

# Audit on Practices of Endotracheal Suctioning in Intensive Care Unit Patients among Health Care Workers (HCWs)

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Received on: 04 September 2023; Accepted on: 16 November 2023; Published on: 31 December 2023

## ABSTRACT

**Background:** Endotracheal suctioning (ETS) is one of the most frequently performed invasive procedures in intensive care units (ICUs). This audit was aimed at studying current practices and knowledge regarding ETS in the Indian critical care setup, with the background aim of raising awareness regarding correct practices as per current recommendations in critically ill patients.

**Materials and methods:** After registering the trial with the clinical trial registry, India, a structured audit questionnaire containing 20 questions pertaining to ETS was distributed through electronic media among resident doctors working in the ICUs across India. Responses received were statistically analyzed.

**Results:** The questionnaire was sent to 530 clinicians, of which only 200 (37.73%) responded. The audit revealed that only 22% respondents set the maximum negative pressure every time before suctioning, on the suction apparatus and only 32% said they would choose a catheter size of less than half the internal diameter of the endotracheal tube (ETT). About 90% of the respondents did not routinely do any form of documentation of the ETS. Almost 72% of the responders opined that closed suction systems reduce the chances of developing ventilator-associated pneumonia (VAP). Only 46% of respondents thought that no solution should be routinely instilled in ETT during ETS.

**Conclusion:** There is lack of awareness regarding frequency and technique of ETS, infection control and monitoring required during ETS. Institutional protocols should be in place to follow correct guidelines for performing ETS.

**Keywords:** Critical care, Endotracheal suctioning, Intensive care unit.

*Indian Journal of Critical Care Medicine* (2024): 10.5005/jp-journals-10071-24615

## HIGHLIGHTS

- This survey identifies the currently followed practices of endotracheal suctioning (ETS) in tertiary care hospitals in India.
- Many respondents were unaware of the correct way to perform ETS.
- Only 32% of respondents could choose the correct catheter size for ETS.
- About 22% respondents checked the maximum negative pressure every time before suctioning.
- This survey will help to incorporate evidence-based ETS protocols into clinical practice.

## INTRODUCTION

Endotracheal suctioning is a common procedure performed for mechanically removing the secretions from artificial airways to keep the airways patent. The presence of an artificial airway in mechanically ventilated patients makes coughing less effective or impossible; hence, ETS is crucial in maintaining bronchial hygiene, preventing obstruction of the artificial airway and allowing smooth airflow through it. However, ETS is an invasive procedure, and is not free from hazards. ETS, if not performed as per evidence-based practice, may result in complications, such as tracheobronchial injury, ventilator-associated pneumonia (VAP), atelectasis, oxygen desaturation, sympathetic stimulation, bradycardia, and an increase in intracranial pressure.

Several practice recommendations have been developed to improve the clinical practice of ETS.<sup>1</sup> However, there is a gap between recommendations and the actual practices of ETS. The aim of this survey was to assess the knowledge and awareness of

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**How to cite this article:** 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.

**Source of support:** Nil

**Conflict of interest:** None

the correct practice of ETS among resident doctors and to highlight the discrepancies between actual practice and recommended standards in order to improve the quality of care.

## MATERIALS AND METHODS

After an institutional review board approval, this prospective, cross-sectional survey was registered with Clinical Trial Registry, India (REF/2022/12/061543). The study design was by distribution of a well-structured survey questionnaire with 21 questions on Google forms which was shared with resident doctors working in intensive care units (ICUs) in various tertiary care hospital ICUs across India after taking a written informed consent digitally. The

inclusion criteria consisted of resident doctors whose designation ranged from postgraduate student to senior residents who had at least 1 year experience of working in the ICU.

**Tools of the Study**

A well-structured questionnaire consisting of 21 questions (Appendix 1) was circulated electronically by sharing the link with the participants. Participants were informed about the objective of this survey and it was conveyed that their participation was totally voluntary, no incentive would be provided for participation and they would also be given anonymity assurance for their responses. Participants had to choose a single answer to most questions and for few questions (wherever indicated), they were allowed to choose multiple options simultaneously. A reminder email was sent twice at an interval of 1 week and the collected responses were analyzed and data were updated on Google which simultaneously charted the information into bar diagrams and pie charts.

**Sample Size Calculation**

We calculated the sample size for the survey from the question ‘Have you ever read at least one guideline on practices of ETS in intensive care unit?’ Assuming a prevalence of 50% and with a population size of 1000 anesthesiologists and type I error of 0.05, the sample size was calculated to be 278 with a confidence level of 95% and 214 with a confidence level of 90%, using OpenEpi version 3.

