Research Article

Knowledge Regarding Evidence-Based Care of Mechanically Ventilated Patients Among Intensive Care Unit Nurses: A Cross-Sectional Study

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Abstract

Background: Mechanical ventilation is a critical procedure used for the treatment of patients experiencing respiratory distress in the ICU. The nursing staff is an important participant in the management of ventilated patients by means of constant monitoring, complication prevention, evidence-based practices application, and assistance in weaning from the ventilator. Adequate knowledge of evidence-based practices of ventilation is required for the safety of patients.

Objectives: To assess the knowledge regarding care of mechanically ventilated patients among intensive care unit nurses and to determine its association with selected socio-demographic variables.

Methods: A quantitative descriptive cross-sectional study was conducted among 150 intensive care nurses working in a tertiary care hospital in Bengaluru, India. Participants were selected using a non-probability convenience sampling technique. Data were collected using a validated structured questionnaire consisting of 45 multiple-choice questions covering six domains of evidence-based ventilator care. Data were analysed using descriptive and inferential statistics.

Results: Among the participants, 38.0% demonstrated inadequate knowledge, 32.7% had moderate knowledge, and 29.3% had adequate knowledge. Nurses showed higher knowledge in general concepts and patient assessment, whereas knowledge deficits were identified in ventilator troubleshooting, ventilator-associated pneumonia prevention, and management of ventilator-related complications. Significant associations were found between knowledge level and age, educational qualification, and ICU experience ($P < .05$).

Discussion: The study identified knowledge gaps among ICU nurses regarding care of mechanically ventilated patients, especially in advanced technical aspects. Continuous professional education and competency-based training are recommended to strengthen critical care nursing practice and improve patient outcomes. Further research can focus on assessing nurses' practical competency and clinical performance related to ventilator management.

Keywords: Critical Care Nursing; Intensive Care Units; Nurses

Introduction

Mechanical ventilation is one of the most frequently used life-support interventions in intensive care units (ICUs). It is essential for managing critically ill patients with acute respiratory failure, neurological disorders, sepsis, trauma, and other life-threatening conditions requiring respiratory support.1 Mechanical ventilation helps ensure adequate oxygenation and ventilation, thus sustaining organ function until treatment of the primary condition takes place.2 Although mechanical ventilation has significantly improved survival among critically ill patients, it is also associated with complications such as ventilator-associated pneumonia (VAP), ventilator-induced lung injury, barotrauma, airway trauma, prolonged

duration of ventilation, increased length of ICU stay, higher healthcare costs, and increased mortality.1,2 Evidence-based nursing interventions have been shown to reduce these complications and improve patient outcomes.1,3

Nurses in critical care play a crucial role in the management of patients on mechanical ventilation, as they constantly conduct bedside assessments and are entrusted with carrying out evidence-based interventions throughout the duration of mechanical ventilation.4 Their duties involve conducting airway assessment, ventilator management, ventilator alarm management, endotracheal suctioning, oral care, infection control, sedation assessment, cuff pressure monitoring, ventilator weaning, and complication detection.5 Effective nursing practices greatly enhance patient safety, quality of care, and outcomes in mechanically ventilated patients.3,4

Various studies carried out in several countries have documented various levels of knowledge of ICU nurses concerning evidence-based ventilator care.6,7,8,9 Although nurses are seen to exhibit adequate knowledge concerning the basics of ventilation care and patients' assessment, gaps in knowledge were found with respect to troubleshooting ventilators, ventilator alarms, prevention of ventilator-associated pneumonia, ventilator weaning, and complications of ventilator care.8,9,10 This lack of knowledge could result in poor practices, delayed complications, occurrence of adverse events, and poor outcomes in patients.2 Previous research has further demonstrated that higher educational qualification, longer ICU experience, and participation in continuing professional education are associated with improved knowledge and competency in mechanical ventilation care.1,4,6,7

In India, the rising need for critical care services has led to an increased use of mechanical ventilation in tertiary care hospitals. Even though there has been an increase in the need for mechanical ventilation, there has not been sufficient research carried out to evaluate the knowledge of ICU nurses in relation to mechanical ventilation care as a whole. Most of the Indian studies carried out thus far have concentrated on one aspect of mechanical ventilation care, such as the prevention of ventilator-associated pneumonia or endotracheal suctioning.11,5 The identification of the knowledge gap is necessary for the planning of future educational programs.

