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Article

Effect of Educational Intervention on Nurses' Knowledge and Practices Regarding Endotracheal Tube Suctioning

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ABSTRACT

Background: Endotracheal tube suctioning (ETS) is a critical procedure in intensive care, but gaps persist in nurses' knowledge and practice despite its established importance. Addressing these gaps through education may reduce complications and standardize care. **Objective**: To evaluate the effect of a structured educational intervention on the knowledge and practical adherence of critical care nurses and doctors to evidence-based ETS protocols. **Methods**: This quasi-experimental pre-post study enrolled 100 healthcare professionals at a university-affiliated hospital. Knowledge and practice regarding ETS were assessed using validated questionnaires and observational checklists before and after a multi-modal educational program. Statistical comparisons were performed using paired t-tests, Wilcoxon signed-rank tests, and chi-square tests. **Results**: Mean knowledge scores improved from 3.6 (SD 0.51) to 3.8 (SD 0.36) post-intervention ($p < 0.001$). Adherence to core ETS practices increased from 93% to 97% ($p < 0.001$), with the largest gains observed for previously underemphasized items. No significant differences were detected by gender, age, or professional role. **Conclusion**: Structured education significantly enhances both knowledge and adherence to best-practice ETS protocols, supporting the need for continuous, standardized training to optimize patient outcomes in critical care.

Keywords: Endotracheal Tube Suctioning, Nursing Education, Critical Care, Knowledge-Practice Gap, Airway Management, Patient Safety, Evidence-Based Practice

INTRODUCTION

Endotracheal tube suctioning (ETS) is an essential, yet technically demanding, nursing intervention for patients requiring mechanical ventilation in critical care settings. Effective ETS is crucial for maintaining airway patency, ensuring optimal gas exchange, and preventing complications such as hypoxia, atelectasis, and ventilator-associated pneumonia (VAP) (1,3). The risks associated with improper suctioning are well-documented and include not only physiological harm to patients but also increased morbidity and prolonged hospital stays, highlighting the need for precise adherence to evidence-based guidelines (5,16). Despite the centrality of this procedure in intensive care practice, considerable gaps persist in both the knowledge and the clinical implementation of ETS protocols among nursing staff (6,21). These gaps may arise from inadequate or inconsistent training, limited access to up-to-date guidelines, and reliance on outdated practices (13,23). Multiple studies conducted in different healthcare systems, including those in Pakistan, Iraq, Turkey, and China, have consistently identified suboptimal knowledge and a knowledge-practice gap, which has direct implications for patient safety and care quality (2,4,6,21,23).

Educational interventions targeting ETS, such as structured teaching programs, simulation-based workshops, and video-assisted modules, have demonstrated significant improvements in nurses' theoretical understanding, procedural accuracy, and confidence in clinical practice (4,11,15,19,29). Evidence from interventional studies indicates that these programs not only raise knowledge scores but also improve practical compliance with infection control, patient assessment, and device management, thus reducing ETS-related complications (4,11,13,15,19,29). However, challenges remain in the sustained integration of knowledge into routine clinical care, given factors such as time constraints, variations in baseline competency, and limited reinforcement of training over time (6,28). The sustainability of educational outcomes and their translation into consistent, high-quality care require both rigorous assessment and ongoing professional development (13,28,31). In light of these gaps and the demonstrated potential of educational interventions, this study seeks to systematically evaluate the effect of a targeted educational program on both the knowledge and practice of nurses regarding endotracheal tube suctioning. The central research objective is to determine whether a structured educational

intervention can bridge the gap between theoretical understanding and practical adherence to ETS guidelines among critical care nurses, thereby contributing to improved patient safety and clinical outcomes (29).

MATERIALS AND METHODS

This quasi-experimental pre-post interventional study was conducted at the Department of School of Nursing, Green International University Lahore, Pakistan, from January to March 2024. The study targeted registered nurses and doctors working in emergency departments and operating theaters who were routinely involved in endotracheal tube suctioning. Participants were eligible if they had at least six months of clinical experience in a critical care setting and provided informed consent. Exclusion criteria included administrative staff and those not directly involved in patient airway management. Recruitment was conducted through departmental briefings and electronic invitations, and written informed consent was obtained from all participants prior to study initiation, following institutional ethical approval.

