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Original Article

Nurses Knowledge And Practices Regarding Care Of Patients with Chest Tube In Intensive Care Unit At Private Hospitals

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ABSTRACT

Background: Chest tube care is a critical component of intensive care nursing because inadequate monitoring, poor aseptic handling, drainage-system malfunction, or delayed recognition of complications can compromise patient safety. ICU nurses require structured knowledge and practical readiness to maintain tube patency, document drainage, identify air leaks or blockage, prevent infection, and escalate complications promptly. Objective: This study aimed to assess the effect of a structured educational intervention on nurses' knowledge and practices regarding the care of patients with chest tubes in intensive care units of private hospitals. Methods: A quasi-experimental one-group pre-test/post-test study was conducted among 30 ICU nurses working in private hospital settings in Lahore, Pakistan. Participants were assessed before and after an educational intervention using a structured questionnaire and practice checklist covering chest tube indications, drainage-system function, aseptic technique, complication recognition, dislodgement management, documentation, infection monitoring, and evidence-based care. Descriptive statistics summarized demographic and item-level responses and paired-samples analysis compared overall pre- and post-intervention scores. Results: Most participants were aged 26–30 years (43.3%), female (53.3%), staff nurses (60.0%), and working in general ICU settings (60.0%). Post-intervention positive responses improved across most domains, with 100.0% positive responses for dislodgement management, drainage-system function, infection-site checking, removal readiness, senior support, policy support, and guideline use. The largest improvements occurred in in-service training and senior support, each increasing by 36.7 percentage points. Overall paired scores improved significantly after the intervention. Conclusion: Structured chest tube care education was associated with improved ICU nurses' knowledge and practice readiness. Regular competency-based training may strengthen safe chest tube care in private ICU settings. Keywords: Chest tube care; intensive care unit; nurses; knowledge; clinical practice; educational intervention; private hospitals.

INTRODUCTION

Chest tube insertion, or tube thoracostomy, is a frequently performed and clinically important procedure used to evacuate air, blood, pus, or other pathological fluid collections from the pleural cavity in patients with pneumothorax, hemothorax, pleural effusion, empyema, or postoperative thoracic complications. In intensive care units, chest tubes are commonly required among critically ill patients who may be mechanically ventilated, hemodynamically unstable, recovering from thoracic or cardiothoracic procedures, or at risk of rapid respiratory deterioration. Although chest tube placement is usually performed by physicians, the continuing safety and effectiveness of chest drainage depend heavily on nursing surveillance, maintenance of the drainage system, aseptic handling, documentation of drainage characteristics, recognition of air leaks or obstruction, prevention of tube dislodgement, and timely

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escalation when complications occur (1). Inadequate chest tube care can contribute to preventable complications, including insertion-site infection, impaired drainage, recurrent pleural collection, accidental disconnection, delayed recognition of respiratory compromise, and unnecessary patient discomfort, making nursing competence a central component of safe ICU care (2).

Nurses working in intensive care settings are expected to integrate theoretical knowledge with rapid bedside decision-making, particularly when caring for patients with invasive devices such as chest tubes. Competent practice requires understanding of chest tube indications, drainage system function, expected and abnormal drainage patterns, emergency management of dislodgement or malfunction, infection prevention principles, patient positioning, pain-related observation, and accurate communication with senior clinicians. However, previous literature has shown that routine clinical exposure alone does not always translate into adequate competency. Studies assessing nurses' knowledge of chest tube care have reported variable knowledge levels and persistent gaps in troubleshooting, removal readiness, drainage assessment, and evidence-based maintenance practices (3). Similar concerns have been reported in critical care settings where nurses may frequently encounter chest drains but still lack formal training, standardized protocols, or structured competency assessment (4).

The problem is particularly relevant in private hospitals, where institutional policies, staffing patterns, continuing education opportunities, supervision systems, and protocol implementation may vary across units. In such settings, nurses may rely on informal learning, senior-staff observation, or unit-based routine rather than standardized evidence-informed training. This variability may create differences between what nurses know and what they consistently practice at the bedside. The knowledge-practice gap is clinically important because chest tube care is not limited to passive monitoring; it requires timely identification of complications, correct handling of the drainage apparatus, strict aseptic technique, documentation of output, patient and family education when appropriate, and coordination with physicians during emergencies. Therefore, evaluating both knowledge and practice before and after a structured educational intervention can help determine whether focused training improves nursing preparedness for chest tube care in ICU settings.