Assessing the knowledge of nurses is equally important for nursing administrators, educators, and hospital managers for the development of competency-based orientation programs, nursing education sessions, simulation training programs, and periodic competency assessment.12,13 Various educational strategies related to the use of ventilators have been found to help increase the confidence level, decision-making skills, following evidence-based practice, and overall quality of care provided by nurses.20 Thus, it is important for the continued development of ICU nurses to provide effective care to their patients.

For this reason, this study was designed to evaluate the level of knowledge of evidence-based practice of critically ill patients under mechanical ventilation among nurses working in the ICU in a tertiary care hospital in Bengaluru, India, along with the correlation between knowledge levels and some socio-demographic factors. The results are hoped to reveal the current knowledge gaps and evidence for implementing educational programs, competence-building programs, and quality improvements.

Materials and Methods

Study Design

A quantitative descriptive cross-sectional study was conducted to assess the knowledge regarding evidence-based care of mechanically ventilated patients among intensive care unit (ICU) nurses and to

determine the association between knowledge levels and selected sociodemographic variables.

Study Setting

The study was conducted at a tertiary care hospital Bengaluru, Karnataka, India that provides comprehensive critical care services. The hospital comprises specialized ICUs, including the Medical Intensive Care Unit (MICU), Coronary Care Unit (CCU), Neuro Intensive Care Unit (Neuro ICU), and Cardiothoracic and Vascular Surgery Intensive Care Unit (CTVS ICU). These units provide multidisciplinary care to critically ill adult patients requiring invasive mechanical ventilation.

Participants

The study population consisted of registered nurses working in the selected ICUs who were directly involved in the care of mechanically ventilated adult patients. Nurses with at least six months of ICU experience who were willing to participate and provided written informed consent were included in the study. Nurses who were on leave during the data collection period or were not directly involved in ventilator care were excluded.

Sample Size

The required sample size was estimated using findings from previous literature and standard statistical methods. Although the minimum calculated sample size was 105 participants, a total of 150 ICU nurses were selected.

Sampling Technique

A nonprobability convenience sampling technique was used to recruit eligible participants from the selected ICUs during the study period.

Study Instrument

Data were collected using a structured self-administered questionnaire developed after an extensive review of published literature and evidence-based mechanical ventilation guidelines. The questionnaire consisted of two sections.

Section I: Sociodemographic characteristics, including age, gender, educational qualification, designation, area of work, years of ICU experience, total clinical experience, and previous ventilator-related training.
Section II: A structured knowledge questionnaire comprising 45 multiple-choice questions covering six domains: (1) general concepts and patient assessment, (2) endotracheal suctioning, (3) prevention of ventilator-associated pneumonia, (4) ventilator weaning, (5) ventilator troubleshooting, and (6) complications of mechanical ventilation.
Each correct response received one point, and incorrect responses received zero points, resulting in a maximum possible score of 45. Knowledge levels were categorized according to Bloom's modified cut-off criteria as adequate (80%-100%), moderately adequate (60%-79%), and inadequate (<60%).13

Validity

Content validity of the instrument was established by a panel of experts from the Departments of Medical-

Surgical Nursing, Critical Care Nursing, and Critical Care Medicine. The questionnaire was revised based on their recommendations before final administration.

Reliability

A pilot study was conducted among 11 ICU nurses to determine the feasibility and reliability of the instrument. Internal consistency was assessed using Cronbach α, which yielded a coefficient of 0.824, indicating good reliability.

Data Collection Procedure

Data were collected between January 30, 2026, and February 28, 2026. Eligible participants were approached during their duty hours, and the purpose of the study was explained. Written informed consent was obtained before questionnaire administration. Participants completed the questionnaire independently in approximately 30 to 45 minutes. Confidentiality and anonymity were maintained throughout the study.