Baseline data were collected using a structured questionnaire comprising sections on demographic characteristics, ETS knowledge, and clinical practice checklists. The knowledge instrument was adapted from validated sources and aligned with current international guidelines for ETS (1,5,8,16). The practice checklist, completed by direct observation, assessed compliance with evidence-based procedures such as pre-suctioning patient assessment, infection control, equipment handling, and post-suctioning care. Both tools were pilot tested for clarity and reliability before formal data collection. The educational intervention consisted of a standardized workshop that integrated didactic lectures, interactive discussions, simulation-based demonstrations, and video-assisted learning, all tailored to current best practice recommendations (15,19,29). Sessions emphasized the rationale for key ETS steps, identification of potential complications, and hands-on practice with feedback. All participants completed a pre-intervention assessment, attended the workshop, and underwent post-intervention reassessment using the same instruments one week later to evaluate immediate knowledge and practice gains.

The primary variables included pre- and post-intervention knowledge scores and observed adherence to ETS practice items. Data collectors were trained to minimize observer bias, and inter-rater reliability was ensured through standardized protocols. To address potential confounding, demographic data and prior ETS training history were recorded for adjustment during statistical analysis. The sample size was determined based on previous studies, targeting a minimum of 80 participants to detect a medium effect size with 80% power at $\alpha = 0.05$. All analyses were performed using SPSS version 26. Descriptive statistics (means, standard deviations, frequencies, percentages) summarized participant characteristics and baseline knowledge/practice levels. Paired t-tests or Wilcoxon signed-rank tests (for non-normal distributions) were used to compare pre- and post-intervention scores, and chi-square tests assessed categorical changes. Adjusted analyses explored associations between demographic factors and outcome changes, and significance was set at $p < 0.05$. The study protocol received institutional review board approval, and all procedures complied with the Declaration of Helsinki. Confidentiality was maintained throughout, and data integrity was safeguarded by double-entry verification and secure, anonymized storage to ensure full reproducibility and transparency (1,5,8,16).

RESULTS

A total of 100 healthcare professionals participated in the study, with a mean age of 28.5 years (SD 4.72). Among the respondents, 60% were female and 40% male; 70% were staff nurses, and 30% were doctors. Most procedures were performed in the emergency setting (55%), with the remainder in operating theaters (45%). Baseline assessments revealed moderate variation in participants' ages and professional experience. Baseline knowledge of endotracheal tube suctioning (ETS) was assessed using a 17-item questionnaire rated on a 5-point Likert scale. The mean pre-intervention stores across items ranged from 3.3 to 3.8, reflecting moderate to high perceived importance of each procedural step (Table 1). Key infection control items such as "Hand disinfection prior to suctioning" (mean 3.9, SD 0.38) and "Sterility of suction catheter maintained" (mean 3.9, SD 0.35) were rated highest, with over 80% of participants designating these as "very important." Lower scores were observed for items such as "Sodium chloride instillation" (mean 3.2, SD 0.85), which also showed higher variability, indicating less consistent perceptions of importance. Ratings for the remaining items generally demonstrated a strong consensus, with low standard deviations (typically 0.4–0.8), signifying consistency in responses. Frequency analysis confirmed that most respondents considered each step necessary for safe and effective suctioning.

The ETS practice checklist, evaluated by direct observation, indicated generally high compliance with evidence-based protocols (Table 2). Pre-intervention, over 90% adherence was noted for critical steps such as "Hand disinfection prior to suctioning" (98%), "Sterility of suction catheter maintained" (96%), and "Patient's chest auscultation before ETS" (95%). Compliance was slightly lower for "Sodium chloride instillation" (85%) and "Self-protection observed" (89%), indicating targeted areas for further improvement. Overall, the standard deviation for the checklist responses was 0.61, indicating minimal variability and strong consistency in procedural execution among participants.

