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Review article

Mobile and electronic applications of resuscitation documentation: A systematic literature review

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ABSTRACT

Background: Accurate and timely documentation during in-hospital cardiac arrest (Code Blue) is essential for patient safety and quality improvement; however, paper-based documentation is frequently incomplete and delayed.

Purpose: This study aimed to evaluate the effectiveness of digital and electronic resuscitation documentation tools in improving documentation completeness, timing accuracy, and adherence to resuscitation algorithms compared with paper-based methods.

Method: A systematic literature review was conducted using databases including Scopus, PubMed, ProQuest, and ScienceDirect, covering studies published from 2016 to 2025. Study quality was assessed using the JBI Critical Appraisal Tools. A total of ten studies were included, comprising six randomized controlled trials, three quasi-experimental studies, and one cross-sectional study. Two studies additionally incorporated qualitative components as part of a mixed-methods design.

Results: Digital systems such as CPReCoder and NeRD demonstrated higher documentation completeness and more accurate time stamping. Cognitive aid–based applications, including Guiding Pad, Code Blue Leader, and PediAppRREST, improved guideline adherence, reduced critical errors, and lowered cognitive workload among resuscitation team leaders. However, most evidence was derived from simulation-based studies.

Conclusion: Digital resuscitation documentation systems show strong potential to enhance documentation quality and resuscitation performance. Effective implementation requires user-centered design, adequate training, integration with electronic health records, and further validation through real-world clinical settings to support nursing practice and patient safety.

1. Background

Cardiopulmonary resuscitation (CPR) is a critical life-saving procedure. According to the American Heart Association (AHA, 2025), cardiopulmonary resuscitation (CPR) is a set of emergency procedures performed when the heart stops beating to maintain circulation and respiration until spontaneous cardiac and pulmonary function can be restored[1]. In a hospital setting, incidents like this are known as Code Blue and require rapid and coordinated action by a multidisciplinary resuscitation team[2]. The AHA 2025 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (ECC) declare that successful resuscitation relies on both technical skills and a strong continuous quality improvement (CQI) framework, accompanied by accurate and timely resuscitation documentation[3][4].

Worldwide, in-hospital cardiac arrest (IHCA) continues to be a significant patient safety issue, with reported incidences varying from 1 to 10 occurrences per 1,000 hospital admissions annually and a survival rate to hospital discharge of roughly 25% or less[5]. The importance of resuscitation

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documentation that can objectively and accurately capture critical process indicators, such as time to CPR initiation, defibrillation, and epinephrine administration in real time, is highlighted by the significant variation in incidence and neurological outcomes across hospitals. This documentation is necessary to support quality evaluation and benchmarking[4][6]. In ordinary clinical practice, resuscitation documentation is often poor or inconsistent, even for electronic health record (EHR) systems, which may introduce bias in evaluations of resuscitation quality[7][8].

Digital resuscitation documentation methods enhance data completeness and timestamp precision while facilitating compliance with resuscitation protocols; nonetheless, issues concerning system integration, usability, and documentation workload remain[7][8][9][10]. According to the AHA 2025 framework, which views digital documentation as a crucial part of resuscitation quality systems[3][4], no thorough analysis has yet to compare the efficacy of digital and paper-based documentation in hospital Code Blue incidents. Therefore, this systematic literature review aims to evaluate the effectiveness of digital resuscitation documentation in terms of completeness, accuracy, and timing; identify barriers and facilitators to implementation; and provide evidence-based recommendations to support continuous quality improvement and patient safety.

2. Methods

2.1 Research design

This study was a systematic literature review of interventional studies evaluating digital or electronic resuscitation documentation systems using the PRISMA framework for study selection and the JBI Critical Appraisal Tools for quality assessment. Included studies were primary quantitative or mixed-methods research published in English from 2016 onward that assessed electronic documentation during in-hospital cardiac arrest (IHCA) or Code Blue events, with comparison to paper-based documentation or evaluation of documentation quality. Books, reviews, editorials, letters, training applications not focused on documentation, duplicate publications, and studies published before 2016 were excluded.

2.2 Setting and sample

The population comprised patients experiencing IHCA and Code Blue events documented by healthcare professionals. Interventions included digital documentation systems such as tablet- or smartphone-based applications, EHR resuscitation modules, automated time-stamping, and real-time data entry platforms. Comparators were conventional paper-based or manual documentation. Outcomes of interest included documentation completeness, accuracy of timekeeping, and precision of recorded clinical interventions such as defibrillation, epinephrine administration, airway management, and return of spontaneous circulation.

