

Effectiveness of a Need-based Interventional Tracheostomy Care Protocol on Knowledge and Practice of Tracheostomy Care among Nurses

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ABSTRACT

Aim and background: Tracheostomy is a commonly conducted surgical intervention in intensive care settings, and many complications result from tracheostomy. The use of an evidence-based methodology for tracheostomy care can effectively mitigate the occurrence of complications. This study aimed to assess tracheostomy complications among patients, determine nurses' knowledge and practice of tracheostomy care, and evaluate the effectiveness of a tracheostomy care protocol (TCP) in terms of improving knowledge and practice of tracheostomy care and reducing complications among patients.

Materials and methods: To conduct this study, a quasi-experimental research design was selected. Ninety-eight intensive care nurses were divided into two groups, with 49 nurses in each group. The experimental group received an intervention, and both groups underwent pre- and posttests using tools related to tracheostomy care knowledge and practice checklists. Complications among patients were observed using a tracheostomy complication checklist. Data analysis involved both descriptive and inferential statistics.

Results: This study identified complications, including bleeding, tube obstruction, hypoxia, and local wound site infection, among tracheostomy patients. About 49% of the nurses in the experimental group and 34.7% in the control group had poor knowledge. There was a statistically significant difference in pre- and postintervention knowledge and practice scores between the groups ($p < 0.001$).

Conclusion: This study revealed a gap in participants' knowledge and practices regarding tracheostomy care. After the TCP was implemented, intensive care nurses improved their knowledge and practices. Postintervention, the number of complications and the length of hospital stay among patients were reduced.

Keywords: Effectiveness, Intensive care unit, Knowledge, Practice, Tracheostomy.

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HIGHLIGHTS

- Proper tracheostomy care is an essential component of nursing practice, and nurses lack knowledge and skill in tracheostomy care, which may jeopardize patient safety.
- The tracheostomy care protocol (TCP) is an important intervention for improving the knowledge and skills of nurses, which improves the quality of nursing care and significantly reduces the occurrence of complications and the length of hospitalization.

INTRODUCTION

Tracheostomy is a surgical technique that involves the creation of an aperture in the front wall of the trachea, enabling easier access to the airway and ventilation. A tracheostomy tube is then inserted into this opening to maintain an airway for breathing. Tracheostomy is necessary in emergencies such as acute upper airway obstruction, laryngeal trauma, prolonged mechanical ventilation, poor airway protection, etc.¹ Tracheostomy is a relatively safe technique in the intensive care settings, though complications, such as infection, tracheomalacia, skin breakdown, and tracheoesophageal fistula, may arise.² Emergencies with tracheostomy can include hemorrhage, tube dislodgement, airway loss, and tube obstruction.³ Implementing proper tracheostomy enhances patient comfort, lowers the risk of laryngeal damage, minimizes the requirement for sedation, facilitates ventilator weaning, and decreases the duration

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of hospital stay.⁴ However, poor tracheostomy care practices may prolong hospital stays and exacerbate complications.^{5,6} Nurses are pivotal in driving positive patient outcomes, as they invest substantial time in delivering tracheostomy care.⁷

A study conducted among 200 tracheostomy patients in an intensive care unit (ICU) reported the complications that occurred at insertion while cannulating and following decannulation. Complications during insertion included major bleeding (5%),

tracheal wall injury (0.5%), and pneumothorax (0.5%). Complications during cannulation included prolonged bleeding (5%), pneumothorax (2%), accidental decannulation (4%), and tube blockage (6%). Severe hypoxia was observed in approximately 40% of the patients, with two patients suffering cardiac arrest in instances of blockage and displacement. Following decannulation, one patient (0.8%) required immediate recannulation.⁸

The study revealed that nurses' knowledge and performance in tracheostomy care were inadequate, ultimately affecting the outcomes of patients.⁹ The findings from a survey of 80 nurses indicated that most (71%) possessed moderate knowledge, while 26.5% had poor knowledge, and a mere (2.5%) demonstrated good knowledge regarding tracheostomy. About 97.5% exhibited a low level of tracheostomy care practice, and the authors highlighted the need for in-service professional development programs for these patients.⁷

A cross-sectional study carried out in Jordanian hospitals involving 260 nurses working in critical care units highlighted that their level of knowledge was less than optimal and that there was an urgent need for education.⁴ Another study conducted in Saudi Arabia in the context of nurses caring for tracheostomy patients suggested that optimal care for these patients can be achieved only through continuous training and thorough competency evaluation.¹⁰ A study conducted in Turkey among 150 ICU nurses revealed that the level of nurses' knowledge of tracheostomy care did not meet the expected standards, indicating a need for educational programs to fill this gap.¹¹ The present study also aims to identify gaps in knowledge and practice and to develop and apply need-based interventional tracheostomy care protocols when caring for patients with tracheostomy. This helps reduce complications, thereby minimizing the length of hospital stays and reducing the financial burden on patients.

