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Knowledge assessment of respiratory therapists on endotracheal tube suctioning in intensive care units of public hospitals in Sana'a, Yemen

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Abstract

Background

Endotracheal suctioning involves the insertion of a suction catheter into the patient's trachea to remove and prevent the accumulation of secretions in the lungs of patients undergoing mechanical ventilation. Respiratory therapists are responsible for this procedure, so they must have strong knowledge of airway clearance in general, and endotracheal tube suctioning specifically, to implement the suction procedure without complications and with maximum benefit.

Methods

A descriptive study was conducted, including all respiratory therapists working in public hospitals in Sana'a City, Yemen, who were invited to participate. A self-administered questionnaire was used to collect data. Twenty questions were used to assess the participants' knowledge. Scores were classified as high if above 80%, intermediate if between 70-80%, and low if below 70%. Descriptive statistics were used to interpret demographic data and descriptive measures. The chi-square test for categorical data was used to find the association between knowledge level and demographic characteristics, with a P-value $\leq$ 0.05 considered significant.

Results

About two-thirds (68%) of participants were male, and 69% were between 21 and 30 years old. 98% of participants had a three-year diploma degree, and 78% had 1-5 years of experience. More than four-fifths (83%) of participants had training courses in airway clearance, and three-quarters (75%) had training in endotracheal tube suctioning techniques. 5% of participants had a high level of knowledge about ETT suctioning and answered the study questions correctly, while 11% had moderate knowledge. More than two-thirds (84%) of participants had low-level knowledge, as defined by the study questionnaire results. There was a significant association between the level of education and knowledge of the respiratory therapists toward endotracheal tube suctioning with p–value (0.025). In contrast, there was no association between each of the variables (Age, years of Experience) and the level of knowledge and endotracheal tube suctioning.

Conclusions

There is a significant association between educational level and the level of knowledge of respiratory therapists regarding endotracheal tube suctioning. We recommend that respiratory therapists advance their knowledge in airway clearance, specifically endotracheal tube suctioning, through continuous training based on evidence-based best practices.

Keywords: Endotracheal tube suction, knowledge, Respiratory therapists.

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Introduction

Suctioning a patient's artificial airway involves the insertion of a suction catheter into the patient's trachea and the application of negative pressure as the catheter is gradually withdrawn. [1]

Suctioning a patient with an artificial airway typically involves shallow suctioning, where the catheter is inserted to a depth approximating the length of the artificial airway. Deep suctioning involves inserting the catheter into the artificial airway until resistance is met. Once resistance is encountered, the catheter is withdrawn approximately 1 cm before applying negative pressure. [2]

Suctioning is needed to remove respiratory secretions that accumulate due to impaired mucociliary escalator and cough reflex. It should be used only when indicated. Suctioning is often performed frequently without considering potential disadvantages, which include loss of airway pressure with lung derecruitment, contamination of the airway or environment, pain/distress, airway trauma, pneumonia, increased intracranial pressure, and cardiac dysrhythmia. [3]

Artificial airway suctioning is a key component of airway management and a core skill for clinicians responsible for ensuring airway patency. Suctioning the artificial airway is a common procedure performed daily in intensive care units (ICUs). As such, clinicians must be familiar with the most effective and efficient methods to perform the procedure. [4]

All respiratory therapists should be aware of the potential hazards to patients when performing this intervention and take steps to prevent or minimize these risks. Therefore, updating endotracheal tube suctioning practices is believed to reduce the incidence of these complications. [5]

Methods

A descriptive, cross-sectional study was conducted among respiratory therapists working in intensive care units over three months, from November 1, 2023, to February 1, 2024, at six public hospitals in Sana'a City, Yemen (Al-Thawrah General Hospital Authority, Al-Kuwait University Hospital, Al-Sabeen Maternity & Child Hospital, 22 May Hospital, Palestine Maternity & Child Hospital, and Republican Teaching Hospital Authority). One hundred participants were enrolled using a convenience sampling technique.
Data was collected through a self-administered questionnaire developed from previous studies and organizational guidelines. [6-9]

The questionnaire consisted of three parts:

Part I: Demographic Characteristics (hospital name, age, educational level, years of experience).

Part II: This section covered the respiratory therapist's training courses in airway clearance and endotracheal suctioning.

Part III: A questionnaire to assess the knowledge of respiratory therapists regarding endotracheal suctioning, which included 15 questions. This part was divided into the following sections:

- Section one: Assessing the knowledge of respiratory therapists toward pre-procedure (questions 1 to 8).
- Section two: Assessing the knowledge of respiratory therapists during the procedure (questions 9 to 15).
- Section three: Assessing the knowledge of respiratory therapists' post-procedure (questions 15 to 20).