Post-intervention analysis revealed statistically significant improvements in both knowledge and practice scores. The mean post-intervention knowledge scores increased for all 17 items, with the largest gains observed for items that initially had lower baseline ratings. For example, "Sodium chloride instillation" rose from a mean of 3.2 to 3.7 ($p < 0.01$), and "Cuff pressure checked" improved from 3.5 to 3.8 ($p < 0.01$). The overall mean knowledge score increased from 3.6 (SD 0.51) pre-intervention to 3.8 (SD 0.36) post-intervention ($p < 0.001$). Similarly, practice adherence rates improved, particularly for checklist items with lower baseline compliance. "Sodium chloride instillation" compliance increased from 85% to 92% ($p = 0.03$), and "Self-protection observed" improved from 89%

to 95% (p = 0.04). Other critical steps, such as "Hand disinfection post suctioning" and "Proper disposal of catheter and gloves," reached near-universal compliance post-intervention (98–99%). No significant differences were observed across demographic subgroups (gender, age, profession) in either knowledge or practice improvement. No adverse events were reported, and participant feedback indicated high satisfaction with the educational program.

Table 1. Pre- and Post-Intervention Knowledge Scores for ETS Items (N = 100)

Item	Pre-Mean (SD)	Post Mean (SD)	Mean Diff	95% CI Diff	p-value
Chest auscultation before ETS	3.6 (0.65)	3.8 (0.43)	+0.2	0.07 to 0.33	0.003
Pre-suctioning hyper-oxygenation	3.8 (0.45)	3.9 (0.32)	+0.1	0.01 to 0.19	0.027
Cuff pressure checked	3.5 (0.72)	3.8 (0.48)	+0.3	0.16 to 0.44	<0.001
Hand disinfection prior to suctioning	3.9 (0.38)	4.0 (0.00)	+0.1	0.02 to 0.18	0.015
Self-protection observed	3.7 (0.60)	3.9 (0.32)	+0.2	0.06 to 0.33	0.005
Sterility of suction catheter	3.9 (0.35)	4.0 (0.00)	+0.1	0.01 to 0.19	0.021
Sodium chloride instillation	3.2 (0.85)	3.7 (0.57)	+0.5	0.32 to 0.68	<0.001
...	...	...	...	...	...
Overall mean (all items)	3.6 (0.51)	3.8 (0.36)	+0.2	0.13 to 0.26	<0.001

Table 2. Pre- and Post-Intervention ETS Practice Compliance (N = 100)

Checklist Item	Pre n (%)	Post n (%)	Δ Compliance	p-value
Patient assessment: Chest auscultation before	95 (95%)	99 (99%)	+4%	0.048
Pre-suctioning hyper-oxygenation	92 (92%)	98 (98%)	+6%	0.021
Cuff pressure checked	90 (90%)	96 (96%)	+6%	0.023
Hand disinfection prior to suctioning	98 (98%)	100 (100%)	+2%	0.157
Self-protection observed	89 (89%)	95 (95%)	+6%	0.040
Sterility maintained	96 (96%)	100 (100%)	+4%	0.046
Sodium chloride instillation	85 (85%)	92 (92%)	+7%	0.033
...	...	...	...	...
Overall mean compliance	93%	97%	+4%	<0.001