MATERIALS AND METHODS

Study Design and Participants

This quasi-experimental study took place within the critical care units of a Tertiary Care Hospital located in Udipi District, Karnataka, from January to July 2022. The study participants were recruited via a purposive sampling technique, that was nonrandomized. The study included staff nurses working in ICUs and adult patients admitted to the ICU setting on the first day of tracheostomy. Patients who underwent tracheostomy outside this particular setting were not included in the study. With the use of the proportion estimation formula, the sample size was determined to be 49 staff nurses for each control and experimental group.

Data Collection

A total of four tools, which were developed by the investigators, were used for data collection:

- Tool 1: Demographic profile of ICU nurses and patients.
- Tool 2: Structured knowledge questionnaire on tracheostomy care.
- Tool 3: Structured observation checklist for tracheostomy care.
- Tool 4: Checklist on tracheostomy complication.

Background information from intensive care nurses and patients was collected via a demographic profile. The nurses' demographic data included age, gender, educational qualification, experience and previous training in tracheostomy care. The patient's characteristics included age, gender, indication for tracheostomy

and the date the tracheostomy was performed. Nurses' knowledge level of tracheostomy care was assessed through the structured knowledge questionnaire. The tool has 30 items, including anatomy, indications, types of tracheostomies, tracheostomy procedures, tracheostomy care, complications and management of complications. The scores were considered good (more than 23 scores, >75%), moderate (15–23 scores, 50–75%), or poor (less than 15, <50%). The structured observation checklist was utilized to gather information about the nurses' tracheostomy care practices without any intervention and after the tracheostomy care intervention. The tool has 40 items, which include the observation of practices for tracheostomy care, such as assessment before the procedure, oral hygiene, the preparation of articles and equipment, the procedure of tracheostomy suctioning, tracheostomy care, and documentation. The practice scores were considered good (more than 36 scores, >90%), moderate (28–36 scores, 70–90%), or poor (less than 28, <70%). The tracheostomy complication checklist was used to identify complications such as hypoxia, infection, obstruction and bleeding among tracheostomy patients.

The content validity of the tool in terms of relevance, accuracy, and appropriateness was established, and the tools were modified on the basis of expert suggestions. The scale content validity index (S-CVI) was 1 for tools 1 and 4, whereas the S-CVI was 0.87 for tools 2 and 3. Using Spearman's split-half method, the reliability of the structured knowledge questionnaire was determined ($r = 0.75$). The reliability of the structured observation checklist for tracheostomy care ($r = 1$) and the reliability of the tracheostomy complication checklist ($r = 1$) were established through interrater reliability.

Prospective data on tracheostomy complications was obtained for three months from patients via a complication checklist. The first 49 nurses from the selected ICUs were recruited as control group participants, followed by 49 nurses as experimental group participants. The data were obtained, a pretest was conducted, and a posttest was performed for the control group participants, followed by data collection, pretesting, and implementation of the intervention, i.e., the TCP and posttest for the experimental group participants. The TCP included a lecture session on tracheostomy care as well as a demonstration of the tracheostomy procedure. Complications were observed after the intervention for 3 months among 20 tracheostomy patients, i.e., 10 in each group, who were being cared for by intensive care nurses in both the experimental and control groups. Upon completion of the study, the control group participants were provided with the TCP.

Statistical Analysis

The data analysis process involved the use of descriptive and inferential statistics with the Statistical Package for Social Sciences (SPSS) version 16.0. The analysis of the data is based on goals and hypotheses. The sample characteristics, knowledge, clinical practice, and complications were described using descriptive and inferential statistics that were organized according to frequencies, percentages, means, standard deviations, independent *t*-tests, and *p* values.

