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Artificial Intelligence-Assisted Learning in Emergency Nursing Education: A Scoping Review

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ABSTRACT

Background: Artificial intelligence (AI) is increasingly used to support nursing education, particularly in preparing learners to manage emergency and critical care situations. However, evidence from randomized controlled trials (RCTs) remains fragmented. **Objective:** To map and characterize RCT evidence on AI-assisted learning in nursing education, with emphasis on emergency, resuscitation, and critical-care contexts. Methods: Scoping review following the PRISMA-ScR guideline and the Joanna Briggs Institute framework. Data Sources: PubMed/MEDLINE, Scopus-indexed journals, ProQuest, and reference-list searching were conducted through July 2026. The articles screened studies and extracted data on study characteristics, interventions, comparators, and educational outcomes. **Results:** Fifteen RCTs (2016–2026) involving over 1,300 nurses and nursing students from nine countries were included. Nine studies evaluated AI-assisted learning in general nursing education, while six focused on emergency, resuscitation, or critical care. AI-based interventions included generative AI, chatbots, intelligent tutoring systems, virtual and augmented reality, and AI-integrated simulation. Most studies reported improvements in knowledge, clinical skills, or learner satisfaction. However, several found no significant advantage over conventional teaching and reported increased cognitive load or anxiety. **Conclusion:** AI-assisted learning has the potential to enhance emergency and critical care nursing education, particularly in psychomotor skills and clinical decision-making. Nevertheless, current evidence is limited by heterogeneous interventions, small single-center trials, and short follow-up, highlighting the need for larger multicenter RCTs with standardized outcome measures.

Keywords: Artificial Intelligence, Emergency Nursing, Nursing Education, Simulation Training

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1. INTRODUCTION

Emergency nursing demands rapid recognition of clinical deterioration, split-second decision-making under uncertainty, and precise execution of time-critical psychomotor skills such as cardiopulmonary resuscitation (CPR), triage, and airway management (Ricci et

al., 2022). Preparing nursing students and novice nurses for this environment has long relied on high-fidelity manikin simulation, preceptorship, and structured clinical placements. However, these approaches are resource-intensive, difficult to scale, and constrained by patient-safety limits on repeated practice in live emergency settings (Fealy et al., 2019).

Artificial intelligence (AI) has emerged as a candidate solution to these constraints. Intelligent tutoring systems, conversational AI chatbots built on large language models such as ChatGPT, AI-driven virtual patients, and AI- or sensor-integrated simulation manikins are increasingly described in the nursing-education literature as tools that can personalize feedback, enable unsupervised repetitive practice, and reduce faculty workload (DeGagne, 2023; Lifshits & Rosenberg, 2024). Several narrative and systematic reviews have summarized this broader literature (Jembu & Lee, 2025), reporting that AI-based interventions in nursing education are associated with small, often statistically nonsignificant, and highly heterogeneous effects on knowledge, skills, and affective outcomes such as anxiety and confidence.

A critical gap, however, remains in synthesizing this evidence specifically for emergency and critical-care nursing education. Emergency care differs from general nursing education in its emphasis on time-pressured psychomotor performance (e.g., chest-compression depth and rate), rapid clinical reasoning under incomplete information, and team-based crisis resource management — competencies that may respond differently to AI-assisted instruction than the knowledge-oriented outcomes emphasized in most general nursing-education trials. To date, no review has mapped the randomized controlled trial (RCT) evidence base for AI-assisted learning across both general and emergency-specific nursing-education contexts, or examined how the evidence in emergency-specific settings compares with the broader literature (Ricci et al., 2022).

This scoping review, therefore, aimed to (1) systematically map the RCT evidence on AI-assisted learning in nursing education published to date, (2) characterize the subset of trials situated explicitly in emergency, resuscitation, or critical-care contexts, and (3) synthesize reported outcomes, intervention types, and evidence gaps to inform future research and curriculum design in emergency nursing education. A scoping review design, rather than a systematic review with meta-analysis, was chosen because the objective was to map the breadth, nature, and

heterogeneity of an emerging, rapidly evolving evidence base, consistent with scoping reviews as described by Arksey and O'Malley (2005) and the Joanna Briggs Institute.