Ethical Approval

The study was approved by the University Ethics Committee for Human Trials (Reference No. EC-25/147-PG-RINER; October 8, 2025). Administrative permission was obtained from the Medical Superintendent and Nursing Administration before data collection. Written informed consent was obtained from all participants

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics, version 20.0 (IBM Corp).14 Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize participant characteristics and knowledge scores. The association between knowledge levels and selected sociodemographic variables was analyzed using the χ^2 test. A 2-sided $P < .05$ was considered statistically significant.

Results

A total of 150 intensive care unit nurses participated in the study.

Participant Characteristics

The sociodemographic characteristics of the participants are presented in Table 1. Nearly half of the participants (48.0%) were younger than 25 years, followed by 25.3% aged 26 to 34 years, 20.0% aged 35 to 44 years, 6.0% aged 45 to 54 years, and 0.7% aged 55 years or older. Female nurses constituted 66.0% of the study population, whereas 34.0% were male.

Regarding educational qualification, 45.3% of participants held a General Nursing and Midwifery diploma, 34.7% had a Bachelor of Science in Nursing degree, 17.3% had a Post Basic Bachelor of Science in Nursing degree, and 2.7% had a Master of Science in Nursing degree. Most participants (90.0%) were staff nurses, whereas 10.0% were shift in-charges.

More than half of the participants (53.3%) were working in the Medical Intensive Care Unit, followed by the Neuro Intensive Care Unit (22.7%), Coronary Care Unit (15.3%), and Cardiothoracic and Vascular

Surgery Intensive Care Unit (8.7%). The distribution of participant characteristics is shown in Table 1.

Overall Knowledge Regarding Evidence-Based Care of Mechanically Ventilated Patients

The distribution of knowledge levels is presented in Table 2. Of the 150 participants, 57 (38.0%) demonstrated inadequate knowledge, 49 (32.7%) demonstrated moderately adequate knowledge, and 44 (29.3%) demonstrated adequate knowledge.

The overall mean knowledge score was 29.81 (SD, 7.37), with observed scores ranging from the minimum to the maximum obtainable score.

Domain-wise Knowledge Scores

Domain-wise knowledge scores are presented in Table 3. The highest proportion of adequate knowledge was observed in the domain of general concepts and patient assessment. Moderate levels of knowledge were observed in endotracheal suctioning and ventilator weaning, whereas lower knowledge scores were identified in ventilator-associated pneumonia prevention, ventilator troubleshooting, and complications of mechanical ventilation.

Among the participants, 62.7% demonstrated inadequate knowledge regarding ventilator troubleshooting, while 54.0% demonstrated inadequate knowledge regarding complications of mechanical ventilation. In the ventilator-associated pneumonia domain, 36.7% demonstrated inadequate knowledge, 39.3% demonstrated moderately adequate knowledge, and 24.0% demonstrated adequate knowledge.

The complete domain-wise distribution is presented in Table 3.

Association Between Knowledge Level and Sociodemographic Variables

The association between overall knowledge level and selected sociodemographic variables is presented in Table 4.

Statistically significant associations were observed between knowledge level and age ($\chi^2 = 84.776$; $P < .001$), educational qualification ($\chi^2 = 33.724$; $P < .001$), designation ($\chi^2 = 31.410$; $P < .001$), years of ICU experience ($\chi^2 = 151.760$; $P < .001$), and total clinical experience ($\chi^2 = 150.398$; $P < .001$).

No statistically significant association was observed between knowledge level and gender ($\chi^2 = 3.302$; $P = .192$) or work area ($\chi^2 = 3.714$; $P = .715$).

Detailed statistical findings are presented in Table 4.

Discussion

Principal Findings

This study evaluated the knowledge regarding evidence-based care of mechanically ventilated patients among intensive care unit (ICU) nurses working in a tertiary care hospital in Bengaluru, India. The findings demonstrated that although ICU nurses possessed satisfactory knowledge of fundamental mechanical ventilation concepts, important deficiencies existed in advanced aspects of ventilator care, particularly ventilator troubleshooting, prevention of ventilator-associated pneumonia (VAP), and management of ventilator-related complications. The overall mean knowledge score was 29.81 (SD, 7.37), with 38.0% of participants demonstrating inadequate knowledge, 32.7% demonstrating moderately adequate knowledge, and only 29.3% demonstrating adequate knowledge. Significant associations were observed

between knowledge level and age, educational qualification, designation, years of ICU experience, and total clinical experience ($P < .001$).