RESULTS

Characteristics of the Study Participants

The study revealed that the mean age of the experimental group participants was 27.6 ± 5.6 years, and that of the control group participants was 27.9 ± 5.30 years. About 34 (69.4%) participants

Table 1: Description of sample characteristics

Demographic variables	Experimental group (n = 49)		Control group (n = 49)	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Age (in years)				
Mean age	27.6 ± 5.6		27.9 ± 5.30	
20–30	35	71.4	35	71.4
31–40	13	26.5	12	24.5
41–50	1	2	2	4.1
Gender				
Male	2	4.1	10	20.4
Female	47	95.9	39	79.6
Qualification				
GNM	34	69.4	34	69.4
BSc (N)	10	20.4	12	24.5
PBBS (N)	5	10.2	3	6.1
Work experience				
0–1 year	13	26.5	13	26.5
2–5 years	17	34.7	15	30.6
6–10 years	14	28.6	18	36.7
More than 10 years	5	10.2	3	6.1
ICU experience				
0–1 year	18	36.7	20	40.8
2–5 years	22	44.9	21	42.9
6–10 years	7	14.3	6	12.2
More than 10 years	2	4.1	2	4.1
Previous training				
Yes	12	24.5	6	12.2
No	37	75.5	43	87.8

in both groups had a diploma nursing qualification. In the experimental group, 17 (34.7%) participants had 2–5 years of work experience, and in the control group, 18 (36.7%) participants had 6–10 years of experience (Table 1).

Tracheostomy Complications among Critically Ill Patients

This section describes the first 3 months of data on tracheostomy complications among 30 tracheostomy patients. The complications observed were as follows: Bleeding, 8 (26.7%); hypoxia, 1 (3.3%); bleeding and hypoxia, 2 (6.7%); bleeding and local wound site infection, 1 (3.3%); tube obstruction and hypoxia, 6 (20%); bleeding, obstruction and hypoxia, 7 (23.3%); and bleeding, obstruction, hypoxia and infection, 2 (6.7%). No complications were observed among 3 (10%) patients (Table 2).

Scores of Knowledge of Tracheostomy Care among the Study Participants

The data presented in Figure 1 show the participants' knowledge scores on tracheostomy care. About 25 out of 49 participants (51%) in the experimental group and 30 out of 49 participants (61.2%) in the control group possessed moderate knowledge. Poor knowledge was observed in 24 individuals (49%) in the experimental group and 17 individuals (34.7%) in the control group. Conversely, good knowledge was present in only 2 individuals (4.1%) in the control group.

Table 2: Description of tracheostomy complications (n = 30)

Variables	Frequency (f)	Percentage (%)
No complication	3	10
Bleeding	8	26.7
Hypoxia	1	3.3
Bleeding and hypoxia	2	6.7
Bleeding and local wound site infection	1	3.3
Tube obstruction and hypoxia	6	20
Bleeding, obstruction, and hypoxia	7	23.3
Bleeding, obstruction, hypoxia infection	2	6.7

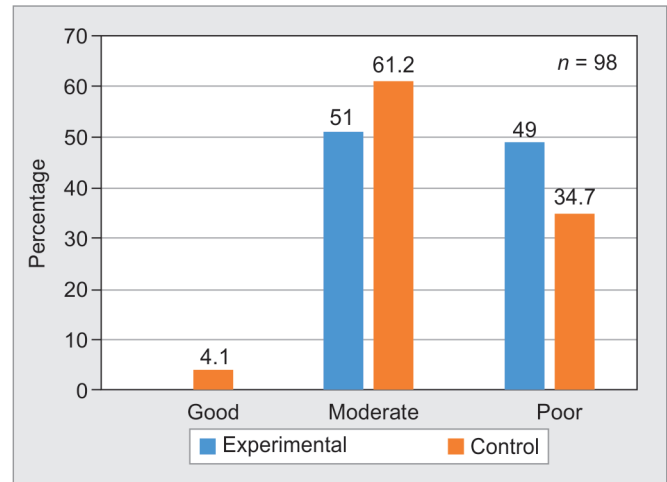


Fig. 1: Pretest knowledge scores on tracheostomy care among participants

Tracheostomy Care Practices among the Study Participants

The data show the participants' scores for tracheostomy care practice. Most of the 35 (71.4%) participants in the experimental group, and 37 (75.5%) participants in the control group had moderate practice scores. Good scores were attained by 11 participants (22.4%) in the experimental group and 10 participants (20.4%) in the control group. On the other hand, poor scores were recorded by 3 participants (6.1%) in the experimental group and 2 participants (4.1%) in the control group (Fig. 2).

