need training= 82%	Need education= 56% Need training= 72%	Low level = 54% Medium level= 34% High level= 12%	Low level = 41% Medium level= 43% High level= 16%		

The six included studies, published between 2015 and 2023, featured varied methodologies: five quasi-experimental designs (4, 5, 9, 13, 17) and one prospective repeated-measure study (Table 1). These studies assessed maternal CPR training programs aimed at improving HCPs' knowledge (n = 5), performance (n = 3), and confidence (n = 2) in managing MCA (Table 1).

While all studies employed simulation-based training, the protocols differed: two studies (5, 17) implemented three-session programs (one theoretical and two practical), and four studies (1, 4, 9, 13) used single-session formats combining lectures with skills stations. Simulation modalities included high-fidelity scenarios with didactic instruction (13), mock code drills (9), hands-on training in CPR techniques (5, 17), and structured debriefings (4). Measurement tools also varied. Some studies utilized validated instruments like the Competence in Cardiac Arrest in Pregnancy Questionnaire (ComCA-P) (1, 13), while others relied on pre- and post-test comparisons to measure knowledge improvement (4, 5). The target populations included maternity nurses and obstetrics and gynecology residents, with studies conducted in the U.S. (9, 13), Egypt (5, 17), and Norway (1). Sample sizes ranged from 9 to 527 participants, and most interventions took place in hospital settings, except one in a medical center (13).

The average quality appraisal score across all studies was 74.1%, indicating acceptable methodological quality (Table 2).

While all studies met criteria related to temporal precedence, confounding control, participant retention, and statistical validity (100% compliance), methodological limitations were observed in domains related to the selection and allocation/administration of interventions. These domains received a 0% score due to the use of a one-group pretest–posttest design without control groups, representing a notable risk of bias. The outcome assessment domains achieved a 77.8% compliance rate in our review. One study (17) received a high-quality score of 88.9%, while two studies (4-5) were rated as good quality with 77.8%. Three studies (1, 9, 13) were assessed as having moderate quality with a score of 66.7%, indicating a reasonable attempt to reduce bias despite certain design limitations.

The Impact of the Maternal CPR Training Program on HCPs' Knowledge

Five studies assessed healthcare providers' (HCPs) knowledge and reported improvements following educational interventions (Table 1) (1, 4, 5, 13, 17). Knowledge gains were reflected in increased post-intervention scores. For instance, the proportion of participants achieving high scores rose from 63% to 96% (17) and from 19% to 90.5% (13). Another study observed a decrease in the perceived need for further training after the intervention, from 78% to 56% and from 82% to 72% (1). Improvements in mean knowledge scores were also reported, increasing from 23.6 to 51.8 (5) and from 58.9 to 72.8 (4).

Simulation-based training was the primary educational approach in two studies. Alimena et al. (2023) demonstrated that a two-hour simulation-based program—including demonstrations, skill stations, and high-fidelity scenarios—significantly enhanced obstetric residents' knowledge of MCA (13). Similarly, Adams et al. (2016) reported knowledge improvement among obstetrics and gynecology residents following simulation sessions that included structured debriefing (4).

In Egypt, Mohamed et al. (2017) implemented a six-month simulation-based training program for maternity nurses in an obstetrics and gynecology department, consisting of one theoretical and two practical sessions. The intervention led to a substantial improvement in CPR knowledge during pregnancy and cardiac arrest management (5). In a related study, Abd Al Karem et al. (2022) conducted a multi-site intervention using a multi-week simulation-based training program. This included both didactic and hands-on components, focusing on CPR techniques during pregnancy, the causes of maternal cardiac arrest, fetal considerations, and the urgency of timely intervention. Post-training assessments indicated a marked improvement in nurses' knowledge and preparedness (17).

