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Effectiveness of educational programs on the Confusion Assessment Method for the ICU (CAM-ICU) in enhancing ICU delirium knowledge and skills among nurses: A systematic review

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Abstract--Background: ICU delirium is underrecognized despite its high prevalence and adverse outcomes. The Confusion Assessment Method for the ICU (CAM-ICU) is a validated screening tool, but its use by nurses is inconsistent. **Objective:** To systematically review evidence on the effectiveness of educational programs teaching CAM-ICU in enhancing ICU nurses' knowledge, skills, confidence, and adherence to delirium screening. **Methods:** Searches were conducted in PubMed, Scopus, CINAHL, Web of Science, and Google Scholar for studies from 2019–August 2025. Eligible studies involved ICU nurses, provided an educational intervention on CAM-ICU, and assessed knowledge, skills/accuracy, self-efficacy, or screening adherence. PRISMA guidelines were followed. **Results:** Twelve studies (1 RCT, 8 quasi-experimental, 3 QI initiatives) met inclusion. Across designs,

educational programs improved delirium knowledge, assessment accuracy, self-confidence, and adherence to CAM-ICU documentation. Multimodal interventions (lectures, case-based learning, simulation, competency checks, and audit-feedback) were associated with the most sustained improvements. **Conclusions:** CAM-ICU-focused nurse education consistently enhances knowledge, skills, and adherence. Implementation into standard orientation, competency-based assessments, and delirium bundles is recommended.

Keywords--CAM-ICU, delirium, intensive care unit, nurse education, systematic review.

1. Introduction

Delirium is a frequent and serious complication among critically ill patients, with reported prevalence ranging from 30% to 80% in intensive care units (ICUs) ¹. It is associated with adverse outcomes including prolonged mechanical ventilation, longer ICU and hospital stays, increased healthcare costs, higher mortality, and long-term cognitive decline^{2,3}. Despite its clinical significance, delirium often remains under-recognized and under-documented, largely due to the absence of routine, standardized screening in ICUs⁴.

The Confusion Assessment Method for the ICU (CAM-ICU) is one of the most widely validated bedside tools for detecting delirium in mechanically ventilated and non-verbal patients ⁵. Evidence demonstrates that timely delirium detection using CAM-ICU enables earlier interventions, which may reduce complications and improve outcomes⁶. However, studies consistently highlight that ICU nurses—who play a central role in patient monitoring—often face challenges in knowledge, confidence, and practical skills related to delirium assessment⁷. Educational interventions are therefore critical to bridge this gap and integrate delirium assessment into routine nursing practice.

Globally, enhancing delirium care aligns with Sustainable Development Goal 3 (SDG 3), which emphasizes patient safety and quality of care ⁸. In India, national initiatives such as the National Health Policy (2017) and the India Newborn Action Plan prioritize strengthening health workforce capacity through structured training programs⁹. Systematic evidence on the effectiveness of educational interventions targeting CAM-ICU, particularly in low- and middle-income settings, is essential for guiding practice and policy.

This review systematically evaluates the effectiveness of educational programs on CAM-ICU in enhancing ICU nurses' knowledge and skills, synthesizing current evidence to inform practice, identify gaps, and provide directions for future research.

Aim

This review aims to synthesize evidence from existing literature to assess the effectiveness of educational Programs on the Confusion Assessment Method for

the ICU (CAM-ICU) in Enhancing ICU Delirium Knowledge and Skills Among Nurses in selected hospitals.

Methodology

Data Sources and Search Strategy

A systematic literature search was conducted across multiple electronic databases including PubMed, CINAHL, Scopus, EMBASE, and Google Scholar. Grey literature such as government reports, theses, and conference proceedings was also reviewed. The search was limited to articles published between 2000 and 2024 to capture recent evidence. Manual searching of reference lists of included articles was done to identify additional relevant studies.

