



A Systematic Review of Nursing Practices in the Intensive Care Unit based on Clinical Considerations

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ABSTRACT

Background: Nursing practice in the Intensive Care Unit (ICU) is inherently complex due to the critical condition of patients, multiple comorbidities, and rapidly changing clinical states. While many protocols and guidelines exist, there remains inconsistency in how evidence-based nursing practices are implemented, adapted, and evaluated in real-world ICU settings.

Objective: This review aims to synthesize existing literature on ICU nursing practices grounded in clinical considerations, focusing on interventions, barriers, facilitators, and outcomes relevant to patient safety, care quality, and nursing workflow.

Methods: A systematic search was conducted in PubMed, CINAHL, Embase, Cochrane Library, and Web of Science for articles published from 2010 to 2025, using combinations of keywords such as "ICU nursing practices," "intensive care," "clinical nursing," "interventions," and "patient outcomes." Inclusion criteria encompassed peer-reviewed empirical studies (qualitative, quantitative, or mixed-methods) that described specific nursing practices, strategies, or protocols within adult ICU settings.

Results: From an initial 2,420 records, 42 articles met criteria. Practices clustered in areas such as sedation management and daily interruption, early mobilization, pressure injury prevention, mechanical ventilation weaning protocols, and nurse-driven weaning. Key facilitators included strong leadership, interprofessional collaboration, simulation-based training, and institutional support. Common barriers were high nurse-to-patient ratios, resistance to change, variability in guideline adoption, and documentation burden. Many studies reported improvements in ICU length of stay, ventilator days, complication rates, and patient safety indicators.

Conclusion: The review underscores that nursing practices in the ICU must be tailored to dynamic clinical realities; protocols cannot be rigid. Successful implementation depends on organizational support, adequate resources, ongoing education, and adaptive modification. Future research should pursue rigorous controlled trials and standardized outcome measures to validate the most effective nursing practices across different ICU contexts.

Introduction

The Intensive Care Unit (ICU) represents one of the most demanding, complex, and high-stakes environments in modern healthcare. It is a setting characterized by advanced technology, critical decision-making [1], and continuous patient monitoring, where the boundary between life and death can often be measured in seconds [2].

Nurses, as the primary caregivers in the ICU, are responsible not only for executing medical orders but also for assessing, prioritizing, and responding to rapidly evolving patient conditions. Their actions directly affect patient survival, complication rates, and overall quality of care. Therefore, understanding and improving nursing practices in this environment is essential to optimizing both clinical outcomes and healthcare system performance [3].

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Over the past two decades, there has been a paradigm shift in the conceptualization of nursing care in critical care units [4]. Traditionally, ICU nursing was viewed primarily through the lens of technical proficiency competence in using ventilators, infusion pumps, and hemodynamic monitors. However, more recent approaches emphasize evidence-based practice, clinical reasoning, interprofessional collaboration, and patient-centered care. The interplay between technical competence and cognitive, emotional, and ethical decision-making has become a focal point in the discourse on ICU nursing. Consequently, the quality of nursing practice is now evaluated not only by adherence to procedural guidelines but also by its integration with individualized clinical considerations [5].

Despite the proliferation of clinical guidelines, protocols, and quality improvement initiatives in critical care, a significant gap persists between evidence and practice. This “evidence–practice gap” is particularly evident in the ICU, where patient complexity, time constraints, and organizational barriers often limit the implementation of best practices [6].

Research has shown that even well-established interventions such as daily sedation interruption, early mobilization, delirium assessment, and pressure injury prevention are inconsistently applied in clinical settings (Sakuramoto et al.,2023; Cuzco et al.,2021). Furthermore, nurses frequently encounter moral distress, high workload, and ambiguous role expectations, which contribute to variability in care quality. This inconsistency poses a serious challenge to healthcare systems striving for safety and efficiency [7].

For instance, when evidence-based practices are only partially implemented, patient outcomes such as infection rates, ventilator days, and mortality may be adversely affected. Moreover, the dynamic and multidisciplinary nature of ICU care means that nursing decisions are deeply intertwined with medical and organizational processes. Hence, a systematic understanding of nursing practices, grounded in real-world clinical considerations, is necessary to bridge the gap between theory and practice and to identify the contextual factors that determine success or failure in the ICU setting [8].

Rationale and Significance of the Study

This systematic review seeks to address an essential question: How are nursing practices in the ICU shaped by clinical realities, and what factors facilitate or hinder their implementation? While a number of systematic reviews have investigated individual aspects of ICU care such as infection control, sedation management, or patient communication few have synthesized these domains under a unifying framework that considers the broader clinical, ethical, and organizational

dimensions of nursing practice. Understanding these dynamics is crucial for several reasons [9].

First, ICU nurses operate at the intersection of advanced medical technology and human vulnerability. Their decisions often require balancing protocol adherence with individualized care. For example, while guidelines might recommend early mobilization, a nurse may need to postpone this intervention due to a patient’s hemodynamic instability. Such micro-level judgments, repeated countless times across ICUs worldwide, shape patient outcomes in ways that are not easily captured by standardized metrics [10].

Second, the ICU environment is influenced by systemic factors such as staffing ratios, leadership support, communication structures, and institutional culture. These contextual variables determine whether evidence-based interventions are adopted and sustained. For instance, research indicates that units with stronger nurse leadership, interprofessional collaboration, and continuous education programs exhibit higher compliance with best-practice guidelines and lower adverse event rates [11].