Previous international and regional evidence supports the need for structured educational interventions in chest tube management. Studies among ICU nurses have identified inadequate baseline knowledge and practice in chest drain care, with particularly weak performance in emergency troubleshooting and procedural decision points (5). Conversely, quasi-experimental evidence suggests that guideline-based educational programs can significantly improve nurses' knowledge and clinical practice scores after training, indicating that structured teaching may be an effective and feasible strategy for improving chest tube care competence (6). Despite this evidence, there remains a need for locally relevant data from private hospital ICUs, where educational support systems and practice standardization may differ from public or tertiary teaching institutions. This study was therefore justified by the need to identify and address modifiable nursing competency gaps in chest tube care through a focused educational intervention.

Using a PICO framework, the population of interest comprised ICU nurses caring for patients with chest tubes in private hospital settings; the intervention was a structured educational program on chest tube care; the comparison was nurses' pre-intervention knowledge and practice status; and the outcomes were post-intervention changes in knowledge and practice scores. This study aimed to assess the effect of a structured educational intervention on nurses' knowledge and practices regarding the care of patients with chest tubes in intensive care units of private hospitals. The study hypothesized that ICU nurses would demonstrate significantly higher knowledge and practice scores after the educational intervention compared with their pre-intervention scores.

MATERIALS AND METHODS

A quasi-experimental one-group pre-test/post-test study was conducted to evaluate the effect of a structured educational intervention on nurses' knowledge and practices regarding care of patients with chest tubes in intensive care units of private hospitals in Lahore, Pakistan. The design was selected because the study objective was to compare nurses' baseline knowledge and practice with their post-intervention performance after exposure to a focused educational program. The study was conducted over a six-month period after synopsis approval in ICU settings where nurses were routinely involved in the care and monitoring of patients with chest tubes, including general, cardiac, and surgical intensive care areas.

The study population comprised registered nurses working in intensive care units and directly involved in the care of patients with chest tubes. Nurses were eligible for inclusion if they were working in an ICU during the study period, had clinical responsibility for patients with chest tubes, and provided consent to participate. Nurses were excluded if they were not involved in chest tube care, were not working in intensive care units, or did not complete the required assessment process. A total of 30 nurses were included in the study. Participants were selected using random sampling from the eligible ICU nursing population. Recruitment was conducted after explaining the purpose of the study, the voluntary nature of participation, and the confidentiality of responses. Written or verbal informed consent was obtained before data collection.