2.3 Literature Search

Literature searches were conducted in Scopus, PubMed, ProQuest, and ScienceDirect up to 10 October 2025 using predefined keywords related to resuscitation documentation and digital systems.

Figure 1 below presents the PRISMA flowchart summarizing the database search, screening, and inclusion process. Records were identified from Scopus (n=99), PubMed (n=955), ProQuest (n=472), ScienceDirect (n=392), SAGE Journal (n=12), EBSCO (n=16), and Cambridge (n=365), totaling 2,311 records. After applying limiters (open access, publication year ≥2015, English language), 238 records remained. Following title and abstract screening (n=127), 10 articles were assessed for full-text eligibility. All 10 articles met the inclusion criteria and were included in the final review; therefore, no studies were excluded during the full-text assessment stage.

2.4 Instruments and data collection

Methodological quality was assessed using Joanna Briggs Institute (JBI) Critical Appraisal Tools. All studies met most criteria and were retained. Randomized controlled trials showed common limitations in blinding due to simulation-based interventions. Quasi-experimental studies demonstrated adequate rigor, while the cross-sectional study met seven of eight criteria with limited confounding control. Qualitative components in mixed-methods studies showed acceptable quality, though researcher reflexivity was inconsistently reported. No studies were excluded. Data extraction and appraisal were conducted independently by both authors. A forest plot was constructed to illustrate effect directions and magnitudes.

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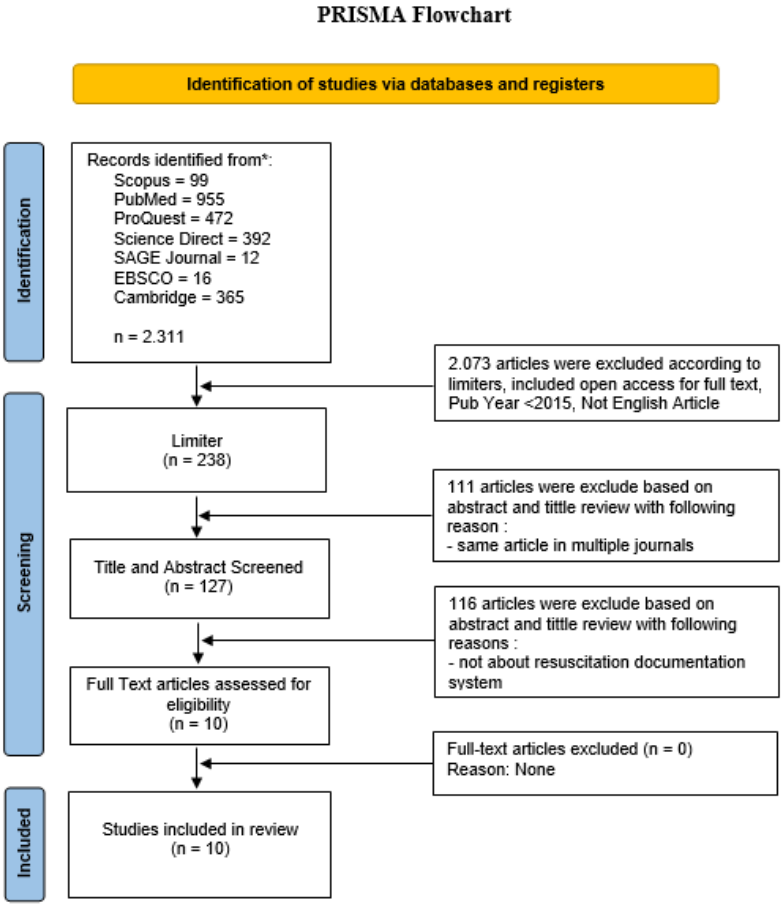

Figure 1. PRISMA Flowchart

2.5 Data analysis

Findings were synthesized narratively, grouped by outcome domain: documentation completeness and accuracy, clinical performance and guideline adherence, intervention timing, and usability and cognitive workload. Effect sizes were extracted where reported and displayed in a forest plot.

3. Results

Of the ten included studies, six were randomized controlled trials, three were quasi-experimental studies, and one was a cross-sectional study. Two studies additionally incorporated qualitative components as part of a mixed-methods design. The predominance of randomized controlled trials reflects efforts to evaluate the effectiveness of digital applications on resuscitation documentation and performance. However, most studies were conducted in simulated environments, which may limit the generalizability of findings to real-world clinical settings.