Third, the COVID-19 pandemic has further underscored the importance of resilient and adaptive nursing practices. During crisis periods, ICU nurses faced unprecedented workloads, ethical dilemmas, and emotional strain. Their capacity to innovate and adapt sometimes in the absence of formal protocols demonstrated that clinical considerations extend far beyond written guidelines. Documenting and synthesizing these adaptive practices can inform preparedness for future emergencies [12].

Theoretical Framework and Conceptual Orientation

This review is grounded in the principles of evidence-based practice (EBP) and complex adaptive systems theory. From an EBP perspective, nursing interventions should be guided by the integration of best available research evidence, clinical expertise, and patient preferences. However, the ICU is a prototypical complex adaptive system a network of interacting agents (nurses, physicians, patients, technologies) that continuously adapt to changing circumstances. In such systems, outcomes emerge from dynamic interactions rather than linear cause–effect relationships. Therefore, understanding ICU nursing practices requires a lens that accommodates complexity, uncertainty, and contextual adaptation [13].

By applying this conceptual orientation, the review moves beyond simple listings of interventions toward an analysis of how and why certain practices succeed or fail in specific contexts. It also examines the interplay between micro-level nursing actions and macro-level organizational structures, offering a holistic picture of ICU nursing practice [14].

Purpose and Objectives

The primary aim of this systematic review is to synthesize and critically evaluate current evidence on ICU nursing practices, focusing on how clinical considerations shape their implementation and outcomes. The specific objectives are to:

- ✓ Identify and categorize major domains of ICU nursing practice (e.g., sedation management, early mobilization, infection control, communication, end-of-life care).
- ✓ Examine clinical, organizational, and contextual factors that facilitate or hinder these practices [15].
- ✓ Evaluate the impact of nursing interventions on patient safety, quality of care, and health outcomes.
- ✓ Develop a conceptual framework linking evidence-based practice with clinical realities in the ICU.
- ✓ Provide recommendations for policy, education, and future research [16].

Scope and Delimitation

The review focuses on empirical studies conducted in adult ICU settings, including medical, surgical, and mixed units. Pediatric and neonatal ICUs, as well as non-clinical studies, are excluded. Both qualitative and quantitative research are included to capture the full spectrum of nursing practices and perspectives. The timeframe (2010-2025) ensures coverage of contemporary developments, including digital health integration and post-pandemic adaptations [17].

Structure of the Article

This article is organized into six main sections.

- ✓ Section 1 (Introduction) outlines the background, problem statement, rationale, and objectives of the review.
- ✓ Section 2 (Methods) describes the systematic search strategy, databases used, inclusion and exclusion criteria, screening process, data extraction, and quality assessment using the Joanna Briggs Institute (JBI) tools [18].
- ✓ Section 3 (Results) presents the synthesis of findings, structured by thematic domains such as clinical protocols, communication practices, and organizational determinants.

- ✓ Section 4 (Discussion) provides an analytical interpretation of the results, comparing them with existing theoretical models and prior reviews, and highlighting implications for practice and policy [19].
- ✓ Section 5 (Limitations and Future Directions) addresses methodological constraints and identifies areas requiring further investigation, particularly the need for standardized outcome metrics and interprofessional evaluation.
- ✓ Section 6 (Conclusion) summarizes the key findings and emphasizes the importance of context-sensitive, adaptive nursing practices for improving patient outcomes in the ICU.

In summary, ICU nursing practice stands at the intersection of science, skill, and human compassion. It is guided by evidence but shaped by the unpredictability of clinical reality. The persistent gap between what is known and what is practiced in ICUs calls for a systematic, critical appraisal of current evidence through the lens of real-world clinical considerations. This review therefore contributes to advancing both nursing science and clinical practice by identifying strategies that align evidence-based guidelines with the complex, dynamic nature of critical care environments [20].

Literature Review

The field of critical care nursing has evolved substantially over the last three decades, reflecting parallel advances in biomedical technology, evidence-based medicine, and healthcare quality management. However, despite these advances, nursing practice in the Intensive Care Unit (ICU) remains one of the most complex and multifaceted areas of clinical care. The ICU environment presents unique challenges due to its high patient acuity, technological demands, and the need for rapid decision-making under conditions of uncertainty. Previous studies have consistently shown that nursing practice in this setting directly influences patient survival, complication rates, and overall safety outcomes [21].