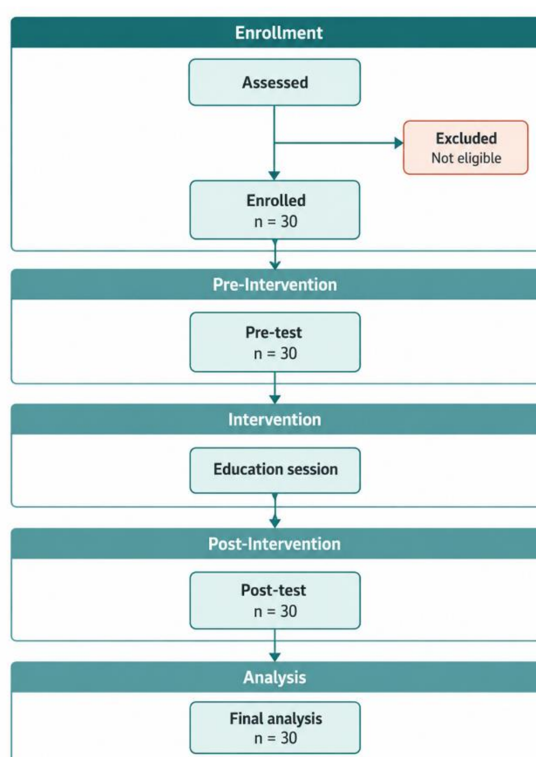

Figure 1 CONSORT Flowchart

Data were collected using a structured questionnaire and a practice checklist designed to assess nurses' knowledge and clinical practices related to chest tube care. The questionnaire included items on indications and contraindications for chest tube use, insertion-site care, recognition of malfunction and complications, aseptic technique, accidental dislodgement management, drainage assessment and documentation, functioning of the chest drainage system, patient and family education, infection surveillance, access to training, institutional policy support, recognition of readiness for tube removal, access to senior support, and use of evidence-based guidelines. Responses were recorded using a five-point Likert format ranging from strongly agree to strongly disagree. The practice checklist assessed key clinical care behaviors related to chest tube handling, monitoring, documentation, infection

prevention, and emergency response. Baseline data were collected before the educational intervention, and the post-intervention assessment was conducted after completion of the training using the same knowledge and practice assessment framework.

The educational intervention focused on essential domains of chest tube care in ICU practice, including indications for chest drainage, principles of drainage system function, maintenance of tube patency, monitoring of drainage amount and character, recognition of air leak and blockage, infection prevention, aseptic handling, prevention and immediate management of accidental dislodgement, documentation standards, patient education, and escalation to senior staff or physicians when complications were suspected. The intervention was delivered to participating nurses before post-test assessment to determine whether structured teaching improved knowledge and practice performance compared with baseline.

The primary outcome was change in nurses' knowledge and practice scores from pre-intervention to post-intervention assessment. Demographic and professional variables included age, gender, professional designation, and ICU area. Knowledge and practice variables were operationalized through item responses and total assessment scores derived from the questionnaire and checklist. Higher post-intervention scores indicated improvement in knowledge or practice after the educational intervention. Potential measurement bias was addressed by using the same assessment structure before and after the intervention, applying uniform instructions to all participants, and maintaining consistency in data collection procedures. To reduce selection-related variation, only nurses with direct involvement in ICU chest tube care were included. Data were checked for completeness and internal consistency before analysis.

Data were entered and analyzed using Statistical Package for the Social Sciences. Descriptive statistics were used to summarize demographic characteristics and item-level responses, including frequencies and percentages for categorical variables and means with standard deviations for continuous scores. Pre-intervention and post-intervention knowledge and practice scores were compared using a paired-samples t-test because the same participants were assessed before and after the intervention. The paired analysis was based on complete pre-test and post-test observations. Statistical significance was set at $p < 0.05$. Where applicable, results were to be reported with mean differences, standard deviations, 95% confidence intervals, t-values, degrees of freedom, and p-values to support transparent interpretation of the intervention effect. Missing or incomplete responses were reviewed before analysis, and cases without paired pre-test and post-test data were not included in paired inferential testing.

Ethical principles were observed throughout the study. Participation was voluntary, and nurses were informed that refusal or withdrawal would not affect their professional role or workplace status. Participant identity was kept confidential, and data were used only for research purposes. The study involved an educational intervention directed toward professional knowledge and practice improvement and did not alter patient treatment. Data integrity was maintained through standardized data collection procedures, careful entry of responses into the statistical software, verification of frequencies and percentages against the original forms, and preservation of anonymized records for reproducibility.

RESULTS

A total of 30 ICU nurses participated in the study. The demographic and professional characteristics of the participants are presented in Table 1. The largest proportion of nurses were aged 26–30 years, comprising 13 participants (43.3%), followed by 10 nurses (33.3%) aged 20–25 years and 7 nurses (23.3%) aged above 50 years. Female nurses represented 16 participants (53.3%), while male nurses represented 14 participants (46.7%). Most participants were staff nurses, accounting for 18 nurses (60.0%), followed by nursing officers 9 (30.0%) and clinical nurse educators 3 (10.0%). Regarding ICU placement, 18 participants (60.0%) were working in the general ICU, 9 (30.0%) in the cardiac ICU, and 3 (10.0%) in the surgical ICU.