**RESULTS**

The questionnaire was sent to 530 clinicians through electronic media, of which only 200 (37.73%) responded. One hundred and thirty (65%) respondents were anesthesiologists and the rest were resident doctors who were pursuing critical care. One hundred and seventy-two (86%) respondents worked in a government hospital, and only 28 (14%) were working in a private institute. Their years of experience of working in the ICU ranged from 1 to 6 years. Of the 200 respondents, 64% had 1–2 years, 21% had 2–4 years and 15% had an experience of 4–6 years of working in the ICU.

Seventy (35%) participants had read at least one guideline pertaining to ETS while 130 (65%) were not aware of any. Seventy-six (38%) respondents would check the suction apparatus every time before suctioning, 124 (62%) either checked it occasionally or once a day and 1% never checked their suction apparatus. In continuation of the above, only 44 (22%) respondents set the maximum negative pressure every time before suctioning, 36 (18%) once a day, 48 (24%) set it occasionally and the majority of 72 (36%) never ever set the maximum negative pressure. One hundred and sixty respondents (80%) knew the normal suction pressure which should be used in adults and 180 (94%) respondents knew the normal suction pressure for ETS in infants (Fig. 1).

Eighty (40%) respondents were of the opinion that any trained paramedical personnel can perform the ETT suction, 56 (28%) said only an intensivist should do it, 40 (20%) opined that the nursing staff should do ETS and 24 (12%) said that any doctor could do ETS. One hundred and twelve (56%) respondents did ETS only if clinically indicated, and 48 (24%) did it routinely at 4 hourly intervals after clinical assessment.

In response to personal protective equipment (PPE) used during ETS, 78% wore gloves and a mask while 16% wore gloves, mask, eyewear, and a gown. When assessing their knowledge regarding

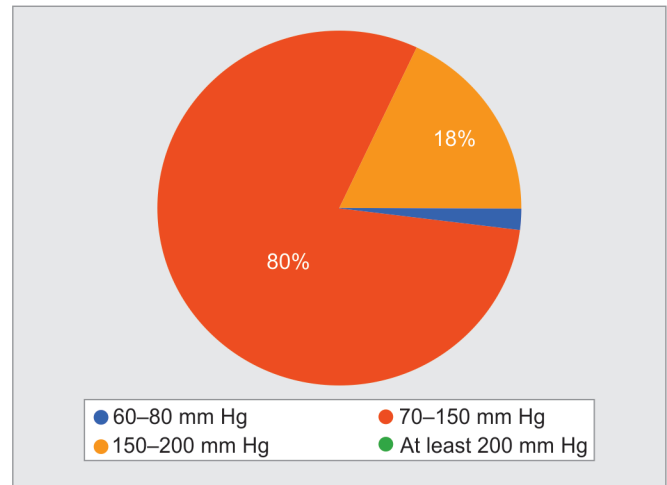


Fig. 1: Response to normal suction pressure for ETT suction in adults

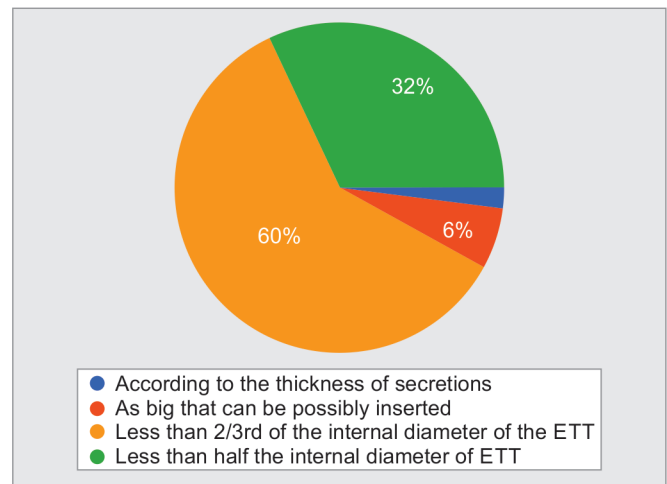


Fig. 2: Response to size of suction catheter for ETT suction

advantages of closed suction, 56 (28%) respondents thought that use of closed suction does not reduce the incidence of ventilator-associated pneumonia, 24 (12%) did not consider continuous oxygenation as an advantage and 36 (18%) respondents did not find it useful in patients who require high PEEP and FiO<sub>2</sub>.