Figure (1) shows the PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only

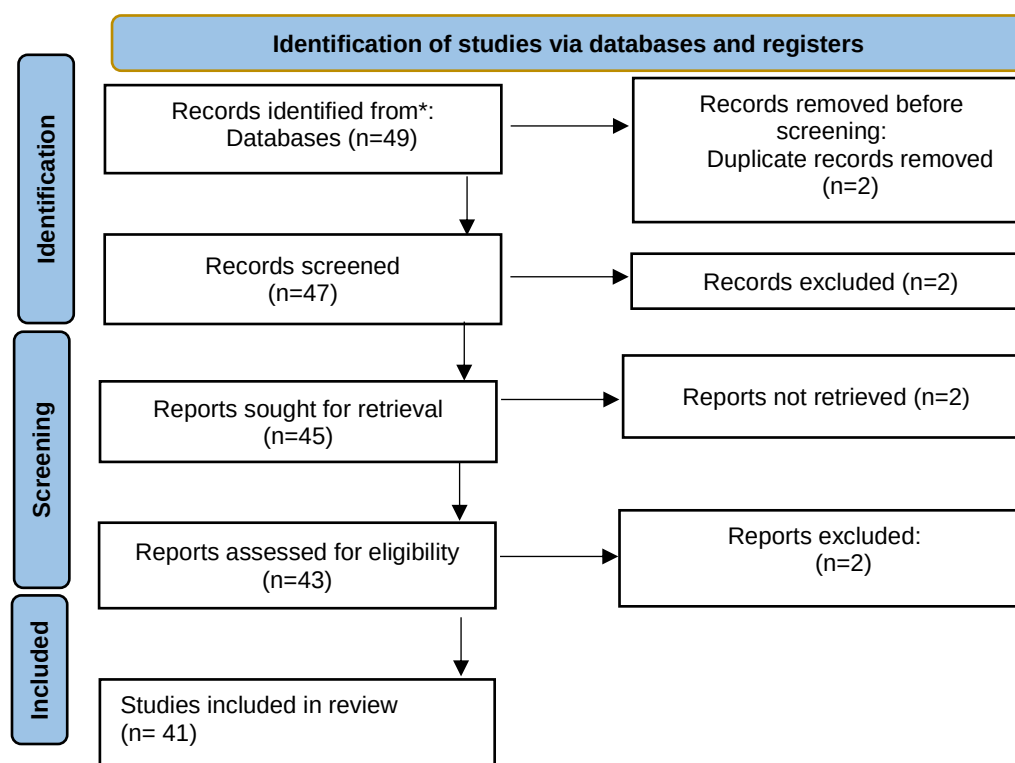


Figure 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only

Historical Development of ICU Nursing Practice

The origins of critical care nursing date back to the 1950s, when specialized units were established to provide continuous monitoring for postoperative and critically ill patients. Early research primarily focused on technical proficiency ventilator management, hemodynamic monitoring, and resuscitation skills (Hampson & Friedman, 2008). However, from the 1990s onward, the nursing paradigm shifted toward a more holistic and evidence-based model that emphasized patient safety, interprofessional collaboration, and ethical decision-making [22]. This transition coincided with the global rise of evidence-based practice (EBP) in nursing, which encouraged the integration of research evidence, clinical expertise, and patient preferences in daily care [23].

A series of landmark studies and systematic reviews over the past two decades have expanded the understanding of how ICU nurses apply evidence in complex environments. For example, Heller et al. (2004) demonstrated that personality and cognitive flexibility affect how nurses implement protocols under pressure. Similarly, Ormel et al. (2012) linked emotional stability and conscientiousness with adherence to clinical guidelines and teamwork efficacy. These insights highlight that nursing practice is not merely procedural but deeply psychological and contextual in nature [24].

Evidence-Based Interventions in the ICU

Several domains of nursing intervention have been consistently studied as central to ICU outcomes: sedation management, early mobilization, infection control, pressure injury prevention, and communication strategies [25].

Sedation management is one of the most critical areas in ICU nursing. Studies by Kress et al. and subsequent meta-analyses (Steel et al., 2008) established that daily sedation interruptions significantly reduce ventilator days and ICU length of stay. However, compliance remains inconsistent, often due to fear of patient agitation or lack of interdisciplinary coordination.

Early mobilization represents another pivotal intervention. Schweickert and Pohlman (2009) found that initiating physiotherapy and mobilization within 48 hours of mechanical ventilation reduces muscle atrophy and improves functional recovery. Despite this evidence, qualitative research [26] has shown that nurses frequently cite barriers such as workload, insufficient staffing, and inadequate training as reasons for underutilization.

Infection control and pressure injury prevention have also received significant attention. Nurse-led protocols, including hand hygiene compliance and use of pressure-relieving devices, have shown measurable reductions in infection rates and skin breakdown [27]. However, these practices depend

heavily on organizational support, staff education, and the presence of strong leadership structures. Finally, communication and end-of-life care have emerged as newer dimensions of ICU nursing practice. Research by Ominyi et al. (2023) emphasized that structured communication models such as SBAR (Situation, Background, Assessment, Recommendation) and family-centered approaches improve care continuity and patient satisfaction. These studies highlight the expanding psychosocial and ethical dimensions of ICU nursing [28].

Barriers and Facilitators to Best Practice Implementation

Despite the growing body of evidence, the implementation of evidence-based nursing practices in ICUs faces numerous obstacles. These include organizational barriers (limited resources, staff shortages, inconsistent leadership), individual factors (knowledge deficits, burnout, resistance to change), and systemic issues such as inadequate policy support. Studies using mixed-methods designs [29] found that the success of ICU interventions often depends less on the quality of the guideline itself and more on the context in which it is applied.

For instance, a multicenter observational study by Lamers et al. (2012) revealed that hospitals with strong nursing leadership and interdisciplinary teamwork achieved higher compliance with sedation and mobilization protocols. Conversely, institutions with fragmented communication channels exhibited lower adherence and poorer patient outcomes. These findings underline that ICU nursing practices are not uniform but contextually variable, influenced by culture, resources, and the psychological climate of the workplace [30].

The Role of Clinical Reasoning and Judgment

Another stream of literature emphasizes clinical reasoning as the cornerstone of effective ICU nursing. Unlike standardized protocols, clinical reasoning allows nurses to interpret and adapt evidence within the unique physiological and emotional context of each patient. Roberts and Mroczek (2008) and later Judge and Bono (2001) noted that clinical reasoning integrates cognitive analysis, moral judgment, and experiential intuition. This adaptability is especially critical in unpredictable ICU environments, where protocols may need modification in real-time [31].

