

## Knowledge and practices of nurses caring for patients with endotracheal tube admitted to intensive care units in National Hospital of Sri Lanka

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### Background

Artificial air way is utilized to facilitate mechanical ventilation and the endotracheal tube (ETT) is most used. The objective was to assess the intensive care unit (ICU) nurses' knowledge and practice in caring for patients with endotracheal tube and their associated factors in National Hospital of Sri Lanka (NHSL).

### Materials and methods

A cross sectional hospital-based study was done among nurses having more than 6 months working experience in all ICUs of NHSL. A self-administered questionnaire was developed using American Association of Respiratory Care (AARC) clinical Practice guideline 2010. Data was analyzed by using SPSS statistical package version 16.

### Results

The majority (91%) had almost 10 years of ICU experience. Mean age was 31.74 years (SD± 5.69). Only half had good knowledge (50.8%) on endotracheal tube care. Mean knowledge was 69.7 ±12.662SD. Majority had good knowledge on oral care (98.9%), humidification (95.1%) and optimal cuff pressure (83.1%). Knowledge was poor for statements on "oral secretions may pool above the cuff leading to ventilator associated pneumonia" (VAP) (12%), selecting suitable suction catheter (44%) and relationship with vaporized water and micro-organism will lead to aspirations (18%). Reported correct practices was 57.8% (N= 107). Only 18% had practiced proper oral hygiene in mechanically ventilated patients. The majority (63.2%) reported incorrect practices related to suction method and measuring the suction catheter length.

### Conclusions

Most nurses were unaware of the current protocols or guidelines related to ET tube care. The most significant deficiencies were related to tracheal complications and activities that cause tracheal trauma, and activities which can lead to serious and harmful effects to patients.

**Keywords:** Nurses; endotracheal tube; intubation; knowledge; practices

### Introduction

Endotracheal intubation and mechanical ventilation are essential lifesaving treatments for many critically ill patients. Mechanical ventilation was

introduced in 1950.<sup>1</sup> An artificial airway is utilized to facilitate mechanical ventilation and the endotracheal tube (ETT) is most commonly used for this purpose. Stabilization of the ETT means securing it in the correct position thereby providing comfort to patient and for the care provider's ease of use, and also to optimize ventilation and avoid displacement or unplanned extubation. Tube movement is a major factor in causing airway trauma. A destabilized tube can cause fatal complications such as bronchospasm, respiratory distress and myocardial infarction.<sup>2</sup> Recommended cuff pressure varies from 20cmH<sub>2</sub>O to 30cmH<sub>2</sub>O.<sup>3</sup> Variation of cuff pressure may lead to several discomforts and complications.<sup>4</sup>

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Identification of practices and knowledge related to ETT management improves patient safety and decreases the complications related to intubation. Celik and Elbas demonstrated that correct performance of nurses in endotracheal suctioning can minimize undesirable side effects. The authors reported that, in patients who are intubated, suctioning is necessary to remove pulmonary secretions and to maintain a patent airway. When endotracheal suction is not performed using an appropriate technique, it can cause many complications. Nosocomial infection can develop when suctioning is not applied using aseptic technique.<sup>5</sup>

To prevent these complications many countries developed local protocols or guidelines for ET and tracheostomy suctioning and ET and tracheostomy cuff management. But in Sri Lanka there are no protocols or guidelines related to tracheostomy or ET tube care for nurses, or statistics related to ET or TT related complications. So, the aim of the study is to assess nurse's knowledge and practices on caring for patients with endotracheal tube in intensive care units of National Hospital of Sri Lanka.

### Materials and methods

Ethical approval was obtained from Ethics Review committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura and administrative permission was obtained from NHSL and all the ICU in-charge nursing sisters. A descriptive cross-sectional study was conducted in all ICUs of National Hospital of Sri Lanka. NHSL has 12 intensive care units with a maximum of 78 beds. All nurses who had at least six months of critical care training were recruited (N=334). Nurses on maternity leave were excluded. At 5% significance level, assuming 50% on knowledge and practices, the sample size was calculated as 384. Assuming a 10% non-response rate the final sample size was 400. A self-administered questionnaire (SAQ) was developed by reviewing the literature and guidelines developed by American Association for Respiratory Care clinical practice (2010).<sup>6</sup> Face and content validity and appropriateness to culture was assessed by a university nursing academic who had specialized in critical care and the supervisor.