One hundred and twenty (60%) would choose a size less than 2/3rd of the internal diameter of the endotracheal tube (ETT) while 64 (32%) would choose a catheter of less than half the internal diameter of the ETT (Fig. 2).

Thirty-six (18%) respondents routinely instilled 1% lignocaine into the ETT during ETS, 24 (12%) instilled normal saline, 48 (24%) instilled soda bicarbonate or N-acetylcysteine and 92 (46%) respondents did not instil any solution. In response to the maximum duration of ETT suctioning, 144 (72%) respondents answered 5–10 seconds (Fig. 3). Regarding depth of the suction catheter during ETS, 136 (68%) respondents thought that shallow suctioning till the tip of the ETT is sufficient and 48 (24%) respondents would insert the catheter till the level of the carina in all patients (Fig. 4).

Twenty-eight (14%) found only SpO<sub>2</sub> monitoring to be adequate for ETS, 56 (28%) monitored ECG and SpO<sub>2</sub> while 112 (56%) would monitor ECG, SpO<sub>2</sub> and BP. According to 176 (88%)

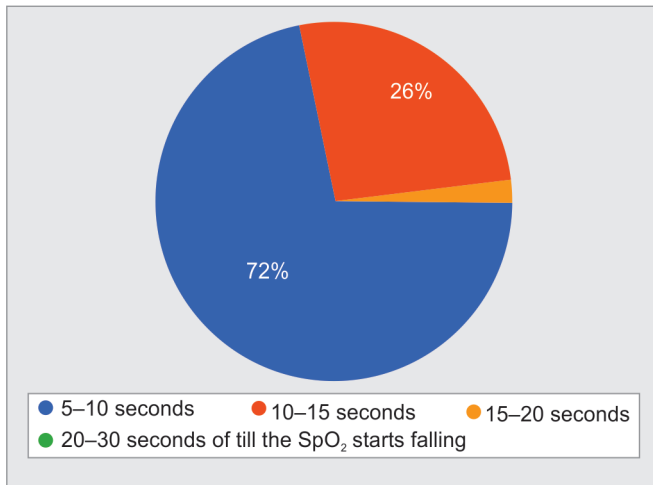


Fig. 3: Response to maximum duration of ETT suctioning

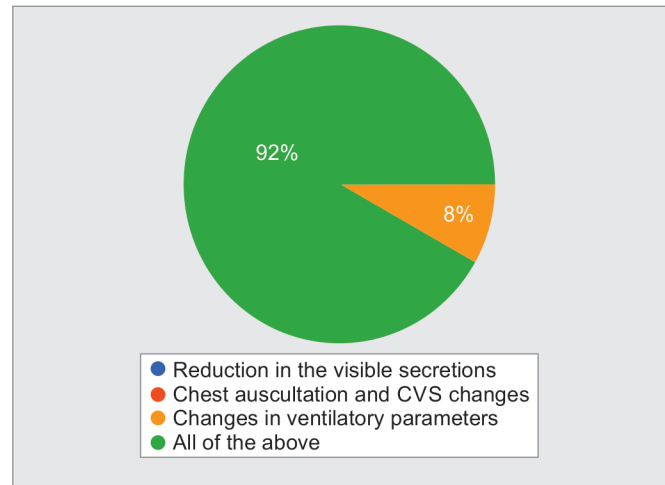


Fig. 5: Response to how to check the adequacy of ETT suctioning

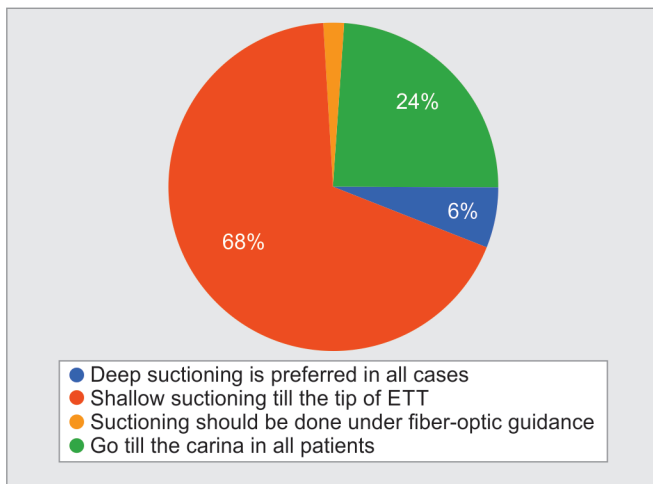


Fig. 4 : Response to depth of insertion of suction catheter in the ETT

respondents, preoxygenation with 100% O<sub>2</sub> should be done in every patient.