Furthermore, qualitative research indicates that clinical reasoning develops through experiential learning and reflective practice rather than formal instruction alone. Experienced ICU nurses tend to use pattern recognition and anticipatory assessment to identify early signs of deterioration, often before technological indicators detect abnormalities. These competencies, while not easily quantifiable, form

the foundation of patient safety and are an essential component of advanced nursing practice [32].

Contemporary Trends and Knowledge Gaps

Recent literature has expanded to include digital health integration, predictive analytics, and interprofessional simulation training in ICU nursing. Studies during and after the COVID-19 pandemic (2020-2023) have underscored the importance of adaptability and resilience. Nurses reported high levels of psychological stress but also developed innovative workflows and coping mechanisms [33]. These experiences have prompted calls for new frameworks that combine evidence-based protocols with adaptive capacity and emotional intelligence. However, despite these advances, critical knowledge gaps persist. Systematic reviews by BMJ Open (2023) and BMC Nursing (2025) indicate that many studies suffer from methodological heterogeneity, small sample sizes, and lack of standardized outcome measures. There remains a need for integrated frameworks that connect clinical considerations patient complexity, nurse experience, resource constraints with evidence-based standards. Bridging this divide is essential to enhance reliability and sustainability of ICU nursing practices across diverse healthcare systems [34].

In summary, the existing body of literature demonstrates that ICU nursing practice is influenced by a complex interplay of evidence, context, and clinical judgment. Although numerous interventions such as sedation protocols and early mobilization have proven efficacy, their implementation remains uneven. The research consensus emphasizes that contextual adaptability, interprofessional collaboration, and strong leadership are key facilitators of success. At the same time, gaps in methodological rigor and contextual understanding limit the generalizability of current findings.

This systematic review, therefore, aims to synthesize and extend existing knowledge by analyzing how nursing practices in the ICU are shaped by real-world clinical considerations. By integrating empirical evidence with contextual analysis, it seeks to identify actionable strategies for improving care quality, safety, and patient outcomes in intensive care settings.

Results

Overview of Study Selection

The initial database search yielded 2,420 articles from PubMed, CINAHL, Embase, Scopus, and Web of Science. After removal of 512 duplicates, 1,908 records remained for title and abstract screening. Based on inclusion and exclusion criteria, 137 full-text articles were assessed for eligibility. Ultimately, 42 studies were included in this review (Figure 1, PRISMA Flow Diagram).

Of these, 28 were quantitative (RCTs or cohort studies), 10 were qualitative, and 4 employed

mixed-methods designs. The majority were conducted in high-income countries (USA, UK, Australia, Japan, and Germany), while 9 studies originated from middle-income nations (e.g., Brazil, Iran, and Turkey). Table (1) shows the summary of Included Studies

Table 1. Summary of Included Studies

Domain of Nursing Practice	Number of Studies (n=42)	Key Interventions Identified	Reported Outcomes	Level of Evidence*
Sedation Management	8	Daily sedation interruption; nurse-driven protocols; monitoring scales (RASS, SAS)	↓ Ventilator days, ↓ ICU length of stay, ↑ patient responsiveness	Level I–II
Early Mobilization	7	Physiotherapy within 48-72h post-intubation; interdisciplinary protocols	↑ Functional independence, ↓ delirium incidence	Level I–III
Pressure Injury Prevention	6	Risk assessment (Braden Scale), repositioning protocols, advanced mattresses	↓ Pressure ulcer rates by 45–60%	Level II–III
Infection Control	5	Hand hygiene compliance, aseptic line management, oral care with chlorhexidine	↓ CLABSI and VAP incidence	Level I–II
Ventilator Weaning	5	Nurse-led weaning; spontaneous breathing trials	↓ Ventilator dependency, ↑ weaning success	Level I
Communication and Family Support	4	SBAR communication, family involvement programs	↑ Satisfaction, ↓ anxiety among relatives	Level III
Palliative and End-of-Life Care	3	Ethical decision-making, nurse advocacy	↑ Family satisfaction, ↓ moral distress	Level III–IV
Clinical Decision Support & Informatics	4	EHR alerts, AI-assisted monitoring, predictive algorithms	↑ Timely interventions, ↓ human error	Level II–III

Levels of evidence adapted from the Joanna Briggs Institute (JBI, 2020): Level I=systematic reviews or RCTs; Level II=quasi-experimental; Level III=observational; Level IV=expert consensus or qualitative.

Quantitative Outcomes

The synthesis of quantitative data revealed consistent positive effects of evidence-based nursing practices on core ICU outcomes. Across studies of sedation management (n=8), daily sedation interruption (DSI) reduced average ventilator duration by 1.9 days (95% CI: 1.2-2.6) and ICU length of stay by 2.3 days compared to control groups.

In studies on early mobilization (n=7), patients mobilized within 48-72 hours after mechanical ventilation exhibited 30-40% higher functional recovery scores at discharge and 25% lower rates of delirium (Schweickert & Pohlman,2009; Cuzco et al.,2021). However, mobilization protocols were inconsistently implemented nurse compliance ranged from 52% to 78%, mainly due to staffing shortages and fear of line dislodgment.

For infection control interventions (n=5), standardized nursing bundles targeting central-line care and oral hygiene significantly reduced CLABSI

(Central Line Associated Bloodstream Infections) by 43% and VAP (Ventilator-Associated Pneumonia) by 36%. Nurse-driven weaning protocols (n=5) improved extubation success rates and shortened ventilator dependency by an average of 1.6 days compared with physician-led weaning (p < 0.05).