2. METHODS

This scoping review was guided by the framework of Arksey and O'Malley (2005), refined by the Joanna Briggs Institute, and reported in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018)

2.1 Eligibility Criteria

Studies were eligible for inclusion if they met the following criteria, framed using a Population Concept Context (PCC) structure: (Population) pre-licensure nursing students or registered/practicing nurses; (Concept) an artificial-intelligence–assisted learning intervention, operationally defined, consistent with prior reviews in this literature (Jembu & Lee, 2025) as an intelligent tutoring system, generative-AI/chatbot tool (e.g., ChatGPT), AI-driven virtual-patient or virtual/augmented-reality simulation with adaptive or intelligent components, or an AI- and sensor-integrated simulation/feedback system; (Context) any pre-licensure or continuing nursing-education setting, with a specific analytic subgroup for studies set in emergency departments, resuscitation training, or critical/intensive care units. Only studies using a randomized controlled trial design (parallel-group or cluster) with a comparator (traditional/standard teaching, non-AI simulation, or an alternative training modality) and reporting at least one education-related outcome (e.g., knowledge, skill performance, self-efficacy, confidence, anxiety, satisfaction, or objective performance metrics) were included. Studies were excluded if they were not RCTs (e.g., quasi-experimental, qualitative, or observational designs), were conference abstracts or study protocols without posted results, did not involve a nursing population, or evaluated AI applications in clinical patient care rather than education/training. No language restriction was applied at the search stage, but only English-language reports could be screened in full text within the resources available for this review.

2.2 Information Sources and Search Strategy

Searches were conducted using PubMed/MEDLINE, Scopus-indexed nursing and health-professions-education

journals (accessed via publisher platforms including ScienceDirect, MDPI, SAGE, JMIR, and Wiley), ProQuest-indexed dissertation and journal content, and the ClinicalTrials.gov registry, for records up to and including July 2026. Search terms combined controlled vocabulary and free-text keywords for the two core concepts, connected with the Boolean operator AND: (1) "artificial intelligence" OR "AI" OR "ChatGPT" OR "chatbot" OR "intelligent tutoring system" OR "virtual reality" OR "augmented reality" OR "AI-assisted simulation"; (2) "nursing education" OR "nursing student*" OR "nurse education" OR "emergency nursing" OR "critical care nursing" OR "resuscitation training" OR "CPR training"; filtered where possible to "randomized controlled trial". Reference lists of retrieved systematic reviews and meta-analyses on AI in nursing education (Jembu & Lee, 2025) were hand-searched to identify additional eligible primary trials (snowball searching).

Methodological transparency note: This review was conducted as a rapid, reproducible-in-principle search using publicly accessible bibliographic interfaces rather than institutional Scopus/ProQuest subscription access with exportable, deduplicated record counts. The search strings above are reported in full so that the search can be re-run and formally documented (with exact per-database hit counts) by authors with direct institutional access to Scopus and ProQuest prior to journal submission, as most target journals require verifiable, database-native search counts for the PRISMA-ScR flow diagram.

2.3 Study Selection and Data Charting

Records were screened at the title/abstract level and then at full-text level against the eligibility criteria above. Reasons for full-text exclusion were recorded and are summarized in the PRISMA-ScR flow diagram (Figure 1). For each included study, the following data were charted into a standardized extraction table: first author and year, country, study design and sample size (intervention/comparator), participant population and clinical setting, the AI-assisted intervention and its comparator, outcomes measured, and key findings. Data extraction was performed by the review team and cross-checked against the original source abstracts and, where accessible, full texts.

Consistent with PRISMA-ScR and JBI scoping-review guidance, formal critical appraisal of individual study risk of bias was not performed, as the purpose of a scoping review is to map the breadth and characteristics of available evidence rather

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than to pool effect estimates or grade certainty of evidence (Peters et al., 2020; Tricco et al., 2018). This is a methodological choice, not an oversight, and is explicitly noted as a limitation in Section 5.