Comparison With Previous Studies

The findings of the present study are consistent with those reported by Abdureman et al, Christie et al, Menezes et al, and Hassen et al, who identified inadequate to moderate knowledge regarding mechanical ventilation care among ICU nurses.8,7,16,9 Similar studies conducted in Ethiopia, India, and China also demonstrated that although nurses were familiar with basic ventilator management, deficiencies persisted in ventilator troubleshooting, alarm management, VAP prevention, and ventilator weaning.1,4,10

The present study demonstrated that nurses achieved the highest scores in the domain of general concepts and patient assessment, suggesting that routine bedside exposure and institutional orientation programs contribute to better understanding of basic ventilator care. Similar observations were reported by Kakoty and Devi, Pandhare et al, and Soubhagya et al, who found that ICU nurses generally performed better in basic ventilator concepts than in advanced ventilator management.11,5,10

Knowledge regarding ventilator troubleshooting was identified as the weakest domain in the present study, with more than half of the participants demonstrating inadequate knowledge. Comparable findings have been reported by Mohammed and Hassan, Hendrix and Rochani, and Hassen et al, who emphasized that ventilator troubleshooting and alarm management remain important educational needs among critical care nurses.17,18,9

Similarly, knowledge regarding ventilator-associated pneumonia prevention was lower than expected. Previous studies have consistently shown that adherence to evidence-based ventilator care bundles significantly reduces the incidence of VAP and improves patient outcomes.1,3,19 However, inadequate knowledge of these interventions may contribute to inconsistent implementation of preventive strategies in clinical practice.

Interpretation of Findings

The observed knowledge deficits may be explained by differences in educational preparation, availability of continuing professional education, and clinical exposure to advanced ventilator management. Although nurses routinely care for mechanically ventilated patients, opportunities for structured competency-based education and simulation training may be limited. In addition, rapid advances in mechanical ventilation technology require periodic updating of nurses' knowledge to ensure evidence-based practice.

The statistically significant association between knowledge and educational qualification, designation, ICU experience, and total clinical experience suggests that professional development and clinical exposure contribute positively to competency in ventilator care. Nurses with higher educational qualifications and longer ICU experience demonstrated better knowledge levels than their counterparts. These findings are consistent with previous research demonstrating that continuing education and specialized critical care training improve nurses' knowledge and clinical performance.6,7,20

No significant association was observed between knowledge level and gender or ICU work area, indicating that competency in ventilator care is influenced more by education and professional experience than by demographic characteristics or unit assignment.

Clinical Implications

The findings of this study have important implications for critical care nursing practice. Healthcare organizations should implement structured orientation programs for newly appointed ICU nurses, competency-based assessments, continuing nursing education, and regular simulation-based training focusing on ventilator troubleshooting, ventilator-associated pneumonia prevention, evidence-based suctioning practices, and ventilator weaning. Periodic knowledge assessment and refresher training may help ensure adherence to current evidence-based guidelines and improve the quality and safety of care provided to mechanically ventilated patients. Strengthening nurses' competency in these areas has the potential to reduce ventilator-related complications, improve patient outcomes, and support institutional quality improvement initiatives.1,3,19,20

Strengths

This study included nurses from multiple specialized intensive care units within a tertiary care teaching hospital, providing a comprehensive assessment across different critical care settings. The use of a structured and validated questionnaire with good internal consistency (Cronbach $\alpha = 0.824$) enhanced the reliability of the findings. The relatively large sample size (N = 150) also improved the precision of the study estimates.

Limitations

The study was conducted at a single tertiary care hospital using a nonprobability convenience sampling technique, which may limit the generalizability of the findings to other healthcare settings. In addition, the study assessed nurses' knowledge through a self-administered questionnaire and did not evaluate actual clinical practice or competency using observational methods. Because the cross-sectional design measures knowledge at one point in time, causal relationships cannot be established.