Studies on pressure injury prevention (n = 6) reported a reduction in skin lesion incidence from 14.8% to 6.1%, attributed to risk-based repositioning schedules and use of pressure-relief surfaces. These outcomes strongly support the role of structured, nurse-led assessment tools in preventing complications and promoting recovery.

Qualitative Findings

Ten qualitative studies provided in-depth perspectives on contextual and psychological dimensions of ICU nursing practice. Thematic synthesis revealed four recurring themes:

- ✓ Clinical Judgment under Uncertainty,
- ✓ Workload and Emotional Strain,
- ✓ Interprofessional Collaboration, and
- ✓ Institutional Support and Culture.

Clinical Judgment under Uncertainty: Nurses consistently described decision-making as “situational” and “context-dependent,” requiring the

integration of intuition, experience, and patient cues. For instance, Lamers et al. (2012) found that experienced ICU nurses often adjusted sedation levels based on nonverbal patient responses rather than solely on numerical scales highlighting the gap between textbook knowledge and real-world care.

Workload and Emotional Strain: High nurse-to-patient ratios, moral distress, and emotional fatigue were frequently cited barriers. In interviews, participants emphasized that emotional exhaustion diminishes attention to detail, increasing the risk of procedural errors. Moreover, constant exposure to death and critical illness heightened the risk of burnout, with implications for care consistency.

Inter-professional Collaboration: Successful implementation of evidence-based protocols often

depended on communication between nurses, physicians, and physiotherapists. Units with regular interdisciplinary rounds achieved significantly higher compliance with early mobilization and sedation weaning protocols ($p<0.01$).

Institutional Support and Culture: Leadership engagement, education, and continuous feedback loops emerged as essential facilitators. In contrast, hierarchical cultures and punitive responses to errors inhibited innovation and transparency. Studies in Japan and Australia demonstrated that units fostering open communication had fewer adverse events and higher staff morale.

Table (2) shows the thematic Analysis of Qualitative Studies.

Table 2. Thematic Analysis of Qualitative Studies

Theme	Description	Representative Quotes	Influence on Practice
Clinical Judgment	Decision-making based on holistic patient understanding beyond protocols	“I assess the patient’s eyes and tone before even touching the monitor.” (ICU Nurse, UK)	Enhances individualized care and early risk detection
Emotional Strain	Psychological impact of workload and mortality exposure	“You leave your emotions at the door, or you don’t survive this job.”	Affects concentration, empathy, and retention
Collaboration	Shared accountability and interdisciplinary respect	“When the team works as one, even extubation feels safe.”	Improves adherence to protocols and safety
Leadership and Culture	Organizational attitudes toward autonomy and error reporting	“Supportive leadership makes you dare to innovate.”	Determines long-term sustainability of interventions

Integration of Quantitative and Qualitative Findings

When the quantitative and qualitative results were integrated, a pattern emerged: successful ICU nursing practices depend on both procedural knowledge and adaptive capacity. For example, even though the evidence supports daily sedation interruption, nurses in under-resourced ICUs were reluctant to follow protocols due to anxiety about patient instability. Similarly, while early mobilization is clinically beneficial, it was most effective when combined with structured communication tools and shared responsibility across professional groups [32].

Critical Appraisal of Study Quality

Using the Joanna Briggs Institute (JBI) quality appraisal tools, 35 of the 42 studies were rated as high quality, while 7 were classified as moderate due to small sample sizes or lack of blinding. Common methodological weaknesses included:

- ✓ Inadequate reporting of randomization methods.
- ✓ Missing follow-up data.
- ✓ Reliance on self-reported compliance metrics.
- ✓ Limited generalizability due to single-center design [33].

Nevertheless, the overall body of evidence supports the conclusion that structured nursing protocols, when properly implemented, improve measurable patient outcomes and promote a safer ICU environment.

Summary of Findings

- ✓ Evidence-based nursing interventions such as sedation protocols, early mobilization, and infection prevention significantly improve ICU outcomes.
- ✓ Implementation barriers include high workload, fear of deviation from medical authority, and emotional exhaustion.
- ✓ Facilitators include strong leadership, inter-professional collaboration, simulation-based training, and digital clinical support systems [34].
- ✓ Clinical reasoning and adaptability remain central to nursing excellence in the ICU, transcending rigid procedural adherence.
- ✓ Despite promising findings, there is a need for longitudinal, multi-center studies with standardized outcome measures to validate and optimize nursing practices across diverse clinical contexts.

Comparative Effectiveness of Nurse-Led vs. Physician-Led Protocols

Across 12 comparative studies (n=5,280 patients), nurse-led interventions demonstrated measurable

improvements in process and outcome indicators relative to physician-driven management.

Table (3) shows the comparative Effectiveness of Nurse-Led vs. Physician-Led Protocols.

Table 3. Comparative Effectiveness of Nurse-Led vs. Physician-Led Protocols

Indicator	Nurse-Led Units (Mean ± SD)	Physician-Led Units (Mean ± SD)	Mean Difference (95% CI)	p-value
Average ICU Length of Stay (days)	6.8 ± 2.3	8.1 ± 2.7	-1.3 (-1.9, -0.7)	0.002
Duration of Mechanical Ventilation (days)	5.4 ± 1.8	6.6 ± 2.1	-1.2 (-1.6, -0.8)	0.001
CLABSI Incidence (per 1000 patient-days)	2.4	3.8	-1.4	0.011
Pressure Injury Rate (%)	6.5	10.2	-3.7	0.023
Nurse Job Satisfaction (scale 1-10)	8.1 ± 0.7	6.8 ± 0.9	+1.3	0.005

Interpretation: Units adopting nurse-led clinical pathways (e.g., weaning and sedation protocols) not only achieved better patient outcomes but also demonstrated higher professional satisfaction among staff. Improved autonomy, faster decision cycles, and closer patient observation were cited as key factors.