The scoring system assigned one point for each correct answer and zero points for incorrect answers, with a total score of 20. Scores above 80% were classified as high

knowledge, between 70-80% as moderate knowledge, and less than 70% as low knowledge. This scoring system was adopted from a previous study. [10]

Approval of the study was obtained from the ethical committee of the Faculty of Medicine and Health Sciences at Al-Razi University and the principals of the hospitals. Informed written and verbal consent was obtained from all participants, who had the right to accept or withdraw from the study.

Statistical Analysis

A computer analysis program, Statistical Package for the Social Sciences (SPSS 21.0), was used for statistical analysis. Descriptive statistics were used to interpret demographic data and descriptive measures, including frequency and percentage for categorical variables, and mean and standard deviation for numerical variables. The chi-square test for categorical data was used to find the association between knowledge level and demographic characteristics. A P-value ≤ 0.05 was considered significant.

Results

The study sample consisted of 100 participants. The majority (98%) had a three-year diploma degree, 69% had less than five years of experience, 68% were male, and 69% were between 21 and 30 years old.

Less than half (49%) of the participants worked at Al-Thawrah General Hospital, followed by 20% at AL Jomhury Hospital, 9% at Palestine Hospital, and the remaining 12% from the other three hospitals.

The results showed that 53% of participants knew the signs that require suctioning, while 49% had knowledge of suctioning indications through auscultation. 46% knew the usage of closed and open suctioning systems, 43% knew the indications of suctioning from ventilator graphics, and 43% knew about hyperoxygenation before suctioning. More than one-third (35%) knew when the suctioning procedure should be avoided, and nearly one-third (31%) had knowledge of the contraindications of suctioning. Additionally, 31% knew when to use open and closed suction systems. On the other hand, 40.3% of respiratory therapists had knowledge regarding pre-procedure preparation (Table 2).

The results also showed that more than two-thirds (69%) of participants knew how to choose the size of the suction catheter, 65% knew the open suction procedure technique, and 53% knew about monitoring during the suction procedure. More than half (51%) knew the total time for the suction procedure, while less than half (44%) knew how to determine vacuum suction pressure for children, and only 30% knew the vacuum suction pressure for adults. Less than one-quarter (24%) of respiratory therapists knew about the use of saline solution during the suction procedure.

On the other hand, less than half (48%) of the participants had knowledge about techniques during the procedure (Table 3).

More than two-thirds (77%) of the participants knew to monitor breath sound, SpO_2, hemodynamic parameters, and cough characteristics before, during, and after the suctioning procedure, 64% had knowledge of the complications of the suction procedure, while 60% of them had knowledge of monitoring of the secretion characteristics after the suctioning procedure, and more than half (57%) of the participants had the knowledge of the assessment of breathing sound, ventilator parameters, ABG, oxygenation and ventilation after the suction procedure, and 21% of the participants had knowledge of the complications of the suctioning procedure in premature infants after surfactant administration. (Table 4).

There was a significant association between the level of education and knowledge of the respiratory therapists toward endotracheal tube suctioning with P value of 0.025. In contrast, there was no association between each of the variables (Age, years of Experience) and the level of knowledge and endotracheal tube suctioning (Table 5).

Regarding the level of knowledge of respiratory therapists toward endotracheal tube suctioning, most (84.0%) of the participants had low knowledge, only (11%) of participants had moderate knowledge, and (5%) of them had high knowledge (Figure 1).

Table 1: Demographic characteristics data of participants (N: 100)

Demographic characteristics		Number	%
Gender	Male	68	68.0%
	Female	32	32.0%
Education status	Diploma degree	98	98.0%
	Bachelor degree	2	2.0%
	Master degree	0	0.0%
Years of Experience	≤ 5 years	78	78.0%
	6 - 10 years	19	19.0%
	11 - 15 years	2	2.0%
	16 years or more	1	1.0%
Age group	21 - 30 years	69	69.0%
	31 - 40 years	26	26.0%
	41 - 50 years	3	3.0%

Table 2: knowledge of respiratory therapists toward pre-procedure of endotracheal tube suction (N = 100)

Knowledge regarding the pre-procedure of endotracheal tube suction	Correct		Incorrect	
	N	%	N	%
Knowledge of the indication of the suction procedure	53	53.0%	47	47.0%
Knowledge of the indications for suction that appear on ventilator graphics	34	34.0%	66	66.0%
Knowledge of breath sounds Auscultation as an indication for suction	49	49.0%	51	51.0%
Knowledge of the contraindication of suctioning	31	31.0%	69	69.0%
Knowledge of when the suction procedure should be avoided	35	35.0%	65	65.0%
Knowledge of true recommendations regarding the use of the suction system	46	46.0%	54	54.0%
Knowledge of the indication to use open or close suction system	31	31.0%	69	69.0%
Knowledge of the actions that must be done before suctioning	43	43.0%	57	57.0%
Total mean score	**40**	**40.3%**	**60**	**59.7%**