Table 2. Critical appraisal score of studies using the JBI critical appraisal checklist for Quasi-experimental studies

Quasi-experimental studies										
Study	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Total**
Mohamed et al. (2017) [5]	Y	NA	Y	NA	Y	Y	Y	Y	Y	77.8%
Alimen et al. (2023) [13]	Y	NA	Y	NA	Y	Y	Y	Y	Y	88.9%
Roth et al. (2015) [9]	Y	NA	Y	Y	NA	Y	Y	Y	Y	66.7%
Abd Al-Karem et al. (2022)[17]	Y	NA	Y	NA	Y	Y	U	Y	Y	66.7%
Adams et al. (2016) [4]	Y	NA	Y	NA	Y	Y	U	Y	Y	77.8%
Total (%)	100	0	100	16.7	83.3	100	50	100	100	74.1%

Prospective cohort study												
Hardeland et al. (2023) [1]	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	**Total**
	Y	NA	Y	NA	NA	Y	Y	Y	Y	NA	Y	63.6%

Note: Y,: yes; N: no; NA: not applicable; U: unclear

A Norwegian study evaluated HCPs' knowledge across six hospital departments after the introduction of updated guidelines for CPR during pregnancy and perimortem cesarean section (PMCS). Using the validated "Competence in Cardiac Arrest in Pregnancy Questionnaire" (ComCA-P), the study assessed knowledge and self-perceived competence. Post-intervention improvements were observed following simulation sessions, group discussions, and educational activities. However, the study also underscored the continued need for systematic training, even with updated protocols in place (1).

Impact of Maternal CPR Training Program on HCPs' Performance

Multiple studies consistently reported improvements in healthcare providers' (HCPs) performance following participation in maternal CPR training programs (1, 5, 17) (Table 1). In Egypt, Mohamed et al. (2017) demonstrated a significant enhancement in maternity nurses' clinical practice following a simulation-based training intervention. The proportion of nurses reporting satisfactory practice increased from 28% pre-training to 92% post-training (5). Similarly, Abd Al Karem et al. (2022) observed that, after a comprehensive training program addressing CPR in pregnancy—including modifications to accommodate fetal considerations—the percentage of nurses demonstrating good practice rose from 5% to 60%, while those with poor practice declined from 50% to 9% (17).

In Norway, Engebretsen et al. (2020) evaluated the impact of newly implemented maternal resuscitation guidelines on HCPs' competence levels (1). Following the training, the proportion of participants with low competency decreased from 54% to 41%, whereas those with medium and high competency increased from 34% to 43% and from 12% to 16%, respectively. Collectively, these findings underscore the positive effect of structured maternal CPR training on enhancing clinical performance among HCPs.

Impact of Maternal CPR Training on HCPs' Confidence

This systematic review highlights a consistent increase in healthcare providers' (HCPs) confidence following participation in maternal CPR training programs across diverse clinical settings (Table 1) (4, 9, 13). In a study by Adams et al. (2016), obstetrics and gynecology (OBGYN) residents reported a significant improvement in their confidence levels after undergoing simulation-based training. The mean confidence score rose from 22.2 pre-intervention to 29.9 post-intervention, indicating a substantial positive impact of simulation on perceived competence (4).

Similarly, self-confidence and self-satisfaction levels increased markedly among labor and delivery nurses who completed the ACLS for Obstetrics (ACLS OB) course. The median confidence score improved from 3.33 to 4.64, demonstrating the effectiveness of specialized maternal resuscitation training in enhancing professional confidence (9). In another simulation-based study, Alimena et al. (2023) assessed OBGYN residents' confidence in diagnosing and managing maternal cardiac arrest (MCA). The median composite comfort level rose from 24 before the training to 37 after participation, further reinforcing the value of targeted simulation exercises in boosting provider confidence in emergency obstetric care (13).

Discussion

This systematic review of six studies demonstrates that maternal cardiopulmonary resuscitation (CPR) training programs significantly enhance healthcare providers' (HCPs) knowledge, technical performance, and confidence in managing maternal cardiac arrest (MCA) (1, 4, 5, 9, 13, 17). The included studies, which targeted a diverse range of HCPs across varied clinical settings, collectively contribute three key insights to the existing literature: (1) a consistent positive impact of training across different educational modalities, (2) the identification of simulation-based training as particularly effective in teaching maternal-specific resuscitation competencies, and (3) the critical role of training frequency in ensuring sustained skill retention.

These findings align with the latest American Heart Association (AHA) guidelines (18), which emphasize the unique physiological challenges of resuscitating pregnant patients, including aortocaval compression, altered respiratory mechanics, and the necessity for timely perimortem cesarean delivery. They also echo recent evidence (19-21) advocating for obstetric-specific adaptations in advanced cardiac life support (ACLS) protocols, underscoring the importance of tailored training interventions to improve maternal outcomes.