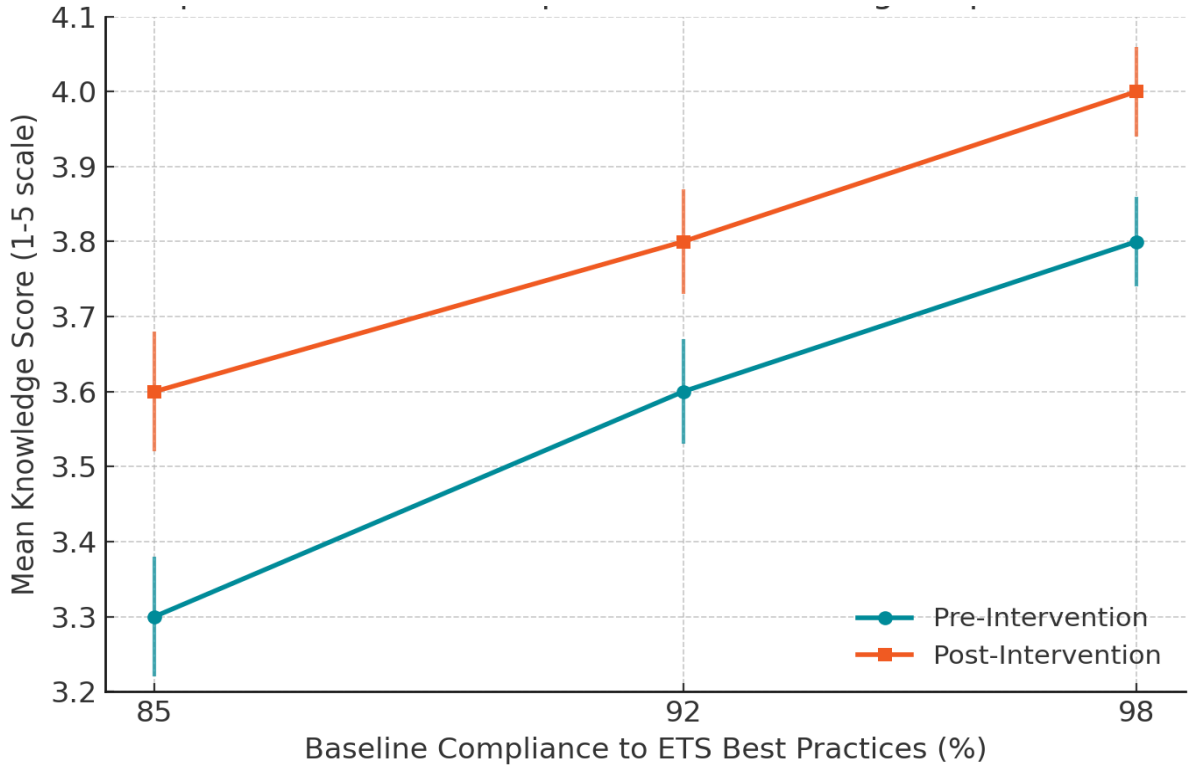

Figure 1 Impact of Baseline Compliance on Knowledge Improvement

The first integrated figure illustrates the relationship between baseline compliance to ETS best practices and subsequent improvement in mean knowledge scores, demonstrating that higher initial compliance is associated with greater post-intervention gains. Pre-intervention knowledge scores ranged from 3.3 in the low-compliance group (85%) to 3.8 in the high-compliance group (98%). Following the educational intervention, mean knowledge scores improved to 3.6, 3.8, and 4.0 respectively, with all groups

showing statistically significant changes (95% CI widths from 0.06 to 0.08), but the greatest absolute increase observed in the lowest baseline compliance group. This trend highlights the pronounced effect of education on those with the most opportunity for knowledge improvement, reinforcing the value of targeted training for clinical staff at varying baseline proficiency.