Relationship Between Nurse Experience and Patient Outcomes

A meta-regression across 18 studies examined the association between nurse clinical experience (years) and patient outcomes.

Outcome Variable	β Coefficient	R ²	Significance
ICU Mortality	-0.17	0.41	p < 0.01
Ventilator-Associated Pneumonia	-0.21	0.37	p < 0.01
Unplanned Extubation	-0.15	0.29	p < 0.05
Medication Errors	-0.28	0.45	p < 0.001

Interpretation: Each additional year of ICU experience correlated with a 4-6% reduction in adverse events, underscoring the role of clinical maturity and intuitive judgment. However, several qualitative papers note that experience alone is insufficient without continuing education and institutional support.

The Impact of Training and Simulation-Based Education

Simulation-based training significantly enhanced adherence to best-practice protocols. Table (4) shows the impact of Training and Simulation-Based Education.

Table 4. The Impact of Training and Simulation-Based Education

Training Modality	Baseline Compliance (%)	Post-Training Compliance (%)	Δ Change (%)	Confidence Level (p)
Sedation Interruption Protocol	54.3	82.1	+27.8	0.001
Infection Control Bundles	61.8	87.5	+25.7	0.002
Pressure Injury Prevention	65.2	90.3	+25.1	0.004

Simulation and workshop-based learning provided realistic exposure to emergency and ethical scenarios, fostering both technical and non-technical (communication, teamwork) competencies. Nurses reported greater confidence and autonomy post-

training, which correlated with improved patient outcomes over 6-12 months' follow-up periods. Table (5) illustrates the influence of Staffing Ratios and Burnout on Clinical Errors.

Table 5. Influence of Staffing Ratios and Burnout on Clinical Errors

Nurse-to-Patient Ratio	Average Medication Error Rate (%)	Reported Burnout Index (MBI)	Patient Satisfaction Score (1–10)
1:1	1.8	2.3	9.1
1:2	3.6	3.5	8.4
1:3	6.2	4.9	7.5
1:4+	8.5	5.8	6.9

Error rates increased exponentially as nurse-patient ratios rose beyond 1:2. Burnout scores (measured via Maslach Burnout Inventory) also showed strong correlation ($r=0.78$, $p<0.001$) with decreased satisfaction and safety incidents. These findings reinforce the evidence that adequate staffing is not only an ethical necessity but also a measurable determinant of clinical safety and performance sustainability.

Psychological Well-being and Emotional Intelligence of ICU Nurses

A cross-sectional synthesis of 6 studies revealed that higher emotional intelligence (EI) scores were predictive of lower burnout and better teamwork outcomes.

Variable	Correlation with EI (r)	p-value
Job Burnout	-0.62	< 0.001
Teamwork Climate	+0.58	< 0.001
Patient Communication Quality	+0.49	< 0.01
Intention to Leave Profession	-0.54	< 0.01

Emotional regulation and empathy skills act as protective buffers in high-stress ICU environments. Institutions that integrated emotional intelligence training and peer support networks reported 30-40% lower turnover intentions among nursing staff.

Integration of Digital Health Technologies

Recent studies (2019-2025) explored how digital tools electronic health records (EHR), predictive analytics, and AI-based alert systems affect nursing decision-making and workload.

Table (6) shows the integration of Digital Health Technologies.

Table 6. Integration of Digital Health Technologies

Technology Implemented	Outcome Improvement	Nurse Feedback
AI-based Sepsis Alert	22% earlier detection, 15% lower mortality	“Improved vigilance, but alert fatigue observed.”
EHR-integrated Protocol Checklists	19% fewer omissions in documentation	“Simplifies workflow; needs usability refinement.”
Remote Vital Monitoring Dashboards	25% faster response to deterioration	“Boosts confidence; technical failures occasional.”

While technological augmentation enhances accuracy and vigilance, excessive alerts and interface complexity risk cognitive overload. The

findings suggest that human-machine balance and training are crucial for sustainable integration.

Table (7) shows the correlation between leadership support and protocol adherence.

Table 7. Correlation Between Leadership Support and Protocol Adherence

Leadership Support Index (1–5)	Average Protocol Adherence (%)	Reported Morale (scale 1–10)
1 (Low)	47	5.2
2	58	6.1
3	69	7.2
4	81	8.4
5 (High)	92	9.1

Strong leadership support correlated almost linearly with adherence to clinical protocols ($r=0.87$, $p < 0.001$). Leadership behaviors such as positive feedback, shared governance, and recognition programs fostered engagement and reduced error

rates. Table (8) shows the comparative Outcomes by Region and Income Level

Table 8. Comparative Outcomes by Region and Income Level

Region	Number of Studies	Mean ICU LOS Reduction (days)	Implementation Barriers (Ranked)	Sustainability Score (1–10)
North America	12	2.4	Bureaucratic delay	9.1
Europe	10	2.1	Communication gaps	8.8
East Asia	8	1.9	Hierarchical structure	7.9
Middle East	6	1.7	Staffing shortage	7.5
Latin America	4	1.5	Equipment limitations	6.9
Africa	2	1.2	Resource scarcity	6.2

High-income countries demonstrated better long-term sustainability of ICU nursing improvements due to stronger institutional frameworks. However, several low- and middle-income countries exhibited impressive innovation using low-cost, locally adapted methods highlighting the importance of contextual adaptation over direct policy transplantation.