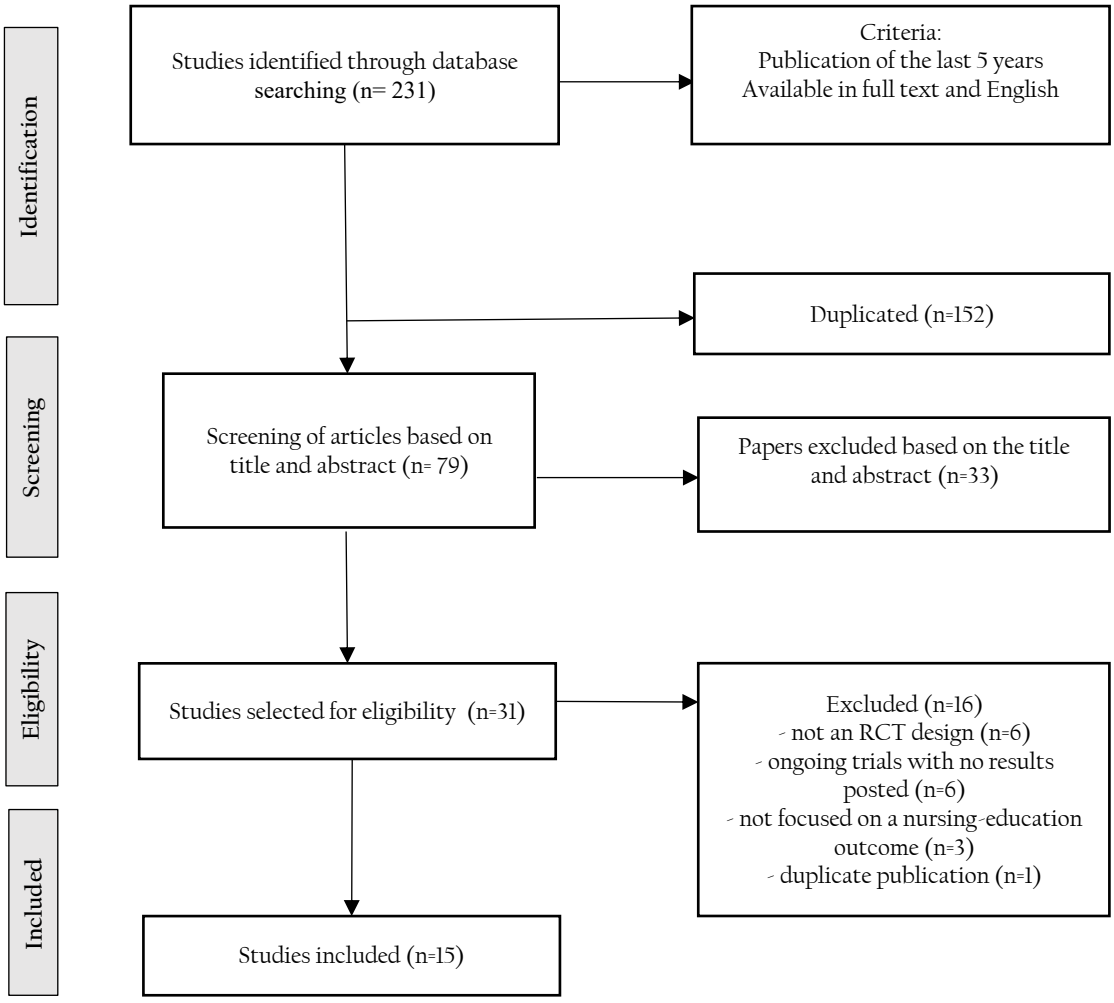

Figure 1. Flowchart PRISMA

3. RESULTS

Study Selection

The search and screening process is summarized in Figure 1. Of 231 records identified through database/registry searching and snowball searching, 79 remained after removal of duplicates. Following title/abstract screening, 31 full-text reports were assessed for eligibility; 16 were excluded (not an RCT design, n=6; registered/ongoing trials with no results posted, n=6; not focused on a nursing-education outcome, n=3; duplicate publication of an already-included trial, n=1). Fifteen RCTs met all eligibility criteria and were included in the review.

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Table 1. Data Extraction (*Continue to page 134*)