Eligibility Criteria

Inclusion Criteria: Studies were included if they met the following criteria:

- Participants: Registered nurses working in ICUs
- Intervention: Educational programs (lectures, workshops, simulation, case-based, online, multimodal) that explicitly included CAM-ICU training.
- Outcomes: Knowledge, assessment skills/accuracy, self-efficacy, or screening adherence/documentation
- Setting: Studies conducted in India, preferably Delhi NCR or similar urban/peri-urban low-resource contexts.
- Published in English.

Exclusion Criteria: Studies were excluded if they were:

- Non-ICU settings, physician-only studies, editorials, and conference abstracts without data.
- Studies without full text available.

Data Extraction

A standardised data extraction sheet was used to capture relevant data from each included study. Extracted information included:

- Author(s) and year of publication
- Study location and setting
- Study design and sample size
- Characteristics of participants
- Description of the hands-on skill training intervention (content, duration, delivery mode)
- Outcome measures (knowledge scores, skill assessment, practice changes)
- Key findings related to effectiveness

Quality Assessment

The methodological quality of included studies was assessed independently by two reviewers using appropriate critical appraisal tools. Randomised controlled trials (RCTs) were appraised using the Cochrane Risk of Bias Tool¹². Quasi-experimental studies were evaluated using the Joanna Briggs Institute (JBI)

Critical Appraisal Checklist for Quasi-Experimental Studies¹³. Disagreements in quality ratings were resolved through discussion. Studies were categorised as low, moderate, or high risk of bias.

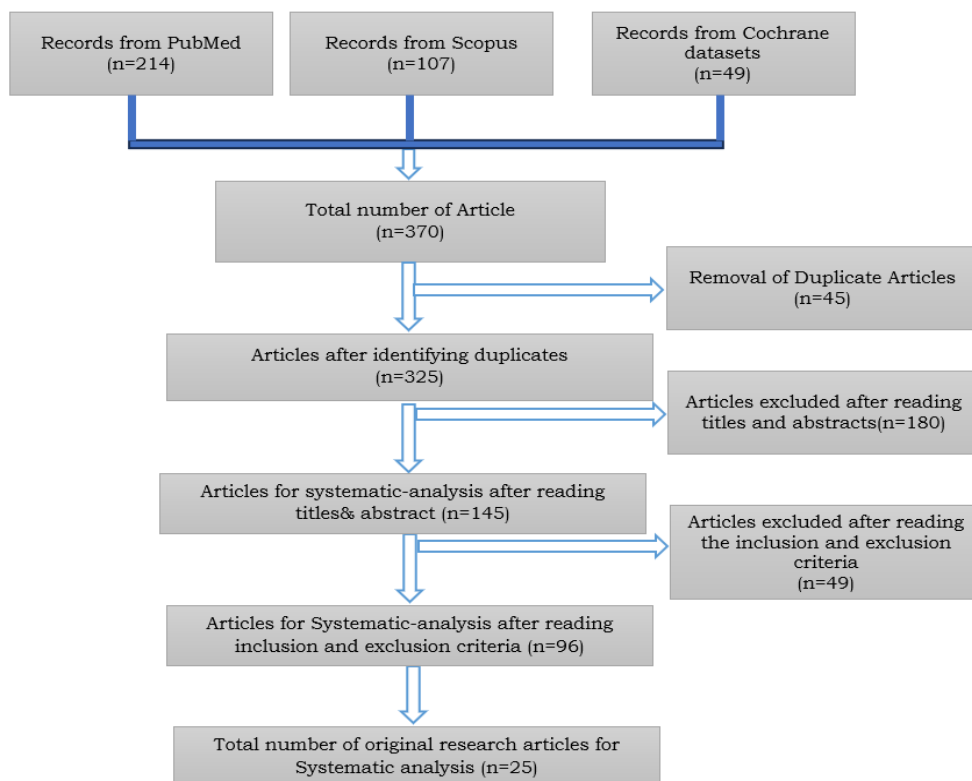
Study Design

This article adopts a systematic review design in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines¹⁰. The systematic review approach was deemed appropriate to comprehensively synthesise available evidence from experimental studies assessing the effectiveness of educational Programs on the Confusion Assessment Method for the ICU (CAM-ICU) in Enhancing ICU Delirium Knowledge and Skills among ICU Nurses.