Regarding the assessment of adequacy of ETS, 164 (82%) participants opined that all the parameters including reduction in the visible secretions, changes in ventilatory parameters, chest auscultation, and CVS changes should be assessed to ensure adequate ETS (Fig. 5). On assessing the knowledge regarding side effects of ETS, 176 (88%) responded that hypoxia, atelectasis, cardiac dysrhythmias, and bronchospasm were all side effects of ETS.

When enquired about the use of a recruitment maneuver after ETS, 156 (78%) respondents did not believe that a recruitment maneuver should routinely be done after ETS, while 44 (22%) answered it should.

When enquired about the documentation of ETS, 180 (90%) respondents did not routinely do it. Lastly, when asked how often the collection container of the suction apparatus is cleaned in their institute, 104 (52%) participants said that it was cleaned daily and 60 (30%) were unsure about the frequency of cleaning.

## DISCUSSION

Endotracheal suctioning is a component of bronchial hygiene therapy and care of mechanically ventilated patient. It involves

the mechanical aspiration of pulmonary secretions from a patient with an artificial airway in place.<sup>1,2</sup> ETS is done to maintain a patent airway to optimize ventilation and oxygenation and to protect the respiratory tract from the lodgement of secretions.<sup>3</sup> Endotracheal suctioning is one of the most frequently conducted invasive procedures in the ICU for mechanically ventilated patients.<sup>4</sup>

It is thus imperative that ETS be performed with correct techniques, proper patient preparation, monitoring and post-suctioning care. Several guidelines have been formulated to make this procedure safe, and noncompliance with these guidelines can lead to numerous adverse effects in the critically ill patient.<sup>5–9</sup> Study findings show that ETS performance by well-educated health care professionals based on the best evidence can diminish its side effects.<sup>10,11</sup> It is therefore necessary that all health care professionals have updated knowledge on the evidence-based practices of ETS.<sup>12</sup>

In developed countries, ETS is usually done by critical care nurses. However, in poorer countries, with perpetual staff shortages, the burden of performing ETS usually falls on the junior doctors. These junior doctors are less experienced, so it becomes all the more necessary that all ICUs have clear protocols in place for all commonly performed ICU procedures. Regular surveys help to identify lacunae in knowledge and clinical practices and should be followed by measures to correct the discrepancies. A questionnaire containing 21 multiple choice questions was distributed digitally and the responses were analyzed.

It is important for all doctors and health care workers (HCW) to check their equipment on a daily basis. Only 38% respondents checked the functioning of the apparatus before beginning ETS and 1% never checked the apparatus. According to New South Wales (NSW) guidelines,<sup>13</sup> the maximum negative pressure set is –80 to 150 mm Hg for closed and open suction systems and a wall mount should have a pressure gauge attached to it. In response to how often do they set the maximum negative pressure, only 22% of participants said that they set it every time before suctioning and 36% never ever set the maximum negative pressure. The American Association of Respiratory Care (AARC) guidelines recommend that the negative pressure of the suction unit must be checked before every suctioning event and the suction pressure should be set at the lowest possible value to be able to clear endotracheal secretions.

When asked about the recommended suction pressures in adults and infants, most respondents were aware of the

recommended pressures to be used but this theoretical knowledge was not being practically applied. In critically ill patient, all equipment must be ensured to be properly functioning as unnecessary delay in suction may result in prolonged suctioning and associated patient morbidity. On the other end of the spectrum, using unregulated or higher suction pressures is also highly detrimental and may result in mucosal trauma, atelectasis, oxygen desaturation, bradycardia, and bleeding. In an adult mechanically ventilated patient, maximum negative pressures of less than 150 mm Hg have been recommended,<sup>14</sup> while in neonates, a maximum pressure of 80–100 mm Hg has been recommended.<sup>15</sup>

In the western world and in many south Asian countries, the ICU nurses perform ETS. In our country too, in many private hospitals, nurses or respiratory therapists are responsible for ETS in ICU patients. That is perhaps the reason why most of the literature available on ETS practices is available in nursing journals.<sup>8,10,13</sup> When asked who should do the ETT suction in ICU patients, 40% of respondents said that any trained paramedical personnel can do it, 28% said only intensivist should do it, 20% were happy with nursing officers doing the job and 12% said that any doctor could do the suctioning. Hence, this very critical part of ICU care is often delegated to a junior doctor with minimal experience and knowledge.