3.1 Documentation Completeness and Accuracy

Digital documentation systems, including CPReCoder, NeRD, eResus, and ARR, were developed to overcome limitations associated with conventional paper-based records, particularly missing data and inaccurate timestamps. Studies evaluating CPReCoder and NeRD demonstrated significantly higher documentation completeness compared with handwritten documentation. CPReCoder improved documentation completeness from 88.1% to 96.8%, while NeRD demonstrated an increase from 20% to 100%[10][11][12]. In feasibility testing, ARR achieved 77.5% documentation completeness and 68% adherence to NRP guidelines[13]. However, several implementation studies reported no statistically significant differences between digital and paper-based documentation, with both capturing approximately 65–70% of essential data elements[14]. User discomfort, workflow misalignment, and delayed EHR entry were identified as key barriers to achieving real-time accuracy, indicating that usability and integration are critical determinants of effectiveness[15].

3.2 Clinical Performance and Guideline Adherence

Cognitive aid–based applications, including PediAppRREST, MAX DCA, Code Blue Leader, and

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Guiding Pad, consistently demonstrated improved resuscitation performance and adherence to established guidelines[16][17][18][19]. A meta-analysis involving 16 simulation studies reported superior performance with electronic cognitive aids compared with paper-based aids (SMD = 1.87), with both outperforming no-aid controls (SMD = 1.16)[16]. Individual studies demonstrated reduced procedural errors, improved technical skills, and enhanced non-technical team performance.

3.3 Impact on Intervention Timing and Resuscitation Workflow

Timing accuracy is critical during resuscitation because interventions must be delivered within predefined therapeutic windows. Real-time tablet-based documentation improved timestamp accuracy compared with paper-based documentation, reducing median timing deviation from 171 seconds to 38 seconds[9]. In addition, post-event documentation time decreased from 12 minutes 19 seconds to 8 minutes 4 seconds. Guiding Pad significantly reduced time to first defibrillation from 211 seconds to 121 seconds[19]. However, improvements in intervention timing were not consistently statistically significant across studies.

3.4 Usability and Cognitive Workload

Overall usability scores were high across digital applications. CPReCoder demonstrated excellent usability, with a System Usability Scale score of 87.9. Users of ARR, Guiding Pad, and Code Blue Leader also reported favorable usability perceptions[16]. Some studies demonstrated reduced cognitive workload among team leaders, reflected by lower NASA Task Load Index scores[16]. However, concerns regarding interface complexity, potential distraction, and insufficient training were also reported.

Summary of the effects of digital documentation and cognitive aid applications on resuscitation documentation quality, timing, and clinical performance is described in Table 1.

Table 1. Summary of the effects of digital documentation and cognitive aid applications on resuscitation documentation quality, timing, and clinical performance[9][11][12][16][17][18][19][20]**.**

Study	Measured Variable / Outcome	Intervention Value	Control Value	Difference (Effect)
CPReCoder	Documentation completeness (%)	96.8%	88.1%	+8.7 (↑ completeness)
NeRD	Documentation completeness (%)	100%	20%	+80 (↑ completeness)
Real-time tablet documentation	Median deviation of intervention timing (seconds)	38 s	171 s	−133 (↓ time deviation)
Cognitive Aid App	CPR performance score (mean)	1.47	1.24	+0.23 (↑ score)
PediAppRREST	Number of guideline deviations (mean)	3.4	6.0*	−2.6 (↓ deviations)
MAX DCA	Technical skills score (median)	80	55	+25 (↑ skills)
Code Blue Leader	Resuscitation performance score (%)	95.3%	81.4%	+13.9 (↑ score)
Guiding Pad	Time to first defibrillation (seconds)	121 s	211 s	−90 (↓ time)

3.5 Quantitative Synthesis and Forest Plot Analysis

A forest plot was constructed to compare effect sizes between intervention and control groups across included studies (Figure 2). The vertical reference line at zero indicated no effect. Positive values represented improvements in documentation completeness and performance scores, whereas negative values represented reductions in intervention delays or guideline deviations.

The forest plot demonstrated consistently favorable effects of digital applications across all measured outcomes. NeRD showed the largest improvement in documentation completeness (+80 percentage points), followed by CPReCoder (+8.7 percentage points)[11][12]. MAX DCA demonstrated a substantial increase in technical skills (+25 points), while Code Blue Leader and the Cognitive Aid App also had better results, with gains of about +13,9 percentage points and 0.23 points, respectively[17][18][20].

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The results for Guiding Pad and real-time tablet documentation were negative because they were based on time. These negative differences show clinically significant gains. Time-dependent outcomes also showed clinically meaningful improvements. Guiding Pad reduced time to first defibrillation by 90 seconds, while real-time tablet documentation reduced timing deviation by 133 seconds [19]. PediAppRREST decreased guideline deviations by 2.6 events compared with controls[16].