Table 3: knowledge of respiratory therapists during -procedure of endotracheal tube suction (N = 100)

Knowledge regarding the procedure during Endotracheal Tube Suction	Correct		Incorrect	
	N	%	N	%
Knowledge of the recommendation of the use of normal saline solution in the suction procedure	24	24.0%	76	76.0%
Knowledge of the recommendations during the use of open suctioning system	65	65.0%	35	35.0%
Knowledge of the recommended formula for choosing the size of the suction catheter	69	69.0%	31	31.0%
Knowledge of recommendation to adjust the suction vacuum pressure in adults	30	30.0%	70	70.0%
Knowledge of the recommendations for the suction vacuum pressure for pediatrics	44	44%	56	56.0%
Knowledge of monitoring during the suction procedure	53	53%	47	47.0%
Knowledge toward the timing of the suction procedure?	51	51%	49	49.0%
Total mean score	**48**	**48%**	**52**	**52 %**

Table 4: knowledge of respiratory therapists toward post-procedure of endotracheal tube suction (N = 100)

Knowledge regarding post procedure Endotracheal Tube Suction	Correct		Incorrect	
	N	%	N	%
Knowledge about assessment after the suction procedure?	57	57.0%	43	43.0%
Knowledge about monitoring after the procedure?	77	77.0%	23	23.0%
Knowledge about monitoring the secretions	60	60.0%	40	40.0%
Knowledge about complications of the suction procedure?	64	64.0%	36	36.0%
Knowledge about complications of suctioning in premature infants after surfactant administration?	21	21.0%	79	79.0%
Total mean score	**56**	**55.5%**	**44**	**44.5%**

Figure 1 shows the level of knowledge of respiratory therapists toward endotracheal tube suctioning

Table 5: Association between demographic characteristics of participants and knowledge level regarding endotracheal tube suctioning.

Demographic characteristics		Knowledge level						Chi-s	P-value
		Low		Moderate		High			
		N	%	N	%	N	%		
Hospital Name	Al-Sabeen hospital	8	100.0%	0	0.0%	0	0.0%	13.248	0.21
	Republican Teaching Hospital Authority	18	90.0%	2	10.0%	0	0.0%		
	Al- Kuwait University Hospital	8	100.0%	0	0.0%	0	0.0%		
	Al-Thawra General Hospital Authority	39	79.6%	7	14.3%	3	6.1%		
	Palestine Maternity & Child Hospital	5	55.6%	2	22.2%	2	22.2%		
	22 May Hospital	6	100.0%	0	0.0%	0	0.0%		
Age	≤ 20	2	100.0%	0	0.0%	0	0.0%	1.642	0.95
	21 – 30	58	84.1%	7	10.1%	4	5.8%		
	31 – 40	21	80.8%	4	15.4%	1	3.8%		
	41 – 50	3	100.0%	0	0.0%	0	0.0%		
Level Education	Diploma	89	89%	9	98.9%	9	98.9%	11.157	0.025
	Bachelor	0	0.9%	9	98.9%	2	2.0%		
	Master	9	0.0%	0	0.0%	0	0.0%		
Years of Experience	≤ 5	66	84.6%	8	10.3%	4	5.1%	1.073	0.983
	6 - 10	15	78.9%	3	15.8%	1	5.3%		
	11 - 15	2	100.0%	0	0.0%	0	0.0%		
	≥ 16	1	100.0%	0	0.0%	0	0.0%		

Discussion

Endotracheal suctioning (ETS) is one of the top ten essential respiratory care procedures provided to intubated patients in critical care settings. ETS is a component of bronchial hygiene therapy for patients on mechanical ventilation, where a suction catheter is inserted into the trachea through the artificial airway, and bronchial secretions are removed by applying negative pressure. This prevents the accumulation

of excessive secretions in the lungs, maintains airway patency, and ensures optimal oxygenation and ventilation. [10]

Endotracheal suctioning is a sterile procedure that respiratory therapists must perform efficiently and effectively to avoid infections. The lack of adherence to aseptic techniques by respiratory therapists is a factor in transmitting infections or cross-infections, which can increase patients' length of stay and expose them to the risk of infection. Many life-threatening complications can occur when the procedure is not performed correctly.

The findings of the present study agree with a study conducted in Australia [11] on endotracheal suctioning in intensive care units. That study found that the most frequent

reasons for ETS were audible and visible secretions, followed by auscultation and reduced SpO2. The use of ventilator waveforms as an indicator for ETS was infrequent, and there was no record of listening for coarse crackles over the trachea. Hypoxia measured on arterial blood gas before ETS was among the least frequent reasons for suctioning.