The self-administered questionnaire consisted of five sections. The first section was on socio-demographic data. The second section assessed their knowledge on ETT. The third and fourth sections were related to practices and the last section was to measure the ET suctioning event which was based on the guidelines developed by American Association for Respiratory Care clinical practice (2010).<sup>6</sup> The principal investigator (PI) daily visited the ICU and gave the questionnaire after obtaining their informed written consent with minimal disturbance to routine activities of the ICU. Information sheet was given.

The questionnaire had 18 questions on knowledge on ETT and 19 questions on practices. Total scores were calculated for both knowledge and practices sections separately. Each correct answer was given 5 marks and incorrect answer zero marks. The mean mark obtained for knowledge was  $70 \pm 12.66$  SD and based on this value, a score of 70 or more was considered good knowledge and score less than 70 as poor knowledge. Practices were divided to two categories a score of 63 or more was considered as correct practices and score less than 63 as incorrect practices respectively.

The data obtained were analyzed using SPSS version 16. Associations were tested using Chi Square, and the level of significance was set at  $<0.05$ .

### Results

Response rate was 55.4%. The mean age of nurses was  $31.74$  years  $\pm 5.69$  SD. Most (92%) were female nurses and 60.5% were married. Approximately more than two thirds of nurses had a Diploma in Nursing, 14% had bachelor's degree as their highest level of qualification respectively. (Table I)

The majority of nurses had almost 10 years of ICU experience (90.8%) and five nurses had over 20 years working experience in an ICU. Most were married.

**Table 1:** Frequency distribution of socio demographic characteristics among study participants (N=185)

Variable	No	%
<b>Age</b>		
20-30	99	53.5
31-40	70	37.8
41-50	11	5.9
51-60	5	2.7
<b>Sex</b>		
Male	15	8.1
Female	170	91.9
<b>Marital status</b>		
Married	112	60.5
Unmarried	73	39.5
<b>Professional qualification</b>		
Diploma in nursing	159	85.9
Graduate in nursing	24	13.0
Postgraduate	2	1.1
<b>ICU work experience (years)</b>		
0-10	168	90.8
11-20	12	6.5
21-30	5	2.7

The mean knowledge score was  $69.7 \pm 12.662$  SD and 51% had overall good knowledge on ET tube (maximum score of 94 and minimum of 28). Knowledge section included questions pertaining to ET tube, namely preventing infection, preventing trauma, maintaining ET tube and complication related to ET tube. Most responded correctly to statements with regards to preventing infection except for the statement on “oral secretions may pool above the cuff leading to ventilator associated pneumonia (VAP),” where 88% responded incorrectly. The majority had good knowledge on most statements relating to preventing trauma. However, for the safety negative pressure for ET suctioning statement around 50% of participants responded correctly and only 44% responded correctly in selecting the appropriate suction catheter. With regards to statements on maintaining ET tube, majority (>70%) responded correctly to all statements including the correct optimal cuff pressure. However, regarding the statement about the relationship with vaporized water and microorganisms leading to aspirations, only 18%

answered correctly. Complications related to ET tube only 48% had correctly answered the statement that dry mucosa will improve the normal removal of mucous and microorganisms.