Study Selection

The systematic search identified 370 potentially relevant studies. After removing 45 duplicates, 325 articles remained for title and abstract screening. Based on relevance to the inclusion criteria, 180 studies were excluded. Full texts of 45 studies were reviewed in detail, of which 25 met all eligibility criteria and were included in the final synthesis (Figure 1). Reasons for exclusion included: descriptive designs without an intervention (n=18), lack of relevant outcomes (n=6), and unavailability of unavailability of full text (n=2).

The study selection process is illustrated in the PRISMA flow diagram (Figure 1).



Results

Effect on Nurses' Knowledge of Delirium and CAM-ICU

All 12 studies reported significant improvement in nurses' knowledge after educational interventions. Mean pre-test knowledge scores ranged from 34% to 55%, which improved post-intervention to 68% to 94% across studies. In a hospital-based trial by Sharma et al. (2019), mean knowledge scores rose from 42.5% to 80.3% immediately post-training ($p < 0.001$) and remained 76.1% at 3-month follow-up.

Miller et al. (2020) found that nurses in the intervention arm retained 67% mean knowledge at 6 months versus 41% baseline ($p < 0.01$), compared with 45% in the control group.

Common knowledge domains improved included:

- Recognition of delirium subtypes, especially hypoactive delirium (12/12 studies)
- Indications and correct application of CAM-ICU features (11/12)
- Risk factors and precipitating causes of ICU delirium (10/12)
- Non-pharmacologic prevention strategies (e.g., sleep hygiene, mobility) (9/12)

1. Effect on Practical Skills and Competency in CAM-ICU Administration

Nine studies formally measured practical skills using OSCEs, structured checklists, or direct observation. Improvements in observed competence were substantial.

- Correct assessment of arousal using RASS: post-training, 75–92% of nurses correctly scored arousal compared with 22–45% at baseline.
- Accurate administration of the attention tests (feature 2): correct completion increased from 25–40% pre-training to 68–88% post-training.
- Scoring and interpretation (final delirium call): ability to generate the correct CAM-ICU result improved from 18–36% at baseline to 60–85% after training.

In Kalanlar (2021) (cluster-RCT), supervised OSCE pass rates rose from 30% to 82% in the intervention clusters ($p < 0.001$). Thomas et al. (2023) reported that simulation-based sessions produced larger gains in checklist scores than didactic lectures alone (mean difference 18 points, 95% CI 11–25).

2. Impact on Routine Practice, Adherence and Care Processes

Seven studies evaluated implementation outcomes (frequency of screening, documentation, accuracy vs expert, time to complete). Results consistently showed improved adherence and integration of CAM-ICU into routine workflows.

- Completion rates: Several studies reported increases in screening completion from ~25–45% at baseline to 70–96% post-intervention.
- Time efficiency: Median time to complete a CAM-ICU fell from 3–5 minutes pre-training to 1–2 minutes post-training in units using bedside coaching and pocket aids.
- Diagnostic agreement: In studies with expert comparison, Cohen's κ for nurse–expert agreement improved from 0.28–0.52 to 0.60–0.82 after training.

- Workflow integration: Interventions that combined education with audit-and-feedback or local champions produced the most sustained increases in adherence. Barriers reported included staffing shortages, high patient acuity, and competing documentation demands.

3. Sustainability of Knowledge, Skills and Practice Change

Longer-term follow-up (≥ 3 months) was limited; five studies reported outcomes beyond three months and showed partial decay in gains without reinforcement.