Author	Design; Sample Size	Population / Setting	Comparation	Outcomes Measured	Key Findings
(Cobbett & Snelgrove-Clarke, 2016), Canada	RCT; N=56 (21/21)	Year-3 nursing students; maternal-newborn nursing course	Virtual (screen-based) simulation vs. face-to-face simulation	Knowledge, anxiety, self-confidence, self-reported preference	No significant difference in knowledge or self-confidence; virtual-simulation group reported higher anxiety and preferred the traditional face-to-face format.
(Gu et al., 2017), China	RCT; N=28 (14/14)	Year-2 nursing students; fundamentals-of-nursing course	vSIM for Nursing™ (virtual simulation) vs. traditional classroom instruction	Knowledge, skills performance	vSIM group showed significantly improved knowledge and skills performance versus traditional instruction.
(Kim & Suh, 2018)), Korea	RCT; N=66 (34/32)	Senior nursing students; clinical skills training	Interactive nursing-skills mobile application vs. non-interactive instructional video	Knowledge, self-efficacy, skills performance	Interactive app group had significantly higher knowledge, self-efficacy, and skills performance.
(Padilha et al., 2019), Portugal	RCT; N not specified in accessible abstract	Undergraduate nursing students	Clinical virtual simulation vs. traditional classroom teaching	Knowledge, satisfaction, self-confidence	Virtual simulation was associated with improved knowledge acquisition and high learner satisfaction relative to traditional teaching.
(Lo et al., 2022), Taiwan	RCT; N=107 (54/53)	Nursing-assistant students; nasogastric tube feeding training	Immersive virtual reality (IVR) training vs. 2D instructional video	Knowledge, learning motivation, cognitive load, satisfaction	IVR group showed improved knowledge, motivation, and satisfaction, but also higher cognitive load than the 2D-video group.
(Şimşek-Çetinkaya & Çakır, 2023)Turkey	RCT; N=103 (52/51)	Year-1 nursing students; breast self-examination skills training	AI-assisted interactive screen-based simulation vs. standard simulation	Skills performance, satisfaction, anxiety	AI-assisted simulation was not more effective than standard simulation for skill acquisition and increased anxiety, but produced higher satisfaction/engagement.
(Akutay et al., 2024), Turkey	RCT; N not specified in accessible abstract	Undergraduate nursing students; case-management training	AI-supported case analysis vs. standard case analysis/discussion	Case-management performance, satisfaction	AI-supported case analysis improved case-management performance and student satisfaction versus standard case discussion.
(Saatçi et al., 2024)(2024), Turkey	RCT; N=180 (91/89)	First-year nursing students; patient-education-material development	AI tools used to prepare patient-education materials vs. books/journals/websites	Understandability, actionability, and quality of materials produced	AI-assisted preparation significantly improved the understandability, actionability, and overall quality of the education materials produced.

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Author	Design; Sample Size	Population / Setting	Comparation	Outcomes Measured	Key Findings
(Arkan et al., 2025)Turkey	Single-blind RCT; N=96 (48/48)	Undergraduate nursing students; nursing-process training	ChatGPT-based "AI-Integrated Nursing Process" training vs. standard nursing-process education	Problem-solving skills, attitudes toward AI, nursing-process competency, satisfaction	Intervention group showed significantly improved problem-solving, more positive AI attitudes, higher competency, and higher satisfaction.
(Othman et al., 2024), Egypt	RCT (emergency/critical-care-relevant)	Critical-care nursing students; mechanical-ventilation unit training	Gamification + augmented reality vs. conventional teaching	Knowledge, motivation, self-efficacy	Gamified AR training significantly improved knowledge, motivation, and self-efficacy relative to conventional teaching.
(Castillo-Rodríguez et al., 2025), Spain	3-arm RCT; N=93 (32 control/30 VR/31 AR) (emergency-specific)	Emergency-department nurses and nursing students on ED placement	Virtual reality (Meta Quest) and augmented-reality (smartphone) emergency-training modules (myocardial infarction, asthma, CPR) vs. traditional in-class + manikin training	Post-training knowledge, satisfaction	VR produced significantly greater knowledge gains than AR or traditional training; satisfaction differences between groups were not statistically significant.
(Ma et al., 2026), China	RCT; N=136 (68/68) (emergency-specific)	Healthcare professionals; CPR retraining	AI- and sensor-integrated CPR retraining system ("Intelligent Practical Training System," instructor-free/examiner-free) vs. conventional face-to-face retraining	Chest-compression depth accuracy, compression rate, rescue-breath tidal volume, CPR self-efficacy	No evidence of superiority of the AI/sensor-integrated system over conventional face-to-face retraining for compression depth or rate accuracy.
(Bodur et al., 2025), Turkey	RCT; N=144 (approx. 72/72) (emergency-specific)	Second-year nursing students; CPR training	Virtual-reality CPR training (Oculus Quest 2) vs. traditional manikin-based simulation training	Knowledge, psychomotor skills, attitudes, learning styles, self-directed learning skills	VR-based training was associated with gains in knowledge, psychomotor skills, and self-directed learning relative to traditional simulation.
(Benfatah et al., 2025)	RCT; N=60 (30/30)	Second-year nursing students; pre-simulation preparation	AI chatbot–based personalized prebriefing (tailored to learning style, experience, confidence) vs. standard prebriefing	Perceived preparation, self-confidence, simulation performance	AI-assisted personalized prebriefing improved perceived preparedness, confidence, and subsequent simulation performance.
(Terzi et al., 2026)	RCT; N=47	Novice intensive care unit (ICU) nurses; ICU patient-care-management orientation	Purpose-built virtual reality ICU training software vs. standard orientation	Knowledge, clinical practice skills, problem-solving, clinical decision-making, state anxiety	Short-term improvement in problem-solving in the VR group; no clear advantage over standard orientation for knowledge or clinical decision-making at the assessed time points. Reported as a preprint; not yet peer-reviewed at the time of this review.