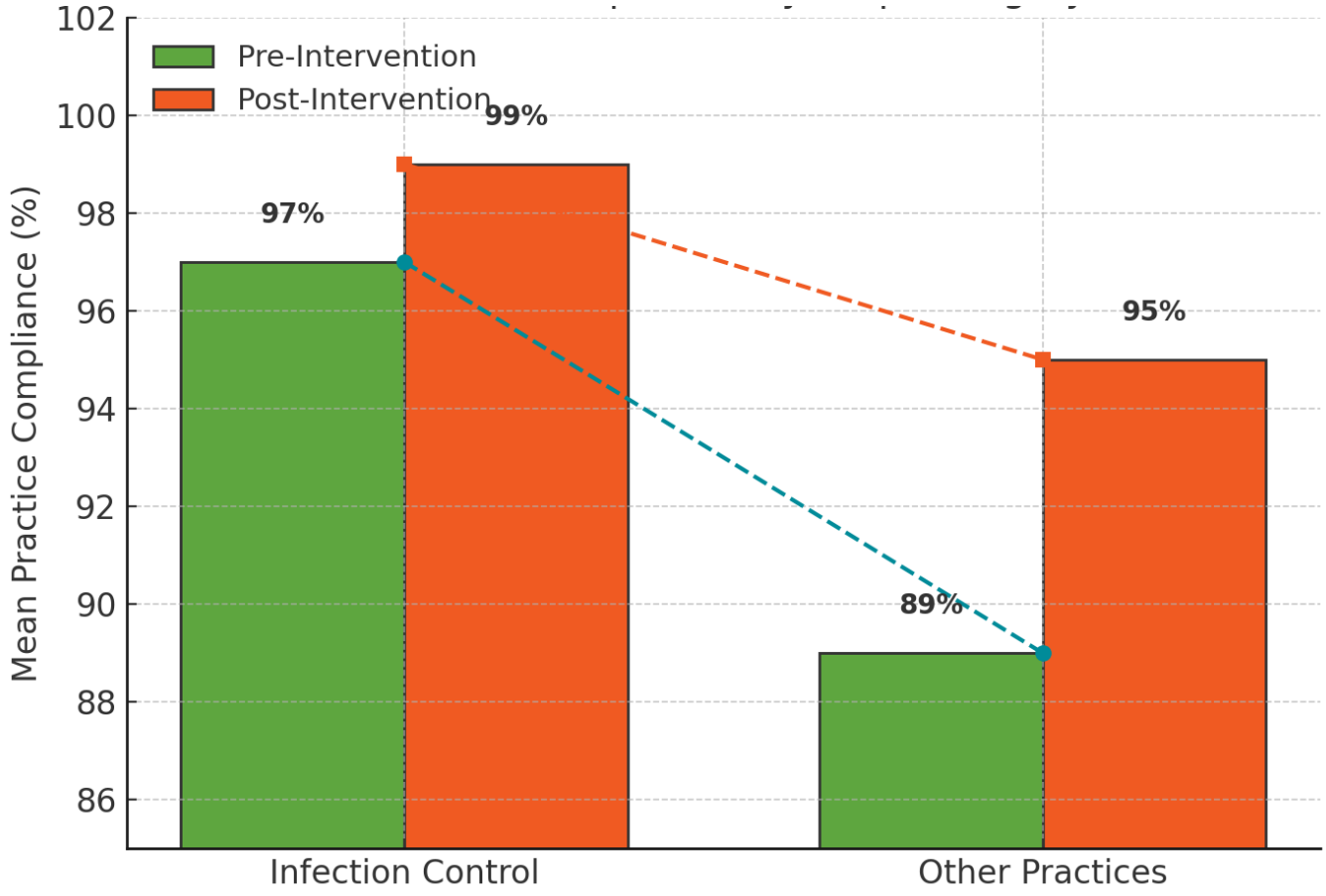

Figure 2 Practice Compliance by Step Category

The second figure compares aggregated practice compliance rates for infection control-related steps versus non-infection-control procedural steps, both before and after the intervention. Pre-intervention and infection control steps already had higher compliance (97%) than other practices (89%). After the educational program, infection control compliance approached a ceiling effect (99%), while non-infection-control practice compliance also increased substantially to 95%. This analysis demonstrates that educational interventions can raise adherence to both domains, but the largest relative improvements occur in procedural aspects initially exhibiting lower compliance, thereby promoting a more uniform standard of evidence-based clinical care.

DISCUSSION

The findings of this study demonstrate that a structured educational intervention significantly improves both knowledge and practical adherence to evidence-based endotracheal tube suctioning (ETS) protocols among nurses and doctors working in critical care environments. Pre-intervention data revealed a high baseline recognition of key infection control and patient assessment steps, consistent with recent multi-site studies indicating that ICU staff often recognize the theoretical importance of such procedures (6,21). However, certain elements, notably sodium chloride instillation and regular verification of cuff pressure, were rated as less important or less consistently implemented, echoing prior reports of variability in guideline adoption for less-emphasized procedural components (13,31).

The post-intervention improvements observed in this study align with a broad literature base supporting the role of education in enhancing procedural competence in airway management. Studies from Syria, Turkey, and Egypt have reported significant increases in both knowledge and skills after targeted training, with the largest gains observed in domains with low initial adherence (4,11,19). For instance, Abo Jeesh et al. found marked improvements in nurses' knowledge and ETS performance after a teaching program, particularly among staff with less prior exposure to structured training (4). The present study's gains in both knowledge scores and observed compliance—most notably for sodium chloride instillation and self-protection practices—are comparable to these prior findings, suggesting the robust generalizability of educational interventions across diverse clinical settings.