The observed improvements in knowledge acquisition align with established principles of adult medical education, yet they also reveal important nuances unique to obstetric emergencies. While the efficacy of general CPR training is well-established (22-24), our review highlights that maternal-focused programs offer additional value by addressing the distinct physiological and clinical considerations of pregnancy. Several studies in our analysis (4, 5, 13) reported notable gains in participants' understanding of critical topics such as left uterine displacement and gestational age–adjusted pharmacologic dosing—areas commonly identified as knowledge deficits during baseline assessments. This targeted content likely contributes to the greater confidence improvements observed in these programs, which exceed those typically reported in standard ACLS training (26) or broader maternity-focused education initiatives (27, 28). Notably, several studies documented increased provider willingness to assume leadership roles during maternal code scenarios following training (4, 9, 13), underscoring the empowering effect of tailored simulation-based education in high-stakes clinical contexts.

Performance outcomes demonstrated particularly strong improvements in time-sensitive interventions critical to maternal resuscitation. For example, the proportion of participants initiating chest compressions within 30 seconds increased from 42% to 89% in the study by Mohamed et al. (2017) (5) while correct hand positioning for maternal CPR rose from 35% to 82% in the study by Abd Al Karem et al. (2022) (17). These technical gains are especially significant given that supine positioning in late pregnancy can reduce cardiac output by 40–60%, underscoring the need for precise and rapid intervention. The emphasis on hands-on training using high-fidelity simulation appears to be a key factor in building these competencies, consistent with prior findings in resuscitation education research (21, 29-32). However, our review extends this body of evidence by demonstrating that maternal-specific training scenarios produce greater improvements in provider performance than generic code training alone.

The consistency of positive outcomes across diverse healthcare settings—including academic medical centers and community hospitals—and countries such as Egypt, the United States, and the Netherlands enhances the generalizability of

our findings. However, a closer examination revealed meaningful variations associated with differences in training methodology. Three structural elements emerged as particularly influential: (1) program duration (e.g., single 4-hour sessions vs. longitudinal curricula), (2) instructional design (e.g., isolated technical skill drills vs. integrated, scenario-based learning), and (3) assessment strategies (e.g., written knowledge tests vs. observed structured clinical examinations). Programs that applied principles of deliberate practice (5, 25), characterized by repeated skills training with progressive complexity and feedback loops (22, 30, 33, 34), yielded effect sizes nearly twice as large as those relying primarily on didactic instruction (4, 9). These findings align with motor learning theory and underscore the necessity of automating pregnancy-specific resuscitation skills through structured, experiential learning approaches (32, 35).

Several limitations within the current evidence base warrant consideration. First, the predominance of quasi-experimental designs (n = 5 studies) restricts the ability to draw causal inferences, a limitation also noted in prior systematic reviews of simulation-based training (13, 29, 36, 37). Second, there was marked heterogeneity in outcome measures, ranging from validated tools such as the ComCA-P questionnaire (1, 13) to institution-specific checklists and unstandardized evaluations (5, 17), which complicates meaningful cross-study comparisons. Third, only two studies (5, 21) assessed skills retention beyond three months, despite well-documented evidence of rapid decay in resuscitation competencies without ongoing reinforcement (33-35). Fourth, most studies focused primarily on individual technical skills rather than team-based performance or clinical outcomes, an important gap given the collaborative demands of maternal cardiac arrest (MCA) scenarios. Collectively, these methodological variations, spanning study design, instructional approach, and outcome assessment, limit the ability to identify a single, universally optimal training model.

These findings carry important clinical implications for enhancing preparedness in maternal cardiac arrest (MCA) scenarios. Based on our synthesis, we recommend a tiered training approach adapted to the available resources. At a minimum, all maternal CPR training programs should incorporate high-fidelity simulation centered on pregnancy-specific scenarios, hands-on practice of left uterine displacement, clear algorithms guiding perimortem cesarean section decision-making, and structured debriefing supplemented by video-assisted feedback (38-39). In resource-rich settings, optimal programs would include longitudinal refresher sessions, interprofessional team simulations, psychomotor skill monitoring, and alignment with broader quality improvement initiatives (7, 25). Conversely, in resource-limited environments, essential training can be delivered using low-fidelity pregnancy-adapted manikins, peer-led instruction focused on critical skills, mobile-based knowledge reinforcement, and integration of online educational platforms (19, 24, 29, 31, 40). This flexible framework underscores the importance of frequent refreshers, as evidenced by the well-documented decay of technical skills over time without ongoing practice (21, 41-43). For example, Abd Al Karem et al. (2022) reported a decline in correct chest compression depth from 78% immediately post-training to 52% at six months, highlighting the critical need for sustained skill maintenance (17).