Mean Pre- and Postintervention Knowledge Scores between the Groups

In the pretest, the mean score of knowledge was 14.32 ± 3.26 for the experimental group and 15.89 ± 4.15 for the control group. The experimental group had a mean knowledge score of 28 ± 0.95 on the posttest, whereas the control group had a score of 16.91 ± 3.68 . Compared with the control group, the experimental group presented statistically significant differences in mean pre- and post-knowledge scores ($p < 0.001$) (Table 3). As a result, it was established that the TCP was efficient in enhancing knowledge of tracheostomy care.

Mean Pre- and Postintervention Practice Scores between the Groups

In the pretest, the mean score of practice was 32.65 ± 3.27 for the experimental group and 33.34 ± 3.03 for the control group.

In the posttest, the mean practice score was 39.26 ± 1.20 for the experimental group and 33.65 ± 2.44 for the control group. There was a statistically significant difference between the mean pre- and postpractice scores between the experimental and control groups ($p < 0.001$) (Table 4). Hence, it was concluded that TCP was effective in improving the tracheostomy care practice.

Postintervention Tracheostomy Complications among Patients

The mean age of the patients was 60.8 ± 11.8 in the experimental group and 49.1 ± 16.3 in the control group. Most of the patients were male, with 7 (70%) in the experimental group and 6 (60%) in the control group. The indications for tracheostomy were prolonged

mechanical ventilation in 8 (80%) of the experimental group and 7 (70%) of the control group, whereas upper airway obstruction was the indication in 2 (20%) of the experimental group and 3 (30%) of the control group.

The complications observed were bleeding and hypoxia among 2 (20%) tracheostomy patients in both experimental and control groups. Bleeding and local wound infection, as well as bleeding and hypoxia, were observed among 1 (10%) of the experimental group and 2 (20%) of the control group patients. In the experimental group, 1 (10%) encountered bleeding, tube obstruction, and hypoxia, while in the control group, this was observed in 3 (30%) of patients. Complications were absent in 5 (50%) of the experimental group and only in 1 (10%) of the control group patients (Table 5).

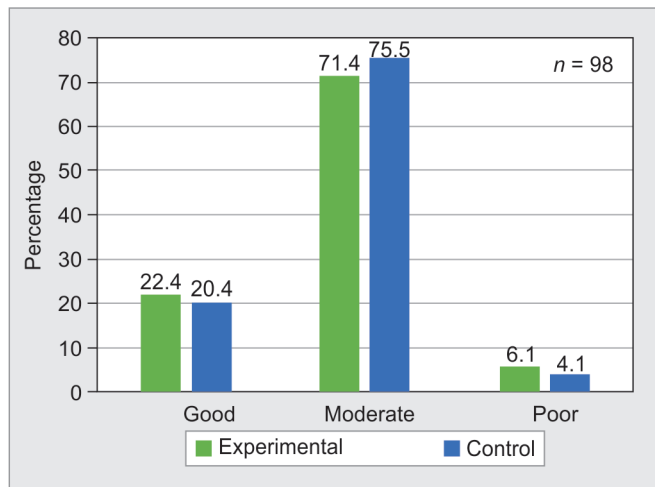


Fig. 2: Pretest tracheostomy care practice scores among participants

DISCUSSION

This study stated that among 30 tracheostomy patients, the complications observed were bleeding 8 (26.7%), hypoxia 1 (3.3%), bleeding and hypoxia 2 (6.7%), bleeding and local wound site infection 1 (3.3%), tube obstruction and hypoxia 6 (20%), bleeding, obstruction and hypoxia 7 (23.3%), bleeding, obstruction, hypoxia and infection 2 (6.7%). There were no complications observed among 3 (10%) patients. In 2017, a study carried out in Maharashtra, India, revealed that 37 patients experienced one or more complications, resulting in a complication rate of 29.81%. The most prevalent complication was surgical emphysema (14.51%), followed by peristomal infection, which was observed in five patients.¹² Among the 100 tracheostomy patients recruited, 53 experienced complications, resulting in a total of 76 complication events, including both single and multiple complications. Among the complications reported, tube blockage (52.6%), accidental decannulation (17.1%), and bleeding (11.8%) were the most common.¹³ The complications reported after tracheostomy were