According to AARC 2010 guidelines,<sup>1</sup> routine ETS of patients is not recommended and should only be done when there is a build-up of secretions in the airway which is suggested by a sawtooth pattern on flow volume loop, rise in peak inspiratory pressures, visible secretions in endotracheal tubes or coarse crepitations on auscultation. Only about half the respondents (56%) were doing suctioning when clinically indicated as is recommended. ETS is associated with a host of complications and is also very painful for the patient and must not be done indiscriminately.

When asked what PPE participants use while doing open suctioning, only 16% of participants use the appropriate PPEs and a majority of 78% use only gloves and mask. It is recommended that sterile gloves and a mask are the minimum that should be worn but most residents were using unsterile gloves. Complete PPE including gloves, masks, and goggles (clean and sterile) should be worn whenever an infective etiology is suspected or known to be present. Infection-control practices are crucial to prevent cross-infections and transmission of infection through hands or equipment.<sup>16</sup> A previous study found that only about half of the critical care nurses disinfect their hands before ETS and only 22.9% disinfect their hands after ETS. These lapses increase the risk of acquiring nosocomial infections.<sup>17</sup> When asked how often the collection container of the suction apparatus is cleaned in their institute, 52% respondents said that it was cleaned daily, and as many as 30% were unsure about the frequency of cleaning.

Two methods of ETS have been defined for ICU patients based on the type of catheter selected. The open suctioning technique requires the patient to be disconnected from the ventilator while the closed suctioning technique requires the attachment of a sterile, closed, in-line suction catheter to the ventilator circuit, through which a suction catheter can be passed into the endotracheal or tracheostomy. As there is no need to disconnect the patient from the ventilator, closed system allows continuous mechanical ventilation and oxygenation while doing suctioning, prevents lung derecruitment and the consequent lower risk of oxygen desaturation and should be used in patients requiring a high FIO<sub>2</sub> and PEEP. As per AARC guidelines, use of closed suction

systems has not been found to reduce the risks of developing VAP.<sup>1</sup> However, a recent study by Sanaie S et al. found that closed tracheal suction systems significantly decreases the risk of developing VAP ventilator-associated pneumonia as compared with open suction tracheal systems.<sup>18</sup> In this survey, 72% respondents were of the opinion that closed suction systems do reduce the chances of developing VAP ventilator-associated pneumonia.

It is also very important to choose the correct size suction catheter. Smaller catheters should be used whenever possible, as it prevents the development of excessive negative pressures and atelectasis.<sup>19</sup> The diameter of the suction catheter should be less than one half the inner diameter of the endotracheal/tracheostomy tube in adults, which means an internal-to-external diameter ratio of 0.5 in adults, and 0.5–0.66 in infants and children.<sup>1</sup> In this audit, only 32% said they would choose a catheter of less than half the internal diameter of the ETT.

Instillation is the administration of a liquid/saline directly into the trachea via an artificial airway to help loosen and remove secretions. However, the majority feel that this practice is unlikely to be of benefit and may in fact cause harm and should not be routinely performed. It is more appropriate to use humidification to decrease the viscosity of secretions. According to the AARC guidelines,<sup>1</sup> the routine instillation of normal saline may lead to excessive coughing, fall in oxygen saturation, bronchospasm, and dislodgement of the bacterial biofilm that colonizes the ETT into the lower airway. Only 46% respondents in this survey audit thought that no solution should be routinely injected into the ETT during ETS. The others would instill saline or lignocaine or soda bicarbonate or N-acetylcysteine routinely.

The duration of each ETS should be less than 15 seconds. This seemed to be known to almost all the respondents. ETS can be either deep or shallow. Deep suctioning implies the insertion of a suction catheter until the carina that is until resistance is met, followed by withdrawal of the catheter by about 1 cm after which suction pressure is applied to commence suctioning. In shallow suctioning, the suction catheter is inserted to a predetermined depth, approximately, the length of the endotracheal/tracheostomy tube. Shallow suctioning prevents trauma to the tracheal mucosa. Deep suctioning may be associated with more tracheal stimulation, trauma and significant adverse events. Most of the respondents (68%) knew this and only 6% practiced deep suctioning. ETS may result in sympathetic and parasympathetic stimulation and hence cardiovascular and respiratory monitoring is warranted. During ETS, SpO<sub>2</sub>, EKG, and BP should be monitored.<sup>1</sup> However, only 56% of our respondents would monitor ECG, SpO<sub>2</sub>, and BP during ETS. Suctioning may lead to the development of hypoxia. It is thus recommended to deliver 100% oxygen to all pediatric and adult patients for 30–60 seconds prior to ETS especially in patients who are already hypoxemic before suctioning.<sup>1</sup> About 88% respondents thought preoxygenation with 100% O<sub>2</sub> should be done in every patient. ETS can lead to many other complications which include decreases in dynamic lung compliance and functional residual capacity, atelectasis, hypoxemia, trauma to tracheal and/or bronchial mucosa, bronchospasm, microbial colonization of lower airways, rise in intracranial pressure, hypertension, hypotension, and cardiac arrhythmias. About 88% of the respondents knew of all these complications.