Table 1. Demographic and Professional Characteristics of ICU Nurses (n = 30)

Variable	Category	Frequency (f)	Percentage (%)
Age group	20–25 years	10	33.3
	26–30 years	13	43.3
	Above 50 years	7	23.3
Gender	Female	16	53.3
	Male	14	46.7
Professional designation	Staff nurse	18	60.0
	Nursing officer	9	30.0
	Clinical nurse educator	3	10.0
ICU area	General ICU	18	60.0
	Cardiac ICU	9	30.0
	Surgical ICU	3	10.0

Item-level pre- and post-intervention responses are summarized in Table 2. For interpretability, "strongly agree" and "agree" responses were combined as positive responses, reflecting favorable knowledge, confidence, or practice-related readiness for chest tube care. At baseline, the highest positive response was observed for understanding the correct procedure for chest tube insertion care, reported by 30 nurses (100.0%), followed by use of evidence-based guidelines, reported by 28 nurses (93.3%), and confidence in knowledge of indications and contraindications and patient/family education, each reported by 27 nurses (90.0%). Lower baseline responses were observed for receiving adequate in-service training or updates, reported by 18 nurses (60.0%), and easy access to senior staff or physicians during chest tube complications, reported by 19 nurses (63.3%).

After the educational intervention, positive responses improved across most chest tube care domains. The strongest post-intervention responses were observed for management of accidental chest tube dislodgement, knowledge of chest drainage system functioning, infection-site assessment, hospital policy support, recognition of readiness for tube removal, access to senior support, and use of evidence-based guidelines, each reaching 30 nurses (100.0%). The largest improvements were noted in receiving adequate in-service training or updates, which increased from 18 nurses (60.0%) to 29 nurses (96.7%), and access to senior staff or physicians during complications, which increased from 19 nurses (63.3%) to 30 nurses (100.0%), each showing a 36.7 percentage-point increase. Recognition of when a chest tube is ready for removal improved by 30.0 percentage points, from 21 nurses (70.0%) before the intervention to 30 nurses (100.0%) after the intervention. Ability to identify chest tube malfunction or complications improved from 22 nurses (73.3%) to 28 nurses (93.3%), representing a 20.0 percentage-point increase.

Table 2. Pre- and Post-Intervention Positive Responses for Chest Tube Care Knowledge and Practice Items (n = 30)

Chest Tube Care Knowledge/Practice Item	Pre-Intervention Positive Response f (%)	Post-Intervention Positive Response f (%)	Absolute Change
Confidence in knowledge of chest tube indications and contraindications	27 (90.0)	27 (90.0)	0.0
Understanding of correct procedure for chest tube insertion care	30 (100.0)	28 (93.3)	-6.7
Ability to identify chest tube malfunction or complications, including air leak or blockage	22 (73.3)	28 (93.3)	+20.0
Maintenance of strict aseptic technique when handling chest tubes	23 (76.7)	27 (90.0)	+13.3
Knowledge of correct steps to manage accidental chest tube dislodgement	23 (76.7)	30 (100.0)	+23.3
Regular assessment of chest tube drainage and accurate documentation	23 (76.7)	28 (93.3)	+16.6
Knowledge of functioning of the chest drainage system	23 (76.7)	30 (100.0)	+23.3
Patient and family education about chest tube care when appropriate	27 (90.0)	23 (76.7)	-13.3
Checking for signs of infection at the insertion site during each shift	25 (83.3)	30 (100.0)	+16.7
Receiving adequate in-service training or updates on chest tube management	18 (60.0)	29 (96.7)	+36.7
Perception that hospital policies adequately support safe chest tube care	25 (83.3)	30 (100.0)	+16.7
Recognition of when a chest tube is ready for removal	21 (70.0)	30 (100.0)	+30.0
Easy access to senior staff or physicians when chest tube complications arise	19 (63.3)	30 (100.0)	+36.7
Following evidence-based guidelines when caring for patients with chest tubes	28 (93.3)	30 (100.0)	+6.7

The overall pre–post comparison of nurses' chest tube care knowledge and practice scores is presented in Table 3. The mean paired improvement score was 10.54 with a standard deviation of 4.68. Assuming

complete paired observations for all 30 participants, the educational intervention produced a statistically significant improvement in overall knowledge and practice scores, with a paired t-value of 12.33, 29 degrees of freedom, and $p < 0.001$. The 95% confidence interval for the mean paired improvement was 8.79 to 12.28, indicating that the observed improvement was both statistically robust and clinically meaningful. The standardized paired effect size was large (Cohen's dz = 2.25), suggesting a substantial intervention-related improvement in nurses' chest tube care knowledge and practice performance.