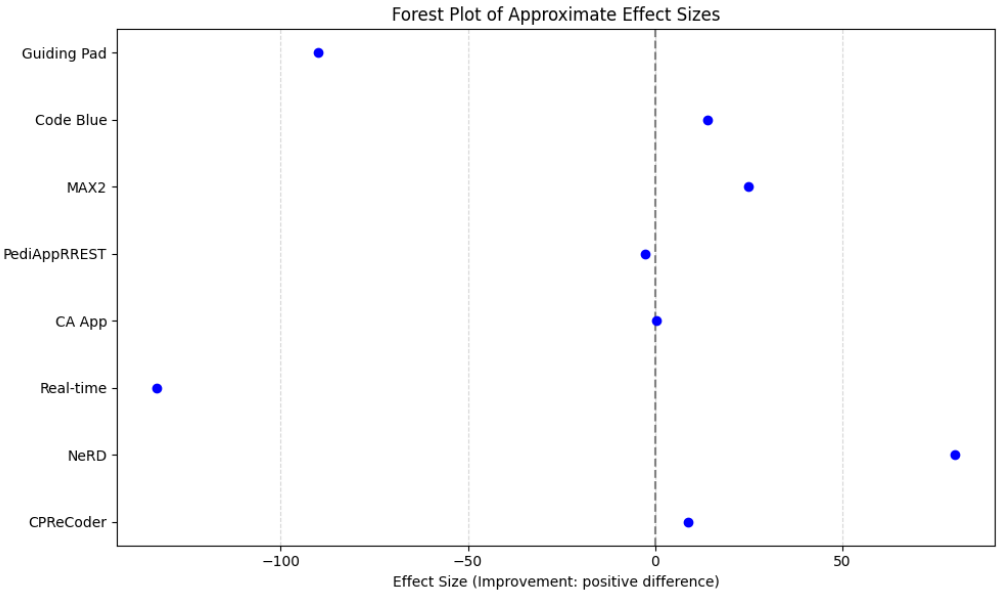

Figure 2. Forest Plot Analysis

4. Discussion

This review demonstrates that digital documentation systems and electronic cognitive aid applications consistently improve several critical dimensions of resuscitation performance, including documentation completeness, technical proficiency, temporal accuracy, and adherence to resuscitation algorithms. The most pronounced effects were observed in documentation-related outcomes, particularly with NeRD and CPReCoder, suggesting that digital systems effectively address longstanding limitations of paper-based documentation, such as incomplete records and inaccurate timestamps.

Improvements in clinical performance observed in applications such as MAX DCA, Code Blue Leader, and PediAppRREST indicate that digital cognitive aids may enhance both technical and non-technical team performance during high-acuity situations. These findings support the theoretical assumption that structured digital prompts reduce cognitive burden and facilitate real-time clinical decision-making during resuscitation.

The observed reductions in intervention delays, particularly in first defibrillation time and timestamp deviation, are clinically significant because early defibrillation and precise timing are strongly associated with improved resuscitation outcomes. Although not all timing outcomes reached statistical significance across studies, the consistent trend toward reduced delays suggests potential clinical relevance.

Despite these promising findings, several implementation barriers remain evident. Workflow disruption, interface complexity, and inadequate user training were repeatedly identified as obstacles to successful adoption. These findings suggest that technological effectiveness is influenced not only by system functionality but also by human factors, usability design, and organizational integration.

Another important finding is that most included studies were conducted in simulation-based environments. While simulation offers controlled conditions for evaluating performance, its external validity for real-world clinical settings remains limited. Therefore, future research should prioritize multicentred clinical trials to evaluate whether improvements in documentation accuracy and algorithm adherence translate into patient-centred outcomes such as return of spontaneous

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circulation, survival to discharge, and neurological recovery.

Overall, these findings support the integration of user-centred digital resuscitation systems as a promising strategy to improve code blue performance. However, successful implementation requires alignment with clinical workflow, adequate training, and robust clinical validation before widespread adoption in hospital settings.

5. Conclusion

Digital resuscitation documentation systems and cognitive aid applications have the potential to improve documentation accuracy, completeness, guideline adherence, and resuscitation performance while reducing cognitive workload. Compared with paper-based methods, these technologies provide more accurate time-stamped records and support timely clinical decision making. However, successful implementation depends on usability, workflow integration, user acceptance, and interoperability with hospital information systems. Given that most available evidence is derived from simulation-based studies, further clinical research is needed to confirm their effectiveness and impact on patient outcomes in real world settings.

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