Adequate ETS can be assessed by improvement in ventilator graphics and breath sounds, a decrease in the peak inspiratory pressure, a decrease in airway resistance or increase in dynamic

compliance, an increase in the tidal volume delivered during pressure-controlled ventilation, improvement in arterial blood gas and oxygen saturation values and the removal of pulmonary secretions.<sup>1</sup>

After ETS, hyperoxygenation should be done for at least 1 min, and lung-recruitment maneuvers may be attempted in those patients with clear evidence of derecruitment.<sup>1</sup> Regarding the routine use of recruitment maneuvers after ETS, 78% did not believe that a recruitment maneuver should routinely be done, while 22% thought it should. As with any other invasive technique in ICU patients, it is important to document the indication, tolerance, and adequacy of suctioning. We found that as many as 90% of the respondents did not routinely do any form of documentation of the ETS.

Our study has some strengths but we also acknowledge several limitations. A strength of our survey was that only physicians working in ICUs were included. Another strength is that we collected data regarding years of experience of working in ICU, thus allowing us to characterize the work setting of each respondent. Despite our survey's strengths, we also acknowledge several limitations. Our survey had a small response rate as compared with calculated sample size despite repeated reminders, but this is a known issue for surveys as has been reported in similar studies.<sup>19</sup> Most responses came from teaching hospitals, thus creating a bias. Furthermore, there could be a self-reported bias since it is probable that those who responded to the survey are those who were more intrigued by the topic.

This survey identifies certain shortcomings related to the practice of ETS in tertiary care hospitals in India. As it is performed by critical care nurses in many institutions in India and worldwide, much of the literature pertaining to ETS is found among nursing professionals.<sup>19</sup> It is imperative that all doctors know all about pre-procedure preparation, steps, precautions and post-procedure management related to ETS. Results of such surveys and audits can provide recommendations to improve ETS practices and raise awareness of doctors and hospital administrators about the guidelines of ETS. Educational institutions should incorporate evidence-based ETS practices into their curriculum and health care administrators should ensure the provision of up-to-date guidelines and continuous training for doctors working in ICU. Further studies are required to study the gap between knowledge and practice as well as the barriers and facilitators for implementing guidelines for ETS.

## CONCLUSION

There is significant difference between the expert recommendations and the followed practices of endotracheal suctioning by the health care providers. Results of such surveys and audits can provide recommendations to improve ETS practices and raise awareness among doctors and hospital administrators about the guidelines of ETS.

## ACKNOWLEDGMENTS

**Registration:** Clinical Trials Registry of India (REF/2022/12/061543). ([www.ctri.nic.in](http://www.ctri.nic.in))

**Protocol:** It can be accessed from the Clinical Trials Registry of India, (REF/2022/12/061543). ([www.ctri.nic.in](http://www.ctri.nic.in))