Future Recommendations

Future multicenter studies involving larger and more diverse samples are recommended to improve the generalizability of the findings. Interventional studies evaluating the effectiveness of simulation-based education, competency-based training, and continuing professional development programs on nurses' knowledge and clinical practice should also be conducted. In addition, future research should assess the relationship between nurses' knowledge, adherence to evidence-based ventilator care practices, and patient outcomes, including ventilator-associated pneumonia, duration of mechanical ventilation, and ICU length of stay.

Conclusion

This study demonstrated that intensive care unit nurses possessed varying levels of knowledge regarding evidence-based care of mechanically ventilated patients, with most participants demonstrating inadequate to moderately adequate knowledge. Knowledge deficits were particularly evident in ventilator troubleshooting, prevention of ventilator-associated pneumonia, and management of ventilator-related complications. Knowledge level was significantly associated with age, educational qualification, designation, years of intensive care unit experience, and total clinical experience. These findings highlight the need for structured continuing nursing education, competency-based training, and regular knowledge

assessment to strengthen evidence-based critical care nursing practice. Enhancing nurses' knowledge and clinical competency is essential to improve the quality and safety of care provided to mechanically ventilated patients and to support better patient outcomes in intensive care settings.

Conflicts of Interest and Source of Funding

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Table 1. Sociodemographic Characteristics of Intensive Care Unit Nurses (N = 150)

Characteristic	Category	No. (%)
Age, y	<25	72 (48.0)
	26–34	38 (25.3)
	35–44	30 (20.0)
	45–54	9 (6.0)

Characteristic	Category	No. (%)
	≥55	1 (0.7)
Gender	Male	51 (34.0)
	Female	99 (66.0)
Educational Qualification	General Nursing and Midwifery	68 (45.3)
	BSc Nursing	52 (34.7)
	Post Basic BSc Nursing	26 (17.3)
	MSc Nursing	4 (2.7)
Designation	Staff Nurse	135 (90.0)
	Shift In-charge	15 (10.0)
Area of Work	Medical ICU	80 (53.3)
	Coronary Care Unit	23 (15.3)
	Neuro ICU	34 (22.7)
	CTVS ICU	13 (8.7)
Years of ICU Experience	<1	44 (29.3)

Characteristic	Category	No. (%)
	2–5	57 (38.0)
	6–10	14 (9.3)
	11–15	21 (14.0)
	≥16	14 (9.3)

Abbreviations: BSc, Bachelor of Science; CTVS, Cardiothoracic and Vascular Surgery; ICU, intensive care unit; MSc, Master of Science.

Table 2. Overall Knowledge Regarding Evidence-Based Care of Mechanically Ventilated Patients (N = 150)

Knowledge Level	Score (%)	No. (%)
Inadequate	<60	57 (38.0)
Moderately adequate	60–79	49 (32.7)
Adequate	80–100	44 (29.3)

Table 3. Domain-wise Distribution of Knowledge Scores (N = 150)

Knowledge Domain	Inadequate, No. (%)	Moderately Adequate, No. (%)	Adequate, No. (%)
General concepts and patient assessment	12 (8.0)	22 (14.7)	116 (77.3)
Endotracheal suctioning	49 (32.6)	46 (30.7)	55 (36.7)
Ventilator-associated pneumonia prevention	55 (36.7)	59 (39.3)	36 (24.0)

Knowledge Domain	Inadequate, No. (%)	Moderately Adequate, No. (%)	Adequate, No. (%)
Ventilator weaning	38 (25.3)	64 (42.7)	48 (32.0)
Ventilator troubleshooting	94 (62.7)	27 (18.0)	29 (19.3)
Complications of mechanical ventilation	81 (54.0)	45 (30.0)	24 (16.0)

Table 4. Association Between Overall Knowledge Level and Selected Sociodemographic Variables (N = 150)

Variable	χ^2 Value	P Value	Significance
Age	84.776	<.001	Significant
Gender	3.302	.192	Not significant
Educational qualification	33.724	<.001	Significant
Designation	31.410	<.001	Significant
Area of work	3.714	.715	Not significant
Years of ICU experience	151.760	<.001	Significant
Total clinical experience	150.398	<.001	Significant

Statistical significance was established at $P < .05$.

Figure Legends
No figures were submitted with this manuscript.

Figures
Not applicable.