Table 3: Pre- and postintervention knowledge scores between the groups

Variables	Experimental group (n = 49)		Control group (n = 49)		t	p
	Mean	Std. deviation	Mean	Std. deviation		
Knowledge pretest	14.32	3.26	15.89	4.15	20.45	0.001
Knowledge posttest	28	0.95	16.91	3.68		

Table 4: Pre- and postintervention practice scores between the groups

Variables	Experimental group (n = 49)		Control group (n = 49)		t	p
	Mean	Std. deviation	Mean	Std. deviation		
Practice pretest	32.65	3.27	33.34	3.03	14.41	0.0001
Practice posttest	39.26	1.20	33.65	2.44		

Table 5: Description of postintervention tracheostomy complications

Complications	Experimental group (n = 10)		Control group (n = 10)	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
No complication	5	50	1	10
Bleeding and hypoxia	2	20	2	20
Bleeding and local wound site infection	1	10	2	20
Tube obstruction and hypoxia	1	10	2	20
Bleeding, tube obstruction, and hypoxia	1	10	3	30

tracheal stenosis (13.9%) and subglottic stenosis (25%).¹⁴ In another investigation, it was revealed that mucous deposition made up 6.86% of complications, blockage of the tracheostomy canula 6.29%, bleeding from multiple attempts 6.06%, and excessive bleeding 2.94%.¹⁵ Minor bleeding (2.2%), surgical emphysema (2.2%) and wound infection (1.1%) were observed postoperatively among surgical tracheostomy patients.¹⁶

The study showed that 25 (51%) individuals in the experimental group and 30 (61.2%) individuals in the control group possessed moderate knowledge. In the experimental group, 24 individuals (49%) had poor knowledge, while in the control group, 17 individuals (34.7%) had poor knowledge. The study also revealed that 35 (71.4%) participants in the experimental group and 37 (75.5%) participants in the control group had moderate levels of practice scores. In the experimental group, 11 participants (22.4%) achieved good scores, while in the control group, 10 participants (20.4%) achieved the same. A study conducted supports the findings of this study, where tracheostomy care knowledge levels ranged from 48 to 52%, and scores above 50% were considered acceptable. Healthcare professionals exhibit significant knowledge gaps in various aspects of tracheostomy care and management.¹⁷ The study revealed that there are gaps in nurses' understanding of tracheostomy care, particularly in routine tracheal care (55%), tracheal care skills (11.6%), and tracheal emergency care (2.3%).¹⁸ The nurses lack sufficient knowledge and expertise in the evidence-based guidelines for tracheostomy care.⁴

In this study, the mean pretest knowledge score was 14.32 ± 3.26 for the experimental group and 15.89 ± 4.15 for the control group. The mean posttest knowledge score was 28 ± 0.95 for the experimental group and 16.91 ± 3.68 for the control group. A statistically significant difference was found in the mean pre- and postknowledge scores between the experimental and control groups ($p < 0.001$). The mean pretest practice score was 32.65 ± 3.27 for the experimental group and 33.34 ± 3.03 for the control group. The posttest mean practice score was 39.26 ± 1.20 for the experimental group and 33.65 ± 2.44 for the control group.

A statistically significant difference was found in the mean pre- and postpractice scores between the experimental and control groups ($p < 0.001$). The study found that TCP significantly enhanced tracheostomy care knowledge and practice. To support these study findings, a study proved that utilizing video-assisted instruction and following established protocols can be a successful approach to enhancing understanding and skills. Additionally, conducting in-service training sessions on tracheostomy care is deemed essential.¹⁹ There was significant improvements in tracheostomy care practice ($p = 0.001$) among nurses who received progressive tracheostomy care procedure training.²⁰ Following the training program, there was marked progress in the staff nurses' knowledge and skills in tracheostomy care.^{21–24} Inadequate knowledge of tracheostomy care was observed among the study subjects. The introduction of an information booklet on nursing interventions significantly improved their knowledge and practice scores.^{25,26}

This study also proved that there was a reduction in complication rates following intervention. No complications were observed among 5 (50%) participants in the experimental group and 1 (10%) participant in the control group. A similar study has proved that a dedicated tracheostomy care nurse program decreased the complication rates and readmissions to the ICUs and reduced the average length of hospital stay.²⁷

LIMITATIONS OF THE STUDY

The participants were from a single hospital; hence, the findings cannot be generalized. The period of observation for complications was limited. Given that the nurses included in the study were from the same ICU, there was a likelihood of the Hawthorne effect.