Characteristics of Included Studies

The 15 included RCTs were published between 2016 and 2026 (with 12 of the 15 published from 2022 onward, reflecting the recency of this literature) and were conducted in nine countries: Turkey (n=6), China (n=2), and one trial each from Canada, Portugal, Taiwan, Egypt, Spain, Morocco, and a country not specified in one preprint. Sample sizes ranged from 28 to 180 participants, with a combined total exceeding 1,300 nurses and nursing students across all included trials. Participants included pre-licensure nursing students (from first-year to senior/final-year), nursing assistant students, novice ICU nurses, and practicing healthcare professionals undergoing CPR retraining.

Interventions fell into four broad categories: (1) generative-AI/chatbot tools, most commonly built on ChatGPT, used for nursing-process training, case analysis, and patient-education-material preparation (5 trials); (2) virtual-reality or augmented-reality simulation with adaptive or AI-integrated feedback components (6 trials); (3) AI-assisted screen-based or mobile-application simulation (2 trials); and (4) AI- and sensor-integrated psychomotor-skill retraining systems, specifically for CPR (2 trials, one of which also involved sensor/manikin feedback without an explicit AI component beyond automated scoring). Comparators were uniformly traditional or standard teaching, face-to-face simulation, or non-AI/non-adaptive versions of the same technology (e.g., 2D video versus immersive VR).

Emergency- and Critical-Care-Specific Subset

Six of the 15 trials (40%) were situated explicitly in emergency, resuscitation, or critical-care contexts: gamified augmented-reality training for mechanical ventilation in critical-care nursing students (Othman et al., 2024); a three-arm VR/AR trial for emergency-department knowledge and skills among nurses and nursing students (Castillo-Rodríguez et al., 2025); an AI- and sensor-integrated CPR retraining system evaluated against conventional face-to-face retraining in healthcare professionals (Ma et al., 2026); a VR-based CPR training trial in nursing students (Rizany et al., 2021); an AI chatbot–based prebriefing trial prior to acute-care simulation scenarios; and a pilot RCT of VR-based orientation for novice ICU nurses (2026 preprint). Findings in this subset were more mixed than in the general nursing-education subset: two of the six emergency-specific trials (Ma et al., 2026) reported no clear advantage of the

AI/VR intervention over standard training on their primary outcomes, while the remaining four reported favorable effects on knowledge, motivation, self-efficacy, or preparedness.

Outcomes Reported

Knowledge acquisition was the most frequently reported outcome (13 of 15 trials), followed by skill/psychomotor performance (9 trials), satisfaction (8 trials), self-efficacy or confidence (7 trials), and anxiety (4 trials). Of the 13 trials reporting knowledge outcomes, 10 reported a statistically significant improvement favoring the AI-assisted intervention, 2 reported no significant difference, and 1 (the CPR retraining trial by Ma et al., 2026) reported no evidence of superiority on its primary compression-quality outcomes. Anxiety findings were inconsistent: two trials reported reduced or unaffected anxiety with AI/VR-based training, while two others (Cobbett & Snelgrove-Clarke, 2016; Şimşek-Çetinkaya & Çakır, 2023) reported increased anxiety associated with the technology-based intervention, generally attributed to unfamiliarity with the new interface.

4. DISCUSSION

This scoping review identified 15 RCTs evaluating AI-assisted learning in nursing education, of which 6 were explicitly situated in emergency or critical care contexts. Three broad observations emerge from this mapping exercise. First, the evidence base is young and geographically concentrated. Twelve of the 15 included trials were published from 2022 onward, and six originated from a single country (Turkey), limiting generalizability across healthcare systems and educational cultures. This pattern mirrors the broader AI-in-nursing-education literature, in which recent systematic reviews and meta-analyses have similarly identified only a handful of RCTs meeting rigorous inclusion criteria (Jembu & Lee, 2025), underscoring that AI-assisted learning in nursing, and particularly in emergency nursing, remains an emerging rather than an established evidence base. Among the Turkish trials contributing to this concentration were studies evaluating AI-supported case analysis (Akutay et al., 2024), AI-assisted preparation of patient education materials (Saatçi et al., 2024), and VR-based CPR and ICU orientation training (Bodur et al., 2025; Terzi et al., 2026).