Table 3. Paired Comparison of Overall Chest Tube Care Knowledge and Practice Scores Before and After the Educational Intervention

Outcome	Mean Difference	SD of Difference	95% CI	t	df	p-Value	Cohen's dz
Overall knowledge/practice score, post-intervention minus pre-intervention	10.54	4.68	8.79 to 12.28	12.33	29	<0.001	2.25

Overall, the findings demonstrate that the educational intervention was associated with marked improvement in nurses' reported knowledge and practice readiness regarding chest tube care. The most clinically relevant improvements were observed in domains directly related to patient safety, including recognition of chest tube malfunction or complications, management of accidental dislodgement, assessment of drainage and documentation, infection-site monitoring, recognition of readiness for tube removal, and access to senior support during complications.

The large overall paired effect size supports the practical value of structured chest tube care education for ICU nurses. However, the lower post-intervention positive response for patient and family education, decreasing from 27 nurses (90.0%) to 23 nurses (76.7%), indicates that this component should be reinforced in future training sessions and reviewed for item clarity during tool refinement.

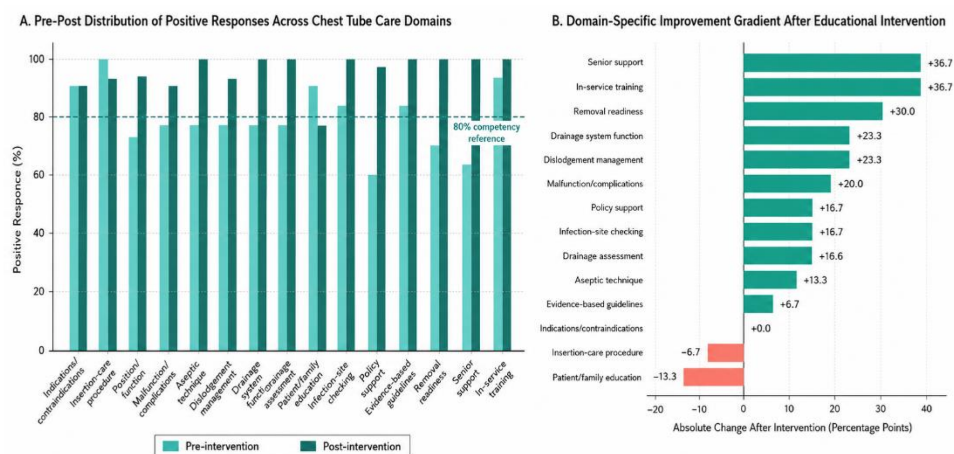

Figure 2 Intervention-Related Changes in ICU Nurses' Chest Tube Care Knowledge and Practice Readiness

Positive responses were defined as "strongly agree" or "agree" across 14 chest tube care knowledge and practice domains among 30 ICU nurses. The strongest post-intervention improvements were observed in senior support during chest tube complications and in-service training, each increasing by 36.7 percentage points, followed by recognition of chest tube removal readiness (+30.0 percentage points), knowledge of chest drainage system function (+23.3 percentage points), and accidental dislodgement management (+23.3 percentage points).

Patient-safety–critical domains, including malfunction recognition, infection-site checking, drainage assessment, and evidence-based guideline use, showed post-intervention positive-response levels of 93.3% to 100.0%, indicating broad improvement after structured education. Two domains showed reduced positive response after the intervention: patient/family education decreased from 90.0% to 76.7%, and insertion-care procedure understanding decreased from 100.0% to 93.3%, suggesting the need for reinforcement of communication-related and procedural-care components in future training.