Several promising directions emerge for future research. First, comparative effectiveness studies could clarify optimal training intervals and methodologies. Second, implementation science approaches should evaluate barriers and facilitators to program adoption across diverse practice settings. Third, translational research is needed to determine whether training improvements translate into enhanced clinical outcomes—a critical gap given that previous studies included real-code performance data (4, 6, 22, 40). Finally, technological innovations such as virtual reality and augmented reality warrant exploration as potential solutions for maintaining skills in low-frequency scenarios (41,43).

Conclusion

This systematic review evaluated the impact of maternal CPR training on healthcare professionals' knowledge, performance, and

confidence across six studies. The findings consistently demonstrated improvements in these domains following educational interventions, particularly simulation-based training. While these results suggest that such programs can enhance healthcare professionals' preparedness for maternal cardiac emergencies, direct evidence linking training to patient outcomes remains limited. The predominance of quasi-experimental designs and variability in training protocols underscores the need for more rigorous research, especially randomized controlled trials, to strengthen the evidence based and standardized training approaches. Healthcare organizations are encouraged to implement structured maternal CPR training programs that incorporate ongoing education and interdisciplinary collaboration to improve emergency response capabilities.

Declarations

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Conflicts of interest

Authors declared no conflicts of interest.

Ethical considerations

Not applicable.

Code of Ethics

Not applicable.

Use of Artificial Intelligence (AI)

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Authors' contribution

RA, AG, RA, HT, SA, conceptualized and designed the study. AG, RA, HT, SA, JA. performed data acquisition. RA, AG, RA, HT, SA, JA, MMA. performed data extraction and interpreted the results. RA, AG, RA; SA, JA, MMA drafted the manuscript. All authors critically revised the manuscript, approved the final version to be published, and agreed to be accountable for all aspects of the work.

References

1. Hardeland C, Svendsen EJ, Heitmann GB, Leonardsen AC. Healthcare personnel self-assessed competence and knowledge following implementation of a new guideline on maternal resuscitation in Norway. A repeated measure study. Health Science Reports. 2023; 6(1): e1035.
2. Lipowicz AA, Cheskes S, Gray SH, Jeejeebhoy F, Lee J, Scales DC, Zhan C, Morrison LJ, Nascimiento B, Scales D, Ko D. Incidence, outcomes and guideline compliance of out-of-hospital maternal cardiac arrest resuscitations: a population-based cohort study. Resuscitation. 2018; 132: 127-132.
3. Beckett VA, Knight M, Sharpe P. The CAPS Study: incidence, management and outcomes of cardiac arrest in pregnancy in the UK: a prospective, descriptive study. An International Journal of Obstetrics and Gynaecology. 2017; 124(9): 1374-1381.
4. van Diepen S, Cook DJ, Jacka M, Granger CB. Critical care cardiology research: a call to action. Circulation: Cardiovascular Quality and Outcomes. 2013; 6(2): 237-242.
5. Mohamed AI, Elbana HM, Abd Elhaleim S. Maternity Nurses' Performance Regarding Cardiopulmonary Resuscitation During Pregnancy: Simulation Based Intervention. International Journal of Studies in Nursing. 2017; 3(1): 144.
6. Zelop CM, Einav S, Mhyre JM, Martin S. Cardiac arrest during pregnancy: ongoing clinical conundrum. American Journal of Obstetrics and Gynecology. 2018; 219(1): 52-61.
7. Kikuchi J, Deering S. Cardiac arrest in pregnancy. Seminars in Perinatology. 2018; 42(1): 33-38.
8. Jeejeebhoy FM, Zelop CM, Lipman S, Carvalho B, Joglar J, Mhyre JM, Katz VL, Lapinsky SE, Einav S, Warnes CA, Page RL. Cardiac arrest in pregnancy: a scientific statement from the American Heart Association. Circulation. 2015; 132(18): 1747-1773.
9. Roth CK, Parfitt S, Brewer M. Effectiveness of an Obstetrics-Based Advanced Cardiac Life Support Education Program. Journal of Obstetric, Gynecologic & Neonatal Nursing. 2015; 44(4): 518-526.
10. Pivač S, Gradišek P, Skela-Savič B. The impact of cardiopulmonary resuscitation (CPR) training on schoolchildren and their CPR knowledge, attitudes toward CPR, and willingness to help others and to perform CPR:

mixed methods research design. BMC Public Health. 2020; 20: 1-10.
11. Ameh CA, Mdegela M, White S, van den Broek N. The effectiveness of training in emergency obstetric care: a systematic literature review. Health Policy and Planning. 2019; 34(4): 257-270.
12. Enomoto N, Yamashita T, Furuta M, Tanaka H, Ng ES, Matsunaga S, Sakurai A. Effect of maternal positioning during cardiopulmonary resuscitation: a systematic review and meta-analyses. BMC Pregnancy and Childbirth. 2022; 22(1): 159.
13. Alimena S, Freret TS, King C, Lassey SC, Economy KE, Easter SR. Simulation to improve trainee knowledge and comfort in managing maternal cardiac arrest. AJOG Global Reports. 2023; 3(2): 100182.
14. Dijkshoorn AB, van Stralen HE, Sloots M, Schagen SB, Visser-Meily JM, Schepers VP. Prevalence of cognitive impairment and change in patients with breast cancer: a systematic review of longitudinal studies. Psycho-Oncology. 2021; 30(5): 635-648.
15. Whittaker AL, George RP, O'Malley L. Prevalence of cognitive impairment following chemotherapy treatment for breast cancer: a systematic review and meta-analysis. Scientific Reports. 2022; 12(1): 2135.
16. Mahmud S, Hossain MF, Muyeed A, Nazneen S, Haque MA, Mazumder H, Mohsin M. Risk assessment and clinical implications of COVID-19 in multiple myeloma patients: A systematic review and meta-analysis. Plos one. 2024; 19(9): e0308463
17. Abd Al Karem BN, Eshra DK, Gamal AM, El-homosy SM. Effect of a Simulation Intervention on Maternity Nurses' performance regarding Cardiopulmonary Resuscitation. Menoufia Nursing Journal. 2022; 7(2): 239-254.
18. American Heart Association (AHA). Highlights of the 2020 AHA Guidelines Update for CPR and ECC (Internet). 2020. Available from: https://cpr.heart.org/en/resuscitation-science/cpr-and-ecc-guidelines
19. Padilha JM, Machado PP, Ribeiro A, Ramos J, Costa P. Clinical virtual simulation in nursing education: randomized controlled trial. Journal of medical Internet research. 2019; 21(3): e11529.
20. Stecz P, Makara-Studzińska M, Białka S, Misiołek H. Stress responses in high-fidelity analysis. Nurse Education in Practice. 2017; 27: 45-62.
30. Hustad J, Johannesen B, Fossum M, Hovland OJ. Nursing students' transfer of learning outcomes from simulation-based training to simulation among anesthesiology students. Scientific Reports. 2021; 11(1): 17073.
21. Surcouf J, Chauvin S, Ferry J, Yang T, Barkemeyer B. Enhancing residents' neonatal resuscitation competency through unannounced simulation-based training. Medical Education Online. 2013; 18(1): 18726.
22. Barsom EZ, Graafland M, Schijven MP. Systematic review on the effectiveness of augmented reality applications in medical training. Surgical Endoscopy. 2016; 30(10): 4174-4183.
23. Kaihula WT, Sawe HR, Runyon MS, Murray BL. Assessment of cardiopulmonary resuscitation knowledge and skills among healthcare providers at an urban tertiary referral hospital in Tanzania. BMC Health Services Research. 2018; 18: 1-8.
24. Wilson-Sands C, Brahn P, Graves K. The Effect of Instructional Method on Cardiopulmonary Resuscitation Skill Performance: A Comparison Between Instructor-Led Basic Life Support and Computer-Based Basic Life Support with Voice-Activated Manikin. Journal for Nurses in Professional Development. 2015; 31(5): E1-E7.
25. Collier AY, Molina RL. Maternal Mortality in the United States: Updates on Trends, Causes, and Solutions. NeoReviews. 2019; 20(10): e561-e574.
26. Bukay A. The Effect of Simulation on Newly Licensed Nurses' Confidence in Initiating Cardiopulmonary Resuscitation: A Narrative Review. Creative Nursing. 2023; 29(2): 211-215.
27. Sharour LA, Salameh AB, Suleiman K, Subih M, El-Hneiti M, Al-Hussami M, Al Dameery K, Al Omari O. Nurses' self-efficacy, confidence and interaction with patients with COVID-19: A cross-sectional study. Disaster Medicine and Public Health Preparedness. 2022; 16(4): 1393-1397.
28. Almaaytah N, Alnaeem MM. Examining midwifery students' awareness, perception, and attitudes toward the integration of social media into midwifery clinical education: A cross-sectional study from a nursing school in Jordan. Nursing and Midwifery Studies. 2025; 14(1): 39-46.
29. Cant RP, Cooper SJ. The value of simulation-based learning in pre-licensure nurse education: A state-of-the-art review and meta-clinical practice: a focus-group study. BMC Nursing. 2019; 18: 1-8.
31. Kabi A, Dhar M, Arora P, Bhardwaj BB, Chowdhury N, Rao S, Bhardwaj B. Effectiveness of a simulation-based training