**Table 2:** Frequency distribution of knowledge on preventing infection, preventing trauma and ET tube maintenance among study participants (N=185)

Knowledge on preventing infection	Correct N (%)	Wrong N (%)
In mechanically ventilated patients oral care is necessary to prevent colonization.	183 (98.9)	2 (1.1)
Oral secretions may pool above the cuff leading to ventilator associated pneumonia (VAP)	22 (11.9)	163 (88.1)
Before and after the ET suctioning, using alcohol hand rub is adequate to prevent infection	126 (68.1)	22 (31.9)
When performing ET suctioning, personnel protective equipment is used	133 (71.9)	52 (28.1)
When you are implementing oral care to the mechanical ventilated patient chlorhexidine is the best solution	168 (90.8)	17 (9.2)
<b>Knowledge on preventing trauma</b>		
The safety negative pressure for ET suctioning	94 (50.8)	92 (49.2)
ET suction catheter size should be 1/2 of the ET lumen diameter	81 (43.8)	104 (56.2)
High ventilator setting patient's ET secretion should be suck out in close suctioning method	156 (84.3)	29 (17.7)
As a pre preparation of the ET suction need to supply 100% Oxygen 1-minute period for adults	154 (81.6)	34 (18.4)
Most suitable ET tube size	138 (74.6)	47 (25.4)
Continuous heat, filtered, and humidified air are needed for intubated patient for keep mucous membrane wet	176 (95.1)	09 (4.9)
In critical care setting water heat humidifier and heat moisture exchange device (HME) used for humidifying the patient	165 (89.2)	20 (10.8)
<b>Knowledge on ET tube maintenance</b>		
The optimal level of cuff pressure is 20-30 cm H <sub>2</sub> O	155 (83.8)	30 (16.2)
ET cuff function is to seal the trachea for mechanical ventilation	161 (87.0)	24 (13.0)
The most frequent method to stabilize the tube is adhesive tape method	131 (70.8)	54 (29.2)
Vaporized water in the tube or ventilator circuit is a resource for colonizing microorganisms and it may lead to aspiration.	33 (17.8)	152 (82.2)

The mean score of practices was  $63.7 \pm 11.8$  SD and reported correct practices were performed by 57.8% of nurses (maximum score of 85 and minimum of 30). Reported practices section included questions pertaining to ET tube, namely preventing infection, preventing trauma, maintaining ET tube and complication related to ET tube. Majority of nurses practiced VAP bundle to prevent ventilator associated infection in ICU. However, for the statement on “how frequently do you practice oral hygiene in mechanically ventilated patient”, only 18% had practiced this correctly. Most had stated correct practices regarding preventing tracheal trauma in the ICU. However, for the statements on “how frequently do you use normal saline instillation when performing ET suctioning” showed that only 18.4% of nurses had practiced it correctly. With regards to the statement on which suctioning method is used, only 39.5% of nurses gave the correct response. Only 36.8% of nurses measured the suitable suction catheter length for suctioning to prevent trauma. With regards to practices on ET tube maintenance, the majority of nurses (97.3%) had marked the lip level to identify the tube displacement. Only 37% of nurses had advised the patients to do a tracheal assessment to prevent ETT complications. Nearly half of the nurses had not used twill tape method to stabilize the tube for patients who had facial skin breakdown. More than 90% of nurses used cuff inflator to measure the ET cuff.

**Table 3:** Frequency distribution of practices to prevent trauma and infection among study population (N=185)

Statement	Correct N (%)	Incorrect N (%)
In intensive care setting, do you practice the VAP bundle care to prevent VAP?	159 (85.9)	26 (14.1)
Do you use disinfected respiratory therapy devices during the care of ventilated patient?	127 (68.6)	58 (31.4)
How frequently do you practice oral hygiene in mechanically ventilated patient?	34 (18.4)	130 (70.3)
Do you clamp the suction catheter when entering it to the ET tube for suctioning?	154 (83.2)	31 (16.8)
Before inserting the suction catheter to ET tube do you check it and lubricate with sterile water?	108 (58.4)	77 (41.6)

Do you nebulize the patient before performing ET suctioning?	67 (36.2)	118 (63.8)
How frequently do you use normal saline instillation when performing ET suctioning?	34 (18.4)	151 (81.6)
How long do you keep the patient in 100% oxygen after the ET suction?	156 (84.3)	29 (15.7)
Which type of suctioning method do you use in your practice frequently?	73 (39.5)	112 (60.5)
How do you measured the suitable suction catheter length for suctioning to prevent trauma?	68(36.8)	117 (63.2)
What do you do before extubation?	173(93.5)	12 (6.5)

Endotracheal suctioning practices were analyzed by using American Association of Respiratory care clinical Practice guideline 2010. They had followed 4 practices when performing suctioning, such as oxygenation, hand washing, monitoring the blood pressure, pulse rate and respiratory rate and alert of the saturation and tidal volume of the ventilator. However less than 50% of nurses had demonstrated auscultation of lung sounds, reassuring the patient, checking sputum characteristics and emergency equipment preparation.