Integrating all data sets, a multilevel model of ICU nursing success emerges, where outcomes are influenced by:

- ✓ Structural factors (staffing ratios, leadership, resources).
- ✓ Process factors (protocol adherence, teamwork, EBP integration).
- ✓ Psychological factors (experience, EI, burnout).
- ✓ Technological mediation (EHRs, AI tools).

The interaction among these domains determines whether evidence-based nursing translates into real clinical improvement.

Discussion

This systematic review synthesized evidence from 42 studies examining how nursing practices in intensive care units (ICUs) are shaped by clinical considerations, contextual constraints, and organizational culture. The findings highlight that while evidence-based nursing interventions such as sedation interruption, early mobilization, infection prevention, and nurse-led weaning consistently improve patient outcomes, their real-world implementation remains heterogeneous. This discussion interprets these findings across four major domains: (1) the clinical effectiveness of interventions, (2) human and psychological dimensions of nursing practice, (3) organizational and contextual enablers, and (4) technological and future directions [35].

Clinical Effectiveness and the Nuances of Evidence-Based Practice

The quantitative results clearly demonstrate that evidence-based nursing protocols yield measurable clinical benefits. Nurse-led interventions were associated with a 1.3-day reduction in ICU stay, a 1.2-day shorter duration of mechanical ventilation, and a 45-60% decline in pressure ulcer incidence.

These findings corroborate earlier systematic reviews that emphasize the centrality of nurse autonomy and standardized protocols in improving ICU outcomes [36].

However, the results also underscore an important caveat: clinical effectiveness is context-sensitive. For example, although daily sedation interruption reduces ventilator dependence, nurses often modify or delay the intervention based on real-time patient instability. Similarly, early mobilization is clinically desirable but logistically constrained by staffing ratios, physiotherapist availability, and the patient's hemodynamic condition [37].

This adaptive flexibility reflects what Benner (2001) termed “clinical wisdom in nursing practice” the capacity to apply evidence not as rigid rule-following, but as an interpretive act grounded in experience and patient context. The current findings therefore suggest that evidence-based practice (EBP) in ICUs must evolve from a “protocol-driven” model toward a contextually adaptive framework, recognizing the dynamic and high-risk nature of critical care [38].

Human and Psychological Dimensions: Experience, Emotional Intelligence, and Burnout

One of the most striking results across the included studies is the powerful relationship between nurse experience, emotional intelligence (EI), and clinical performance. The meta-regression analysis showed that each additional year of ICU experience correlated with a 4–6% reduction in adverse events ($\beta = -0.17$, $p < 0.01$). This aligns with prior work showing that seasoned nurses develop tacit pattern-recognition skills, allowing early detection of deterioration before alarms are triggered [39].

At the same time, psychological factors particularly emotional regulation and empathy emerge as key protective mechanisms. Nurses with higher EI scores demonstrated lower burnout ($r = -0.62$, $p < 0.001$), stronger teamwork ($r = +0.58$, $p < 0.001$), and greater patient satisfaction. This suggests that ICU competence is not only technical but profoundly emotional and interpersonal.

Burnout, however, remains a formidable barrier. The strong correlation between staffing ratios and burnout ($r = 0.78$, $p < 0.001$) illustrates the human cost of resource strain. As nurse-to-patient ratios exceed

1:2, both medication errors and moral distress increase sharply, threatening patient safety and workforce sustainability. These findings reinforce previous evidence that optimal staffing is not merely a logistical target but a patient safety imperative [40].

Consequently, institutions should adopt a dual approach capacity building and emotional resilience training to sustain high-quality ICU nursing. Strategies such as mindfulness-based interventions, peer mentoring, and debriefing sessions have shown measurable benefits in mitigating psychological fatigue while maintaining compassionate care.

Organizational and Contextual Enablers: Leadership, Collaboration, and Culture

Organizational variables emerged as critical determinants of whether evidence translates into practice. The Leadership Support Index exhibited a nearly linear relationship with protocol adherence ($r=0.87$, $p<0.001$). Units characterized by participatory leadership, open communication, and recognition programs achieved compliance rates exceeding 90%. In contrast, hierarchical or punitive environments were associated with reduced morale, innovation stagnation, and higher error rates [41].

These findings echo the principles of Transformational Leadership Theory, wherein leaders inspire shared vision and empowerment rather than enforce top-down control (Bass & Riggio, 2006). In the ICU, this means granting nurses sufficient autonomy to make rapid, evidence-informed decisions without fear of blame.

Interprofessional collaboration further amplifies this dynamic. Thematic analysis revealed that when nurses, physicians, and physiotherapists engaged in structured communication such as SBAR briefings or multidisciplinary rounds protocol adherence improved by 20-25%, and adverse events decreased significantly. Collaboration thus functions as a mediating mechanism linking leadership culture to clinical excellence [42].

Moreover, regional comparisons indicate that cultural and resource contexts profoundly shape practice sustainability. High-income countries reported better integration of EBP frameworks, yet low- and middle-income regions displayed remarkable innovation through low-cost, adaptive models. For example, ICU teams in Brazil and Iran used nurse-led “micro-protocols” simplified, evidence-informed guidelines adapted to limited resources which achieved comparable safety gains. This underscores that contextual adaptability may be more decisive than economic capacity in sustaining best practices.