CONCLUSION

This study revealed that there is a gap in participants knowledge of tracheostomy care and tracheostomy care practices. The development of a TCP based on need resulted in improved knowledge and practice of tracheostomy care among intensive care nurses. Furthermore, there was a notable decrease in tracheostomy complications, suggesting its potential application in ICUs for patient care.

Clinical Significance

Tracheostomy is a frequent procedure in ICU settings, and nurses need to deliver appropriate care to patients with tracheostomies to avoid complications. Studies have shown that nurses lack the knowledge and practice skills to perform proper tracheostomy care. Nursing interventions are effective in increasing knowledge and improving practice skills. In-service education and training programs should be provided to critical care nurses continuously to achieve better results.

STATEMENT OF ETHICS

The study received ethical approval from the Institutional Ethics Committee of Kasturba Hospital, Manipal (IEC:696/2021), before the study and CTRI registration (CTRI/2022/01/039607) before data collection. The guiding principles of the Declaration of Helsinki were followed when the study was conducted. Every participant received a participant information leaflet, and informed consent was obtained. The participants were made aware that no personal information would be revealed in the publication of the data obtained. The study's confidentiality was upheld at all times.

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REFERENCES

- Hyzy RC, McSparron JI. Tracheostomy: Rationale, indications, and contraindications. 2024. [online]. Available from: <https://www.uptodate.com/contents/tracheostomy-rationale-indications-and-contraindications>. [Last accessed October, 2024].
- Ho YM, Wysocki AP, Hogan J, White H. An audit of characteristics and outcomes in adult intensive care patients following tracheostomy. *Indian J Crit Care Med* 2012;16(2):100–105. DOI: 10.4103/0972-5229.99124.
- Morris LL, Whitmer A, McIntosh E. Tracheostomy care and complications in the intensive care unit. *Crit Care Nurse* 2013;33(5):18–30. DOI: 10.4037/ccn2013518.
- Abu-Sahyoun R, ALBashtawy M, Mohammad K, Baker N, Al-Sheyab N, Alyahya M, et al. Critical care nurses' knowledge of tracheostomy care. *Iran J Nurs Midwifery Res* 2023;28(5):504–508. DOI: 10.4103/ijnmr.ijnmr_180_22.
- Ross J, McMurray K, Cameron T, Lanteri C. Use of a silicon stoma stent as an interim step in high-risk tracheostomy decannulation. *OTO Open* 2019;3(1):2473974X19836432. DOI: 10.1177/2473974X19836432.