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## REFERENCES

1. American Association for Respiratory Care. AARC Clinical Practice Guidelines: Endotracheal suctioning of mechanically ventilated patients with artificial airways 2010. *Respir Care* 2010;55(6):758–764. PMID: 20507660.
2. Guglichnotti J, Desmots JM, Dureuil B. Effects of tracheal suctioning on respiratory resistances in mechanically ventilated patients. *Chest* 1998;113(5):1335–1338. DOI: 10.1378/chest.113.5.1335.
3. Zeb A, Ul Haq S, Ali F, Hussain N, Haidar S, Shah A, et al. Knowledge and practice of ICU nurses regarding endotracheal suctioning in tertiary care hospitals. *Peshawar J Nurs Care* 2017;06:2–5. DOI: 10.4172/2167–1168.1000400.
4. 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):339–345. DOI: 10.1016/j.iccn.2014.06.003.
5. Favretto DO, Silveira RC, Canini SR, Garbin LM, Martins FT, Dalri MC. Endotracheal suction in intubated critically ill adult patients undergoing mechanical ventilation: A systematic review. *Rev Lat Am Enfermagem* 2012;20:997–1007. DOI: 10.1590/s0104-11692012000500023.
6. Sole ML, Bennett M, Ashworth S. Clinical indicators for endotracheal suctioning in adult patients receiving mechanical ventilation. *Am J Crit Care* 2015;24(4):318–324.
7. Pedersen CM, Rosendahl-Nielsen M, Hjermdind J, Egerod I. Endotracheal suctioning of the adult intubated patient-What is the evidence? *Intensive Crit Care Nurs* 2009;25:21–30. DOI: 10.1016/j.iccn.2008.05.004.
8. Leddy R, Wilkinson JM. Endotracheal suctioning practices of nurses and respiratory therapists: How well do they align with clinical practice guidelines? *Can J Respir Ther* 2015;51(3):60–64. PMID: 26283870.
9. Patak L, Gawlinski A, Fung NI, Doering L, Berg J. Patients' reports of health care practitioner interventions that are related to communication during mechanical ventilation. *Heart Lung* 2004;33(5):308–320. DOI: 10.1016/j.hrtlng.2004.02.002.
10. Ansari A, Alavi NM, Adib-Hajbagheri M, Afazel M. The gap between knowledge and practice in standard endo-tracheal suctioning of ICU nurses. Shahid Beheshti Hospital. *J Crit Care Nurs* 2012;5:71–76.
11. Ntoumenopoulos G, Hammond N, Watts NR, Thompson K, Hanlon G, Paratz JD, et al. Secretion clearance strategies in Australian and New Zealand Intensive Care Units. *Aust Crit Care* 2018;31:191–196. DOI: 10.1016/j.aucc.2017.06.002.
12. Heidari M, Shahbazi S. Nurses' awareness about principles of airway suctioning. *J Clin Diagnostic Res* 2017;11:LC17–LC19. DOI: 10.7860/JCDR/2017/25550.10452.
13. Chaseling W, Bayliss SL, Rose K, Armstrong L, Boyle MS, Caldwell J et al. Suctioning an adult ICU patient with an artificial airway: A clinical practice guideline 2014. Available from: <http://handle.westernsydney.edu.au:8081/1959.7/uws:50103>. Accessed on: 30 November 2023.
14. Wilińska M, Zielińska M, Szepter T, Lesiuk W, Wilkowski J, Ziółkowski J, et al. Endotracheal suctioning in neonates and children. *Med Wieku Rozwoj* 2008;12(4 Pt 1):878–884. PMID: 19471061.
15. Plevak D, Ward J. Airway Management. In: Burton G, Hodgkin J, editors. *Respiratory Care: A Guideline to Clinical Practice*. New York: Lippincott Williams & Wilkins; 1997. pp. 555–609.
16. Pittet D, Allegranzi B, Boyce J, World Health Organization World Alliance for Patient Safety First Global Patient Safety Challenge Core Group of Experts. The World Health Organization guidelines on hand

- hygiene in health care and their consensus recommendations. *Infect Control Hosp Epidemiol* 2009;30(7):611–622. DOI: 10.1086/600379.
17. Mwakanyanga ET, Masika GM, Tarimo EAM. Intensive care nurses' knowledge and practice on endotracheal suctioning of the intubated patient: A quantitative cross-sectional observational study. *PLoS One* 2018;13(8): e0201743. DOI: 10.1371/journal.pone.0201743.
  18. Sanaie S, Rahnemayan S, Javan S, Shadvar K, Saghaleini S, Mahmoodpoor A. Comparison of closed vs open suction in prevention of ventilator-associated pneumonia: a systematic review and meta-analysis. *Indian J Crit Care Med* 2022;26(7):839–845. DOI: 10.5005/jp-journals-10071-24252.
  19. Pinto HJ, D'Silva F, Sanil TS. Knowledge and practices of endotracheal suctioning amongst nursing professionals: A systematic review. *Indian J Crit Care Med* 2020;24(1):23–32. DOI: 10.5005/jp-journals-10071-23326.