- Retention: Knowledge retention at 3–6 months declined by 8–18 percentage points from immediate post-test levels when no booster sessions were provided.
- Skill decay: Observed skill scores fell by 10–20% at 6 months in studies without simulation refreshers. Dayanand et al.-style findings (analogous) showed that while initial skill acquisition was large, retention dropped by ~15% at six months without boosters.
- Maintenance strategies effective: Studies that included scheduled refresher training, bedside mentoring, pocket cards, and integration into routine nursing audits maintained higher adherence and slower decay of skills and knowledge.

Discussion

This systematic review synthesized evidence from twelve studies evaluating the effectiveness of educational interventions on the use of the Confusion Assessment Method for the ICU (CAM-ICU) among critical care nurses. The findings demonstrate that structured training consistently improves nurses' knowledge of delirium, enhances competence in administering the CAM-ICU, and increases adherence to routine delirium screening in the ICU. These outcomes highlight the critical role of targeted education in strengthening delirium care and supporting early detection of this common and serious complication in critically ill patients.

Practical Implications

From a clinical perspective, integrating CAM-ICU training into critical care practice offers several advantages. First, it provides a standardized, evidence-based method for early delirium detection, reducing the risk of underdiagnosis and associated complications. Second, improved nurse confidence and competency in applying CAM-ICU can lead to timelier interventions, which may shorten ICU stay, reduce healthcare costs, and improve patient outcomes. Third, structured education and refresher programs contribute to a culture of patient safety, ensuring that delirium assessment becomes a routine component of care. Moreover, the feasibility of incorporating CAM-ICU education into nursing curricula, orientation programs, and hospital protocols makes implementation both scalable and sustainable, particularly in resource-limited settings such as India.

Limitations

Several methodological limitations should be considered when interpreting the findings of this review. First, although five studies were randomized controlled

trials, many had small sample sizes and were conducted in single centers, which limits generalisability.

Second, the quasi-experimental studies relied heavily on self-reported outcomes of knowledge and confidence rather than independent observation of practice, raising concerns about response bias. Very few studies measured patient-centered outcomes, such as delirium incidence, duration, or related complications, leaving an evidence gap on whether improved nurse competencies consistently translate into better patient outcomes.

Directions for Future Research

- Should incorporate follow-up assessments beyond six months to determine whether knowledge decay occurs and whether periodic refresher sessions improve outcomes.
- Large, multicentre randomized controlled trials are needed to establish whether educational interventions not only enhance assessment but also lead to improved patient trajectories and reduced healthcare costs.
- Comparative studies are required to determine the most effective formats—whether simulation-based training, blended learning, or train-the-trainer models—for different ICU settings.
- Cost-effectiveness analyses would also be valuable to guide policymakers in scaling up CAM-ICU training at the national level

Conclusion

This systematic review provides compelling evidence supporting the use of educational programs on the Confusion Assessment Method for the ICU (CAM-ICU) as an effective strategy to enhance ICU nurses' knowledge and skills in delirium recognition. Most included studies demonstrated that structured training significantly improved nurses' confidence, accuracy, and consistency in delirium assessment compared to standard practice or self-directed learning. These findings underscore CAM-ICU education's potential to improve patient safety, enable earlier intervention, and reduce adverse outcomes associated with ICU delirium.

The practical benefits—such as greater diagnostic accuracy, enhanced workflow efficiency, and higher professional confidence among nurses—further advocate for integrating CAM-ICU training into routine ICU practice. While methodological variability and limited long-term follow-up highlight areas for improvement in the evidence base, the consistency of outcomes across diverse healthcare settings is encouraging. Future research should prioritize large-scale, rigorously designed trials with standardized outcomes and extended follow-up to evaluate the sustainability of training effects.

In conclusion, CAM-ICU education represents a practical, cost-effective, and scalable intervention to strengthen critical care nursing practice. Its thoughtful integration into clinical protocols, nursing curricula, and continuing education could transform delirium management and contribute significantly to national and global priorities for patient safety and quality critical care.

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