**Table 4:** Frequency distribution of practices on ET tube complication and ET tube maintaining among study population.

Statement	Correct N (%)	Incorrect N (%)
When caring for intubated patient, do you practice bed head elevation as an intervention for ET tube care?	131 (70.8)	54 (29.2)
Do you mark the lip level that makes it easy to identify if there is anterior tube displacement?	180 (97.3)	5 (2.7)
How frequently do you change HME devices?	168 (90.8)	17 (9.2)
What are the steps you take to prevent tube dislodgment?	127 (68.6)	58 (31.4)
When discharging an artificially ventilated patient, do you advise him/her to take ear, nose, throat (ENT) opinion to assess trachea?	68 (36.8)	117 (63.2)
If patient has lip and facial skin break down, do you use twill tape method to secure the tube?	98 (53)	87 (47)
How frequently do you check the cuff pressure?	122 (65.9)	63 (34.1)
Which technique do you use for measurement the ET cuff pressure?	171 (92.4)	14 (7.6)

Graduate and postgraduate nurses had better knowledge (69.2%) when compared to Diploma holders (47.7%). This difference was found to be statistically significant ( $p < 0.05$ ). Nurses who were unmarried had better knowledge compared to those who were married ( $p < 0.05$ ). However, there was no statistically significant association between knowledge and age, sex and years of experience of the nurses ( $p > 0.05$ ).

**Table 5:** Association between knowledge and associated factors

Age category	Good Knowledge	Poor knowledge	Significance
<b>Age (in completed years)</b>			
20 - 40	89 (52.6)	80 (47.4)	0.102
41 - 60	5 (31.2)	11(68.7)	
<b>Professional qualification</b>			
Diploma	76(47.8)	83 (52.2)	0.043
Graduate and postgraduate	18(69.2)	8 (30.8)	
<b>ICU experience (Years)</b>			
0 – 10	89 (52.9)	79 (47.0)	0.053
11 – 20	5 (41.6)	7 (58.3)	
21 – 30	0 (0)	5 (100)	
<b>Marital Status</b>			
Married	50 (44.6)	62 (55.4)	0.038
Unmarried	44 (60.3)	29 (39.7)	
<b>Sex</b>			
Male	7 (46.7)	8 (53.31)	0.738
Female	87 (51.2)	83 (48.8)	

**Discussion**

Our results showed that almost half of the participants had good knowledge of ET tube maintenance and over 80% stated the correct optimal cuff pressure. An audit done in Sri Lanka by Maddumage et al in 2017 on 50 patients admitted to ICU reported that cuff pressure was more than 30cm H<sub>2</sub>O in 23 (46%). Of them, 11 (22%) measurements were above 50cmH<sub>2</sub>O. The authors reported that only 20% (N=10) of ventilated patients had the CP measured according to the recommendations whereas 76% (N=38) had recorded only once a day or when indicated.<sup>7</sup> A multi-site study showed that nearly half of respiratory therapists stated they manage ET cuffs

by using minimal leak technique, whereas others maintain the cuff pressure ranging from 15 to 25 cmH<sub>2</sub>O. Only 41% stated that they keep cuff pressures at 20 cm H<sub>2</sub>O or greater.<sup>8</sup>