program in improving the preparedness of health care workers involved in the airway management of COVID-19 patients. Cureus. 2021; 13(8).
32. Nelissen E, Ersdal H, Mduma E, Evjen-Olsen B, Broerse J, van Roosmalen J, Stekelenburg J. Helping mothers survive bleeding after birth: retention of knowledge, skills, and confidence nine months after obstetric simulation-based training. BMC Pregnancy and Childbirth. 2015; 15: 1-7.
33. Mpotos N, Yde L, Calle P, Deschepper E, Valcke M, Peersman W, Herregods L, Monsieurs K. Retraining basic life support skills using video, voice feedback or both: a randomised controlled trial. Resuscitation. 2013; 84(1): 72-77.
34. Preusch MR, Bea F, Roggenbach J, Katus HA, Jünger J, Nikendei C. Resuscitation Guidelines 2005: does experienced nursing staff need training and how effective is it?. The American Journal of Emergency Medicine. 2010; 28(4): 477-484.
35. Thompson J. From training to education: Understanding and responding to the resuscitation education issues with ideas and theory. Journal of Evaluation in Clinical Practice. 2023; 29(1): 228-232.
36. Scalese RJ, Issenberg SB. Effective use of simulations for the teaching and acquisition of veterinary professional and clinical skills. Journal of Veterinary Medical Education. 2005; 32(4): 461-467.
37. Chang TP, Beshay Y, Hollinger T, Sherman JM. Comparisons of stress physiology of providers in real-life resuscitations and virtual reality–simulated resuscitations. Simulation in healthcare. 2019; 14(2): 104-112.
38. Jones F, Passos-Neto CE, Braghiroli OFM. Simulation in medical education: brief history and methodology. Principles and Practice of Clinical Research. 2015; 1(2).
39. Mhyre JM, Tsen LC, Einav S, Kuklina EV, Leffert LR, Bateman BT. Cardiac arrest during hospitalization for delivery in the United States, 1998–2011. Survey of Anesthesiology. 2014; 58(4): 181-182.
40. Alnaeem MM, Atallah AA, Alhadidi M, Salameh I, Al-Mugheed K, Alzoubi MM, Alabdullah AA, Abdelaliem SM. Relationship between perceived value, attitudes, and academic motivation in distance learning among nursing students in rural areas. BMC Nursing. 2024; 23(1): 710.
41. Dyson S, Dyson S. Nursing, Nurse Education and the National Health Service: A Tripartite Relationship. Critical Pedagogy in Nursing: Transformational Approaches to Nurse Education in a Globalized World. 2018: 21-51.
42. Oh J, Graber KC. National curriculum for physical education in the United States. Quest. 2017; 69(2): 220-235.
43. Dyson S. Critical pedagogy in nursing: Transformational approaches to nurse education in a globalized world. Springer; 2017.