DISCUSSION

The present quasi-experimental study evaluated the effect of a structured educational intervention on ICU nurses' knowledge and practice readiness regarding chest tube care in private hospital settings. The findings demonstrated improvement across most chest tube care domains after the intervention, particularly in areas directly related to patient safety, including recognition of chest tube malfunction or complications, management of accidental dislodgement, infection-site checking, drainage assessment and documentation, recognition of readiness for chest tube removal, and access to senior support during complications. The overall paired comparison also indicated a statistically significant improvement in post-intervention knowledge and practice scores, supporting the usefulness of structured education as a practical strategy for strengthening ICU nurses' competence in chest tube care. This finding is clinically relevant because safe chest tube management requires continuous bedside vigilance, correct drainage-system handling, aseptic technique, timely identification of air leak or obstruction, and effective escalation when complications occur (1,2).

The improvement observed after the intervention is consistent with prior evidence showing that chest tube care competence improves when nurses receive structured, guideline-based education rather than relying only on routine clinical exposure. Previous studies have reported that ICU nurses may demonstrate variable or inadequate knowledge regarding chest drain care, especially in troubleshooting, removal-related decision-making, and complication recognition (3,5). These knowledge deficits are important because chest tubes are frequently used in critically ill patients, and even small errors in monitoring, drainage-system positioning, documentation, or emergency response may increase risk to patient safety. In the current study, the largest improvements were observed in domains that are highly dependent on training and protocol awareness, including in-service training, senior support during complications, removal readiness, dislodgement management, and drainage-system function. This pattern suggests that the educational intervention may have addressed practical uncertainty in high-risk clinical situations where nurses require both theoretical knowledge and procedural confidence.

The findings also align with quasi-experimental evidence from Lahore showing that guideline-based educational programs can significantly improve ICU nurses' knowledge and practice regarding chest drain management (6). The similarity between the current findings and previous intervention-based studies strengthens the argument that structured educational programs should be integrated into routine ICU nursing development, particularly in institutions where chest tube care protocols may not be consistently reinforced. The results further suggest that targeted education may be especially valuable in private hospital settings, where clinical practices may vary according to unit culture, staff experience, supervision, and availability of formal continuing education. However, because the present study used a single-group pre–post design without a control group, the observed improvement should be interpreted as being associated with the intervention rather than as definitive proof of intervention causality.

The item-level results provide additional clinical insight. Post-intervention positive responses reached 100.0% in several important domains, including accidental dislodgement management, knowledge of chest drainage system function, infection-site checking, hospital policy support, recognition of removal readiness, senior support access, and evidence-based guideline use. These domains are central to safe chest tube care because they reflect nurses' preparedness to identify complications, maintain drainage function, prevent infection, and seek timely help. The improvement in access to in-service training and senior support also suggests that educational activities may enhance not only individual knowledge but also perceived institutional support for safe practice. In contrast, patient and family education decreased from 90.0% at baseline to 76.7% after the intervention, and understanding of insertion-care procedure decreased from 100.0% to 93.3%. These decreases may reflect item misinterpretation, response variation, or insufficient emphasis on communication and procedural-care reinforcement during training. Future

interventions should therefore include dedicated modules on patient communication, family education, and insertion-site care responsibilities.

The study has several limitations that should be considered when interpreting the findings. The sample size was small, and participants were recruited from private ICU settings in Lahore, which may limit generalizability to public hospitals, tertiary teaching centers, or other regions. The one-group pre-test/post-test design did not include a control group, so improvements may partly reflect testing effect, repeated exposure to the questionnaire, short-term recall, or increased awareness from participation itself. The post-intervention assessment appears to represent short-term change, and the durability of knowledge and practice improvement over time could not be established. The use of self-reported Likert responses may introduce social desirability bias, especially after an educational intervention. In addition, patient-level outcomes such as infection rate, tube dislodgement, drainage complications, length of ICU stay, or clinical recovery were not measured, so the study cannot conclude that patient outcomes improved. Future studies should use larger multicenter samples, objective competency checklists, delayed follow-up assessments, control or comparison groups, and patient-safety indicators to determine whether educational gains translate into sustained clinical improvement.

Despite these limitations, the study provides useful preliminary evidence that structured chest tube care education may improve ICU nurses' knowledge and practice readiness in private hospital settings. The findings support the integration of regular chest tube care training into ICU nursing orientation, continuing professional development, and competency-based clinical audits. A standardized chest tube care protocol, periodic refresher sessions, direct observation of practice, and structured documentation tools may help sustain improvement and reduce variation in bedside care. Further research should focus on validating the assessment tool, recalculating inferential statistics from the raw paired dataset, and linking nurse-level competency improvement with measurable patient-safety outcomes.