## Appendix: Questionnaire

Institute:   Specialty :

Designation:   Duration of experience:

Please tick the single best answer

1. Have you ever read at least one guideline on practices of endotracheal suctioning in intensive care unit?
  - a. Yes
  - b. No
2. How often do you check the adequacy of suctioning apparatus?
  - a. Never.
  - b. Every time before suctioning.
  - c. Once in a day.
  - d. Occasionally.
3. How often do you set the maximum negative pressure?
  - a. Never.
  - b. Every time before suctioning.
  - c. Once in a day.
  - d. Occasionally.
4. Who does the ETT suction in ICU patients in your institute?
  - a. Intensivist.
  - b. Nursing staff.
  - c. Any trained paramedical personnel.
  - d. Any doctor (JR, Intern etc).
5. Who should do the ETT suction in your opinion?
  - a. Intensivist.
  - b. Nursing staff.
  - c. Any trained paramedical personnel.
  - d. Any doctor (JR, Intern etc).
6. What should be the normal suction pressure for ETT suction in adults?
  - a. 60–80 mm Hg.
  - b. 70–150 mm Hg.
  - c. 150–200 mm Hg.
  - d. At least 200 mm Hg.
7. What should be the normal suction pressure for ETT suction in infants?
  - a. 60–80 mm Hg.
  - b. 70–150 mm Hg.
  - c. 150–200 mm Hg.
  - d. At least 200 mm Hg.
8. How often do you do the ETT suctioning?
  - a. Every 6 hourly.
  - b. Routinely after clinical assessment at 4 hour interval.
  - c. Routinely after 8 hours.
  - d. Only if clinically indicated after assessment.
9. What personal protective equipment do you use while suctioning?
  - a. Gloves.
  - b. Gloves and Mask.
  - c. Gloves, Mask and eye wear.
  - d. Gloves, Mask, eyewear and gown.
10. Which one is not the advantage of closed suctioning?
  - a. It allows continuous oxygenation and also prevents lung derecruitment.
  - b. It significantly reduces the incidence of ventilator-associated pneumonias.
  - c. It is useful in patients requiring high PEEP and FiO<sub>2</sub>.
  - d. It does not require sterile gloves to be used for suctioning.
11. How do you choose the size of suction catheter for ETT suction?
  - a. According to the thickness of secretions.
  - b. As big as can possibly be inserted.
  - c. Less than 2/3rd of the internal diameter of the ETT.
  - d. Less than half the internal diameter of ETT.
12. What solution should be routinely injected in the ETT to loosen the secretions?
  - a. 2–3 mL of 1% lignocaine.
  - b. 2–3 mL of normal Saline.
  - c. 2–3 mL of soda bicarbonate or N-acetylcysteine if blockage suspected.
  - d. No solution should be routinely injected.
13. What should be the maximum duration of ETT suctioning?
  - a. 5–10 seconds.
  - b. 10–15 seconds.
  - c. 15–20 seconds.
  - d. 20–30 seconds or till the SpO<sub>2</sub> starts falling.
14. How deep do you insert the suction catheter in the ETT?
  - a. Deep suctioning is required.
  - b. Shallow suctioning till the tip of the ETT.
  - c. Suctioning should be done under fiber-optic guidance.
  - d. Go till the carina in all patients.
15. What monitoring do you do before, after and during the ETT suctioning?
  - a. SpO<sub>2</sub>
  - b. ECG and SpO<sub>2</sub>.
  - c. ECG, SpO<sub>2</sub> and BP.
  - d. No routine monitoring necessary.
16. Do you always preoxygenate the patient prior to ETT suctioning?
  - a. Preoxygenation is not necessary for the ETT suctioning.
  - b. Preoxygenation with 100% O<sub>2</sub> should be done in every patient.
  - c. Preoxygenation with 100% O<sub>2</sub> should be done in select patients only.
  - d. Preoxygenation with 50% O<sub>2</sub> is also sufficient in some patients.
17. How do you check the adequacy of ETT suctioning?
  - a. Reduction in the visible secretions.
  - b. Chest auscultation and CVS changes.
  - c. Changes in ventilatory parameters.
  - d. All of the above.
18. Which one is the side-effect of ETT suctioning?
  - a. Hypoxia and atelectasis.
  - b. Cardiac dysrhythmia.
  - c. Bronchospasm.
  - d. All of the above.

19. Do you routinely do recruitment maneuver after ETT suctioning?
- a. Yes
  - b. No
20. Do you routinely document the indication, tolerance and adequacy of ETT suctioning?
- a. Yes
  - b. No
21. How often is the collection container of suction apparatus cleaned in your institute?
- a. Daily removed and cleaned.
  - b. Once in a week.
  - c. Only when it gets filled.
  - d. Twice in a week