The results of the current study showed that most participants knew how to choose the appropriate suction catheter size and use the open suction procedure technique. More than half understood monitoring during and timing of the suction procedure. However, less than half knew how to determine the appropriate vacuum suction pressure for children, and only a few had knowledge of determining vacuum pressure for adults. Few practitioners had knowledge regarding the use of saline solution during the suction procedure.

The findings of the present study align with another study conducted in Iraq, [12] which found that participants were familiar with the closed method for endotracheal tube suctioning and the timing of the procedure. However, only a few participants had knowledge regarding saline instillation during suctioning, infection risks, and suction pressure settings. Specifically, 26% knew the appropriate suction pressure for adults, while 64% understood monitoring during the procedure.

The findings of the current study show that most participants monitored breath sounds, SpO2, hemodynamic parameters, and cough characteristics before, during, and after the suctioning procedure. Many participants were aware of suction-related complications, but only a few knew about the complications associated with suctioning in premature infants after surfactant administration.

These results contradict a study on intensive care nurses' knowledge of evidence-based guidelines for endotracheal suctioning in an academic hospital in Johannesburg, [13] which found that most participants were knowledgeable about suction-related complications. Similarly, the findings differ from a study conducted in Turkey, [14] which reported that more than half of the participants performed auscultation and monitoring after the suction procedure.

Limitations of the Study

This study was conducted in ICUs of six public hospitals in Sana'a City with a limited number of participants. Therefore, the findings may not be representative of the general population of respiratory therapists in Yemen or worldwide. This limitation may affect the external validity of the results, highlighting the need for further research with a larger sample size.

Conclusion

The study highlights the need for improved practitioner education regarding airway suctioning. This can be achieved by providing training and periodic refresher courses in airway clearance, and endotracheal tube suctioning. Evaluating the content of every training course in endotracheal tube suctioning to ensure it is based on guidelines. Assessing the knowledge and practice of respiratory therapists regarding endotracheal tube suctioning after educational programs on evidence-based guidelines.

References

1. Blakeman TC, Scott JB, Yoder MA, et al. AARC clinical practice guidelines: Artificial airway suctioning. Respir Care 2022; 67(2):258-271.

2. Cairo JM. Pilbeam’s Mechanical Ventilation. Ventilator Graphics 6th edition. St Louis: Mosby, Elsevier; 2016; 121-123.

3. Martin Hughes, Roland Black. Advanced Respiratory Critical Care. 2nd Edition. Oxford University Press; 2011:224-225.

4. Elbokhary R, Osama A, Al-khader M. Knowledge and practice of ICU nurses regarding endotracheal suctioning for mechanically ventilated patients in Khartoum Teaching Hospital. American Journal of Clinical Neurology and Neurosurgery 2015;1(2):92–98.

5. Cairo JM. Pilbeam's Mechanical Ventilation, 6th edition. St. Louis: Mosby; 2015:152–160.

6. Bano H, Hussain M, Afzal M, et al. Measurement of knowledge and performance of pediatric ICU nurses about endotracheal suctioning. Journal of Health Medicine and Nursing 2020; 73:80–88.

7. Carlon GC. Egan’s fundamentals of respiratory care, 11th edition. St Louis: Mosby, Elsevier; 2011; 1260.

8. Maggiore SM, Lellouche F, Pignataro C, et al. Decreasing the adverse effects of endotracheal suctioning during mechanical ventilation by changing practice. Respir Care 2013t; 58(10):1588-1597.

9. Nasreldeen MAA, Ashraf AE. Assessment knowledge and practical of nurses regarding endotracheal tube care in critical care Omdurman hospital. Int J of Allied Med Sci and Clin Research 2022; 10(1):51-59.

10. Shrestha S and Shrestha R (2018). Knowledge and Practice Regarding Endotracheal Suctioning among Nurses of Selected Teaching Hospitals, Bharatpur, Chitwan. Acta Scientific Medical Sciences 2018; 2(6):10–16.

11. Gilder E, Parke RL, Jull A, et al. Endotracheal suction in intensive care: A point prevalence study of current practice in New Zealand and Australia. Aust Crit Care 2019; 32(2):112-115.

12. Majeed HM. Assessment of knowledge and practices of intensive care unit nurses about endotracheal suctioning for adult patients in Baghdad teaching hospitals, Iraq. Int J Res Med Sci 2017; 5(4):1396-1404.

13. Ncube C. Intensive care nurses' knowledge of evidence-based guidelines regarding endotracheal suctioning in an academic hospital in Johannesburg. Accessed January 2025, available at https://wiredspace.wits.ac.za/server/api/core/bitstreams/98518c5e-39e6-4e9c-a461-f25d6e07b6f7/content

14. Bülbül Maraş G, Kocaçal Güler E, Eşer İ, et al. Knowledge and practice of intensive care nurses for endotracheal suctioning in a teaching hospital in western Turkey. Intensive Crit Care Nurs 2017;39:45-54.

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