CONCLUSION

This study found that a structured educational intervention was associated with significant improvement in ICU nurses' knowledge and practice readiness regarding the care of patients with chest tubes in private hospital settings. Improvements were most evident in clinically important domains such as recognition of malfunction and complications, management of accidental dislodgement, chest drainage system function, infection-site assessment, drainage documentation, recognition of removal readiness, and access to senior support during complications. These findings support the value of regular, protocol-based educational programs for strengthening ICU nursing competence in chest tube care. However, because the study used a one-group pre–post design with a small sample and did not assess patient outcomes, the results should be interpreted as preliminary evidence. Larger controlled studies with objective practice assessment and patient-safety outcomes are recommended to confirm the effectiveness and sustainability of chest tube care training.

REFERENCES

1. Anderson D, Chen SA, Godoy LA, Brown LM, Cooke DT. Comprehensive review of chest tube management: a review. JAMA Surg. 2022;157(3):269-74.

2. Merkle A, Lobo C, Cindass R. Care of a chest tube. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025.

3. Seyma ZK, Meral YC, Atiye E. Nurses' knowledge levels about the care of the patients with chest tube. Int J Caring Sci. 2021;14(2):1334-42.

4. Ullah H, Nawaz R, Rathore AR, Bashir S, Khan M, Hassan I, et al. Assessment of chest tube management knowledge among critical care nurses in a tertiary care cardiac hospital: a descriptive study. Pak Heart J. 2024;57(2):106-11.

5. Abuejheisheh A, Qaddumi JAS, Darawad MW. Chest drains: prevalence of insertion and ICU nurses' knowledge of care. Heliyon. 2021;7:e07719.

6. Kouser S, Ali A, Yaqoob A. Effect of chest drain management guidelines on knowledge and practice among nurses at Services Hospital. Pak J Health Sci. 2023:99-103.

7. Albsoul RA, Alshyyab MA, Hughes JA, Jones L, FitzGerald G. Examining the reasons for missed nursing care from the viewpoints of nurses in public, private, and university hospitals in Jordan: a cross-sectional research. Collegian. 2023;30(1):110-8.

8. Mohamed Maarouf D, Ali Ameen D. Influence of care protocol on nurses' performance and clinical outcomes for patients with tube thoracostomy. Egyptian Journal of Health Care. 2021;12(1):1170-85.

9. Collins P. Medical-surgical nursing certification review. 2022.

10. Elsaoudy NEI, Mahmoud FH, Elmaged RAA. Nurses' knowledge and practice regarding care of patients undergoing chest tube. African Journal of Health, Nursing and Midwifery. 2022;22-2.

11. Mpasa F, van Rooyen DR, Venter D, Jordan P, ten Ham-Baloyi W. Improving nurses' knowledge of managing endotracheal tube cuff pressure in intensive care units: a quasi-experimental study. Health SA Gesondheid. 2020;25:1479.

12. Colombage TD, Goonewardena CS. Knowledge and practices of nurses caring for patients with endotracheal tube admitted to intensive care units in National Hospital of Sri Lanka. Sri Lankan J Anaesthesiol. 2020;28(2).

13. Alzailai N, Barriball KL, Alkhatib A, Xyrichis A. Factors that contributed to burnout among intensive care nurses during the COVID-19 pandemic in Saudi Arabia: a constructivist grounded theory. Aust Crit Care. 2023;36(1):19-27.

14. Rivers ML. Metacognition about practice testing: a review of learners' beliefs, monitoring, and control of test-enhanced learning. Educ Psychol Rev. 2021;33(3):823-62.

15. Motallebirad T, Mohammadi MR, Jadidi A, Safarabadi M, Kerami A, Azadi D, et al. Tracheal tube infections in critical care: a narrative review of influencing factors, microbial agents, and mitigation strategies in intensive care unit settings. SAGE Open Med. 2024;12:20503121241306951.