6. Onuoha J. Developing an educational program for tracheostomy care [Doctoral Dissertation]. Minneapolis, MN: Walden University; 2019. [online]. Available from: <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=8213&context=dissertations>. [Last accessed October, 2024].
7. Gaterega T, Mwisenzeza MJ, Chironda G. Nurses' knowledge and practices regarding tracheostomy care at a selected referral hospital in Rwanda—A descriptive cross-sectional study. *Int J Afr Nurs Sci* 2021;15:100350. DOI: 10.1016/j.ijans.2021.100350.
8. Glosop A, Meekings TC, Hutchinson SP, Webber SJ. Complications following tracheostomy insertion in critically ill patients—experience from a large teaching hospital. *J Intensive Care Soc* 2011;12(4):301–306. DOI: 10.1177/175114371101200411.
9. Yelverton JC, Nguyen JH, Wan W, Kenerson MC, Schuman TA. Effectiveness of a standardized education process for tracheostomy care. *Laryngoscope* 2015;125(2):342–327. DOI: 10.1002/lary.24821.
10. Mahfoz TM Bin. Attitude and practices of tracheostomy care among nursing staff in Saudi Arabia. *BMC Nurs* 2022;21(1):367. DOI: 10.1186/s12912-022-01150-3.
11. Mungan İ, Kazancı D, Bektaş Ş, Sarı S, Çavuş M, Turan S. The evaluation of nurses' knowledge related to tracheostomy care in tertiary intensive care units. *Int Med* 2019;1(6):313. DOI: 10.5455/im.54258.
12. Kawale MA. A prospective study of complications of tracheostomy and management in tertiary care hospital in rural area. *Glob J Otolaryngol* 2017;5(4):555667. DOI: 10.19080/GJO.2017.05.555667.
13. Nyanzi DJ, Atwine D, Kamoga R, Birungi C, Nansubuga CA, Nyaitera V, et al. Tracheostomy-related indications, early complications and their predictors among patients in low resource settings: A prospective cohort study in the pre-COVID-19 era. *BMC Surg* 2023;23(1):59. DOI: 10.1186/s12893-023-01960-5.
14. El-Anwar M, Nofal A, Shawadfy M, Maaty A, Khazbak A. Tracheostomy in the intensive care unit: a university hospital in a developing country study. *Int Arch Otorhinolaryngol* 2016;21(1):33–37. DOI: 10.1055/s-0036-1584227.
15. Kiran VAK, Kiran NAS, Kumar VA, Ghosh A, Pal R, Reddy VV, et al. The outcome analysis and complication rates of tracheostomy tube insertion in critically ill neurosurgical patients; a data mining study. *Bull Emerg Trauma* 2019;7(4):355–360. DOI: 10.29252/beat-070403.
16. Kiran S, Eapen S, Chopra V. A comparative study of complications and long term outcomes of surgical tracheostomy and two techniques of percutaneous tracheostomy. *Indian J Crit Care Med* 2015;19(2):82–86. DOI: 10.4103/0972-5229.151015.
17. Khanum T, Zia S, Khan T, Kamal S, Khoso MN, Alvi J, et al. Assessment of knowledge regarding tracheostomy care and management of early complications among healthcare professionals. *Braz J Otorhinolaryngol* 2022;88(2):251–256. DOI: 10.1016/j.bjorl.2021.06.011.
18. Mosalli R, Aboumoustafa GA, Khayyat W, Bokhari AN, Almatrafi MA, Ghazi M, et al. Assessment of nurses' knowledge and confidence regarding tracheostomy care in a pediatric long term care hospital in Saudi Arabia. *Risk Manag Healthc Policy* 2022;15:1809–1821. DOI: 10.2147/RMHP.S374730.
19. Sharma B. A quasiexperimental study to assess the effect of video assisted teaching module regarding tracheostomy care on knowledge and skill of staff nurses at Vinayaka Mission Hospital, Salem, Tamilnadu. *Res J Pharm Technol* 2014;7(7):737–742. Available from: <https://www.researchgate.net/publication/289343426>.
20. Omar Y, Ahmed A. Effect of tracheostomy care training on nurse's performance at critical care units in Erbil City. *Erbil J Nurs Midwifery* 2023;6(2):125–134. DOI: 10.15218/ejnm.2023.14.
21. Malk RN, Fahem EM, Soultan AAA. Effectiveness of training program regarding tracheostomy care on nurses' performance at intensive care unit. *Egypt J Health Care* 2022;13(1):267–279. DOI: 10.21608/ejhc.2022.216212.
22. Chitaranjan G, Kumar MA, Shashi P. To assess the effectiveness of the video assisted teaching on knowledge and practice regarding tracheostomy care among staff nurses with a view to develop protocol on tracheostomy care. *South Asian Res J Nurs Healthc* 2024;6(1):1–6. DOI: 10.36346/sarjnhc.2024.v06i01.001.
23. Abdulrahman E, Musa MT, Eltayeb RM, Ali Fadlalmola H. Effect of an educational training program in tracheostomy care on nurses' knowledge and skills. *Int J Nurs Educ* 2021;13(2):17–26. DOI: 10.37506/ijone.v13i2.14618.
24. Kaur K. A pre-experimental study to assess the effectiveness of structured teaching programme on knowledge and practice regarding tracheostomy care among staff nurses at selected hospitals of Punjab. *Int J Sci Res (IJSR)* 2019;8(3):593–598. DOI: 10.21275/ART20196062.
25. Amin N, Bhat A, Wali U. Effectiveness of information booklet on knowledge regarding tracheostomy care among nursing officers working in intensive care units of SKIMS, Soura Srinagar. 2022. [online]. Available from: <https://www.researchgate.net/publication/365209221>. [Last accessed October, 2024].
26. Thomas TT, Rao VV, Mahmood LS, Bhat M, Dsouza C. The role of a 'tracheostomy care training module' in improving the knowledge, attitude and practices among nurses in high dependency units. *Indian J Otolaryngol Head Neck Surg* 2024;76(3):2706–2713. DOI: 10.1007/s12070-024-04489-y.
27. Sodhi K, Shrivastava A, Singla MK. Implications of dedicated tracheostomy care nurse program on outcomes. *J Anesth* 2014; 28(3):374–380. DOI: 10.1007/s00540-013-1718-1.