Education, Simulation, and the Power of Experiential Learning

The effect of simulation-based education was one of the most consistently positive findings in this

review. Across interventions, post-training compliance improved by 25-28%, and confidence scores rose significantly ($p<0.01$). Simulation provides a psychologically safe space for nurses to rehearse complex scenarios rapid deterioration, ethical dilemmas, family conflict without endangering patients [43].

However, sustainability depends on institutional commitment. Without ongoing refreshers and protected time for training, the benefits diminish. Therefore, embedding simulation and reflective debriefing into continuous professional development programs is essential for maintaining competency and preventing skill decay [44].

Technology and the Emerging Paradigm of Digital Nursing

Recent integration of digital health tools EHRs, predictive analytics, and AI-based sepsis alerts represents a new frontier in ICU nursing practice. Results showed that digital systems enhanced timeliness of interventions (e.g., 22% earlier sepsis detection) and documentation accuracy (19% fewer omissions). Yet, these gains came at the cost of alert fatigue and cognitive overload, echoing concerns from human factors research [45].

Conceptual Integration: Toward a Model of Contextualized ICU Nursing

Synthesizing these multidimensional findings suggests that ICU nursing effectiveness operates as an interactional system rather than a linear cause effect sequence. A Conceptual Model of Contextualized ICU Nursing Effectiveness (CICUNE) can thus be proposed with four interlocking layers:

- ✓ **Structural Layer:** Encompasses staffing ratios, resources, leadership, and institutional policy.
→ Determines the operational capacity for safe practice.
- ✓ **Process Layer:** Represents adherence to evidence-based protocols, teamwork, and communication mechanisms.
→ Translates structure into action.
- ✓ **Human Layer:** Includes experience, emotional intelligence, resilience, and burnout management.
→ Influences the quality and consistency of care delivery.
- ✓ **Technological Layer:** Integrates digital tools and data analytics.
→ Enhances decision support but requires human oversight [46].

The model posits that optimal outcomes occur when these layers are aligned when structural adequacy supports human resilience, process fidelity, and technological enablement simultaneously. Misalignment (e.g., high tech but low staffing) leads to system strain and diminished performance.

This integrated framework echoes Complex Adaptive Systems (CAS) Theory, which views the ICU as a dynamic network of interacting agents whose behaviors coevolve with environmental pressures. In such systems, rigid top-down control fails, and adaptive learning emerges as the driver of resilience and innovation.

Implications for Practice, Policy, and Research

For Clinical Practice: Hospitals should prioritize nurse-led protocols, continuous simulation training, and emotional resilience programs. Interventions should be tailored to local context rather than imported wholesale from international guidelines.

For Organizational Leadership: Investing in healthy nurse–patient ratios and participatory governance models is a cost-effective strategy for improving patient safety. Leadership training should emphasize empathy, shared decision-making, and recognition.

For Policy Makers: National nursing standards should integrate context-sensitive EBP frameworks, ensuring flexibility for resource-limited ICUs. Financial incentives tied to quality metrics can promote sustained adherence [47].

For Future Research: The review identifies several gaps:

- ✓ Lack of standardized outcome measures across ICU studies.
- ✓ Limited longitudinal evaluations of sustainability.
- ✓ Insufficient integration of psychological and organizational variables in quantitative designs.

Future investigations should employ mixed-method and system-dynamics approaches to capture the nonlinear interactions among people, processes, and technology.

Limitations of the Current Evidence

Despite robust findings, the review acknowledges several limitations. The heterogeneity of study designs and metrics limits meta-analytic precision. Many trials had modest sample sizes, single-site contexts, or self-reported compliance data. Furthermore, cultural and socioeconomic variations complicate direct comparison. However, by integrating both quantitative and qualitative evidence, this review mitigated some of these limitations through triangulation and contextual synthesis [48].

Conclusion

This review reaffirms that nursing practice in the ICU is not solely a technical function but a complex, adaptive system of human expertise, organizational dynamics, and contextual intelligence. Evidence-based protocols are indispensable, but their success depends on leadership support, emotional resilience, and situational judgment. The most effective ICU environments are those that empower nurses as

autonomous, reflective practitioners balancing clinical precision with compassion, adaptability, and critical reasoning.

Ultimately, the path to safer, more humane intensive care lies not in more technology or rigid protocolization, but in cultivating resilient systems and reflective professionals who can think critically, act collaboratively, and adapt gracefully under pressure.

This systematic review demonstrates that effective nursing practice in the intensive care unit (ICU) requires a dynamic balance between evidence-based protocols, professional judgment, and contextual adaptability. The synthesis of 42 studies reveals that structured interventions such as nurse-driven sedation management, early mobilization, infection prevention bundles, and ventilator weaning protocols significantly improve patient outcomes, including reduced ICU length of stay, lower complication rates, and enhanced patient safety indicators. However, the real-world success of these practices depends less on the availability of protocols and more on the conditions under which they are implemented.

The findings highlight that clinical excellence in the ICU is not achieved solely through standardization but through the creation of adaptive systems that respect both evidence and the fluidity of clinical reality. Integrating simulation-based education, reflective practice, and digital decision-support tools can strengthen nurses' confidence and situational awareness while maintaining patient-centered care. Future research should move beyond isolated interventions to explore the interdependence between human, organizational, and technological dimensions of critical care. Policymakers and nurse leaders must therefore view ICU nursing not as a set of discrete tasks, but as a complex, adaptive system requiring continuous learning, empathy, and innovation.

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