Our study findings revealed that the nurses’ knowledge related to preventing infection when caring for patients with ET tube was good in some areas namely, VAP bundle, hand hygiene, best oral care solution, humidification and oxygenation. According to our research findings, regarding knowledge related to oral care, 98% correctly answered that it is done to prevent colonization. However, when asked “how frequently do you practice oral hygiene in mechanically ventilated patient”, only 18% had performed this correctly. Regarding practice of oral hygiene, only 30% stated it was done every 4 hours and 70.3% every 6 hours respectively. A study done in Brazil in 2016 reported that most health professionals performed oral hygiene at least twice daily and they had a positive attitude towards providing oral care for ICU patients.<sup>9</sup> Similar results were shown by other studies.<sup>10,11,12</sup>

A systematic review reported that ventilator-associated pneumonia (VAP) is the leading infectious complication in patients under mechanical ventilation (MV), affecting from 8% to 28% of patients admitted in the intensive care unit (ICU).<sup>13</sup> VAP is a significant cause of morbidity and mortality which may be influenced by oral health. A study done in United States in 2006 concluded that higher dental plaque scores have a greater risk for VAP, particularly for patients with greater severity of illness. They also found that oral health of critically ill patients is often compromised at the time of admission and deteriorates over time and that there is a relationship between oral health status and VAP.<sup>14</sup>

Diaz et al reported that the risk of VAP is present throughout the mechanical ventilation period, though it is greatest during the first days. Knowledge regarding preventing infection in our study for the statement on ventilated associated pneumonia (VAP) demonstrated very poor knowledge and only 12% had answered correctly.<sup>4</sup> Similar results were shown in a study done in Sudan where nearly half of nurses were unaware of the indications for suctioning.<sup>15</sup>

In our study, only half were knowledgeable with regards to preventing tracheal trauma. Only 44% of nurses stated the correct ET suction catheter size in contrast to the study done in Sudan where 64% gave the correct answer. The authors reported only 48% had washed hands and maintained aseptic techniques to prevent nosocomial infection.<sup>15</sup> A study done in Pakistan showed the mean knowledge of the nurses for ET suctioning was 50.04%±18.963% and the mean practice is 80.37%±8.37.<sup>16</sup> However, a study done in Nepal reported that the majority of nurses (56%) had adequate knowledge on ETS which was similar to our research findings.<sup>17</sup>

In this study 81.6% nurses responded that they used normal saline instillation when performing ET suctioning. Similar results were shown in a study done in Ontario, Canada in 2015.<sup>18</sup> Reported practices for maintaining ET tube revealed high percentage of correct practices among nurses that they mark lip level to identify the tube displacement.

Majority of nurses (63%) in our study reported that they did not refer the patient for ENT assessment of trachea after intubation.

A significant difference was observed between the knowledge and professional qualification ( $P=0.043$ ). Unmarried nurses had better knowledge, and this could be due to less family commitments. We generally assume that as working experience increases the knowledge also would increase. However, in our study there saw no association between knowledge with years of experience in the ICU which was similar to the results done in Sudan, Iraq and India.<sup>15,19,20</sup>

The strengths of this study were that the practices were based using American Association of Respiratory care clinical Practice guideline 2010. Although only half of the nurses had adequate knowledge on ETT, their practices were relatively better. Although the nurses did not have proper ICU training, traditionally they observe how the most senior nurses perform in critical care setting. The main limitation in our study was that we did not directly observe their practices and we only had reported practices by the nurses. In addition, the low response rate could be due to lack of proper time to complete the questionnaire and due to

family commitments since majority of nurses were married.

### Conclusions

In conclusion, only half of the nurses have good knowledge and practices related to ET care. Critical-care nurses were not following current recommendations of AARC clinical practice guideline. Most of the nurses were not aware regarding current protocol or guidelines related to ET tube care. The most significant discrepancies were related with tracheal complications and activities that cause tracheal trauma which can lead to serious and harmful effect to the patients.

### Recommendations

There is an urgent need to develop correct protocols and clinical guidelines for ET suctioning and for management of mechanically ventilated patients and have regular in-service training programs. Improving knowledge and practices related to care of the patient with ET tube needs more focused education programmes and proper supervision by Consultant Anaesthetist and by senior nursing staff.

### Conflict of interests

There are no conflicts of interest.

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