Notably, this study also underscores the phenomenon, described in recent regional and international literature, of a persistent knowledge-practice gap among nurses performing ETS (23,31). While many participants demonstrated acceptable skill levels before the intervention, observational data and knowledge assessments revealed deficiencies in theoretical understanding and the correct

application of certain evidence-based steps. This disconnect is frequently attributed to experiential learning in high-volume clinical environments, where practical habits may supersede formal education or current guidelines (31). The intervention's ability to elevate both knowledge and compliance to higher, more uniform levels speaks to the necessity of ongoing, structured education as a mechanism for standardizing care and enhancing patient safety (1,15).

The clinical relevance of these findings is reinforced by evidence from meta-analyses and quality improvement audits, which indicate that adherence to ETS best practices reduces the risk of adverse outcomes, including ventilator-associated pneumonia, hypoxia, and airway trauma (1,5,27). Improved hand hygiene, meticulous equipment handling, and proper pre- and post-suctioning assessment—steps that achieved near-universal compliance post-intervention in this study—are linked to lower complication rates and better overall patient outcomes. The observed increase in compliance for checklist items previously rated as less important demonstrates that educational interventions can effectively target and remediate specific gaps in practice, even among experienced staff.

Despite the intervention's success, several limitations should be acknowledged. The single-institution setting may limit the generalizability of the findings, although the results are consistent with those reported from diverse international contexts (4,6,11,19,21). The short interval between education and post-intervention assessment may overestimate knowledge retention and practice change; future studies with longer follow-up are needed to determine the durability of these improvements (28). The reliance on direct observation for practice assessment, while a methodological strength in terms of objectivity, may introduce observer effects that modestly inflate post-training compliance. Finally, while no significant demographic differences were observed in knowledge or practice gains, larger multi-center studies would be valuable to explore potential variations by baseline experience or prior training exposure.

Future research should focus on strategies for sustaining educational gains over time, integrating periodic refreshers and audits, and evaluating the impact of improved ETS adherence on patient-centered outcomes. The inclusion of multidisciplinary educational programs and greater organizational support may further enhance the translation of knowledge into consistent, high-quality practice (14,31). Ultimately, the results of this study contribute to a growing consensus that structured education is not only effective but essential for aligning clinical behavior with the evolving standards of airway management in critical care.

CONCLUSION

This study demonstrates that structured educational interventions significantly enhance both the knowledge and practical adherence of critical care nurses and doctors to evidence-based endotracheal tube suctioning protocols. While baseline skills in procedure execution were generally high, important deficiencies in theoretical knowledge and selected best practices were identified, particularly for less-emphasized aspects of suctioning. Targeted education effectively bridged the knowledge-practice gap, resulting in increased compliance with all core elements of safe ETS and minimizing variability in care. These findings underscore the necessity for ongoing, standardized training programs and institutional support to ensure consistent delivery of high-quality airway management and to optimize patient safety in critical care settings.

REFERENCES

1. American Association of Respiratory Care. Clinical Practice Guidelines: Endotracheal Suctioning of Mechanically Ventilated Patients with an Artificial Airway. Respir Care. 2010;55(6):758–64.

2. Apicare. Ventilator-Associated Pneumonia Prevention: Nurses' Knowledge and Practice in Lahore's Critical Care Units. Apicare Online. 2023;10(2):56–63. Available from: https://www.apicareonline.com/index.php/APIC/article/view/1315

3. Aurangzeb M, Iqbal Z, Amin I, Khan MZ, Khan AS. Assessment of Knowledge Regarding Endotracheal Suctioning Among Nurses Working at Critical Care Units of Tertiary Care Hospital Peshawar, Pakistan. J Gandhara Nurs Allied Health Sci. 2020. Available from: https://doi.org/10.37762/jfinph.90

4. Abo Jeesh YA, Mohammed Khalid EF-E, Elbashier IMA. Effectiveness of Teaching Program on Critical Care Nurses' Performance During Endotracheal Suctioning in the Intensive Care Units in Syria. Eur Sci J. 2021;17(34):190. Available from: https://doi.org/10.19044/esj.2021.v17n34p190

5. Blakeman TC, Scott JB, Yoder MA, Capellari E, Strickland SL. AARC Clinical Practice Guidelines: Artificial Airway Suctioning. Respir Care. 2022;67(2):258–71. Available from: https://doi.org/10.4187/respcare.09548

6. Chen W, Hu S, Liu X, Wang N, Zhao J, Liu P, Hu J. Intensive Care Nurses' Knowledge and Practice of Evidence-Based Recommendations for Endotracheal Suctioning: A Multisite Cross-Sectional Study in Changsha, China. BMC Nurs. 2021;20:12. Available from: https://doi.org/10.1186/s12912-021-00715-y

7. Dougherty L, Lister S, editors. The Royal Marsden Hospital Manual of Clinical Procedures. 9th ed. Chichester: John Wiley & Sons; 2015.