Second, effects on knowledge and skill outcomes were generally, but not uniformly, favorable. Consistent with the pooled small-to-moderate effect reported in prior meta-analytic work on AI and

nursing-student knowledge, most trials in this review reported improved knowledge or skills with AI-assisted interventions relative to traditional teaching. However, the two trials evaluating AI- or sensor-integrated systems against conventional face-to-face instruction for CPR retraining and ICU orientation, arguably the most emergency-relevant, high-stakes psychomotor and decision-making skills in this review, found no clear performance advantage for the technology-based intervention (Ma et al., 2026). This suggests that AI-assisted tools may add the most value for knowledge-oriented and lower-stakes procedural learning, while highly practiced psychomotor skills such as chest-compression technique may be less responsive to AI/sensor feedback than to hands-on instructor coaching, at least in single, short-duration training sessions. This favorable pattern for knowledge and skills outcomes is also consistent with earlier virtual-simulation trials (Gu et al., 2017; Kim & Suh, 2018; Padilha et al., 2019), as well as with more recent findings on gamified augmented-reality instruction (Othman et al., 2024) and AI-supported case analysis (Akutay et al., 2024).

Third, affective outcomes deserve closer attention, specifically in emergency nursing education. Anxiety increased in two trials involving unfamiliar simulation or virtual-reality technology (Cobbett & Snelgrove-Clarke, 2016; Şimşek-Çetinkaya & Çakır, 2023), a finding with particular relevance to emergency nursing, where managing stress and anxiety under pressure is itself a core competency. If AI-assisted tools introduce a novel source of technology-related anxiety during training, this could work against (rather than for) the goal of preparing learners for high-pressure clinical performance, unless adequate orientation and repeated exposure are built into curricula, as suggested by several included trials (Castillo-Rodríguez et al., 2025; Lo et al., 2022). AI-assisted personalized prebriefing, which improved perceived preparedness and confidence prior to simulation (Benfatah et al., 2025), and the finding of no clear anxiety-reduction advantage for VR-based ICU orientation over standard orientation (Terzi et al., 2026), further illustrate that affective outcomes in this literature remain mixed and intervention-specific.

Taken together, these findings suggest that AI-assisted learning is best positioned, on current evidence, as a complement to conventional emergency nursing instruction: valuable for scalable knowledge delivery, personalized prebriefing, and repeatable low-stakes practice, but not yet demonstrated to

outperform expert-led, hands-on instruction for the highest-stakes psychomotor skills central to emergency and resuscitation care.

5. CONCLUSION

This scoping review identified 15 randomized controlled trials evaluating AI-assisted learning in nursing education, six of which were explicitly situated in emergency, resuscitation, or critical care contexts. The evidence suggests that AI-assisted tools (including generative AI chatbots, adaptive virtual/augmented reality simulations, and AI- or sensor-integrated feedback systems) can improve knowledge, self-efficacy, and satisfaction in nursing education. However, evidence for their superiority over conventional, hands-on instruction for the highest-stakes psychomotor and decision-making skills central to emergency nursing remains limited and mixed. Given the small number of emergency-specific trials, their geographic concentration, and predominantly single-center, short follow-up designs, AI-assisted learning is currently a promising adjunct rather than a validated replacement for conventional emergency nursing education. Larger, multi-site, and longer-follow-up RCTs (with standardized outcome measures for both cognitive and psychomotor emergency-care competencies) are needed to determine whether, and under what conditions, AI-assisted learning meaningfully improves emergency nursing readiness and, ultimately, patient outcomes.

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AUTHOR CONTRIBUTIONS

NN was responsible for conceptualization, search strategy design, screening, data extraction, and manuscript preparation, supervised the review process, contributed to the methodological design, and critically revised the manuscript, contributed to data interpretation and provided critical review and final approval of the manuscript.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the publication of this article.

DATA AVAILABILITY STATEMENT

The data extraction table for this review is presented in full in Table 1.

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