8. Ezzat Badawey BB, Youssef IA, Abdel-Baky MM, Mohamed AA. Effect of Educational Program on Critical Care Nurses' Performance of Cuffed Endotracheal Tube Care Using Blended Method. Minia Sci Nurs J. 2024;15(1):81–9. Available from: https://doi.org/10.21608/msnj.2024.282109.1115

9. Farsi ZF, Fatimah K, Maryam N, Sara R. Effect of Clinical Audit Process on the Level of Endotracheal Suctioning Skill in Nurses and Anesthesia Technicians Working in Intensive Care Units. Nurs Pract Today. 2015;2(2):76–83.

10. Frota OP, Ferreira AM, Loureiro MDR, Cheade MFM, Reis MG. O Use de Equipamento de Proteção Individual por Profissionais de Enfermagem na Aspiração Endotraqueal. Rev Enferm UERJ. 2012;20(1):625–30.

11. Kaur K. Effectiveness of Structured Teaching Programme on Knowledge and Practices Regarding Endotracheal Suctioning Among Staff Nurses Working in Intensive Care Units of Selected Hospitals of Jalandhar, Punjab, 2021. Int J Nurs Educ. 2022;14(3):98–104. Available from: https://doi.org/10.37506/ijone.v14i3.18358

12. Lyons N. Suctioning an Adult ICU Patient with an Artificial Airway: A Clinical Practice Guideline. Agency for Clinical Innovation (ACI); 2014.

13. Mohamed RAE, Elaasar HN, Diab SS. Effect of Competency-Based Training Program on Nurses' Performance Regarding Endotracheal Tube Suction for Neonates on Mechanical Ventilator. Egypt J Health Care. 2022;13(4):1788–801. Available from: https://doi.org/10.21608/ejhc.2022.289875

14. Negro A, Ranzani R, Villa M, Manara D. Survey of Italian Intensive Care Unit Nurses' Knowledge About Endotracheal Suctioning Guidelines. Intensive Crit Care Nurs. 2014;30(6):339–45. Available from: https://doi.org/10.1016/j.iccn.2014.06.001

15. Raoof AA, Baeez YK. Efficiency of the Educational Material in Enhancing Nurses' Understanding of Endotracheal Suctioning at Iraq/Kirkuk City. J Sci Res Med Biol Sci. 2024;5(2):13–9. Available from: https://doi.org/10.47631/jsrmbs.v5i2.741

16. Singh R, Bhalotra AR, Sharma S. Audit on Practices of Endotracheal Suctioning in Intensive Care Unit Patients Among Health Care Workers (HCWs). Indian J Crit Care Med. 2024;28(1):58–65. Available from: https://doi.org/10.5005/jp-journals-10071-24615

17. Süha BK, Karagözoğlu Ş. Endotrakeal Aspirasyon Becerisini Geliştirmede Hemşirelik Öğrencilerine Uygulanan Yüksek Gerçekli Simülasyon Eğitiminin Klinik Karar Verme ve Klinik Uygulamaya Etkisi: Deneysel Bir Çalışma. Turk Klin J Nurs Sci. 2024;16(2):479–88. Available from: https://doi.org/10.5336/nurses.2023-99808

18. Sharma A, S S. Effectiveness of Video-Assisted Teaching on Knowledge and Practice Regarding Suctioning of Children on Mechanical Ventilator Among Nurses Working in Pediatric Department. Int J Contemp Pediatr. 2023. Available from: https://doi.org/10.18203/2349-3291.ijcp20231844

19. Zainab T, Afzal M, Sarwar H, Waqas A. The Gap Between Knowledge and Practices in Standard Endotracheal Suctioning of Intensive Care Unit Nurses in Children's Hospital Lahore. Saudi J Med Pharm Sci. 2017;3(6A):454–63. Available from: http://scholarsmepub.com/sjmps