ORIGINAL RESEARCH

Knowledge and Practices of Endotracheal Suctioning amongst Nursing Professionals: A Systematic Review

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Abstract

Introduction: Ventilator-associated pneumonia, a common cause of mortality and morbidity, is commonly seen among patients with endotracheal intubation due to unsafe suctioning practices by health professionals.

Objective: A systematic review was conducted to explore the gaps in the existing practices of nurses and thus proposing comprehensive guidelines for safe practice.

Materials and methods: A two-phase strategy was adopted to identify the studies through a comprehensive electronic search in PubMed, Google Scholar, ProQuest, Ovid, and Helinet Summon by using predefined keywords within a year limit of 2002–2016. The quality of studies was reviewed using tools endorsed by Joanna Briggs Institute. This review was conducted according to the guidelines described in the preferred reporting items for systematic reviews and meta-analyses (PRISMA). Qualitative data were described through the process of metasynthesis. Quantitative analysis was performed to combine the competent quantitative evidences to identify knowledge and practices of endotracheal suctioning (ETS).

Results: Thirty studies had been subjected for metasynthesis, among which six provided relevant information for quantitative analysis. Quantitative analysis of the studies reported that only 36% of the nurses had assessed patients prior to suctioning and had knowledge about the size of the suction catheter while only 46% were aware of the appropriate suction pressure to be used for ETS. Handwashing compliance prior to suctioning was observed in only 62% of the nurses. It is reported that, despite the awareness on possible complications, nurses fail to adhere to the recommended practice guidelines.

Conclusion: The current review would explore the best evidence-based practices (EBPs) among nurses related to ETS, which would ensure quality care to critically ill patients.

Keywords: Endotracheal suctioning, Knowledge, Nurses, Practices.

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Introduction

Endotracheal intubation with mechanical ventilation is a widely used airway management practice in patients admitted to the critical care units of a hospital with the sole purpose of maintaining a clear and patent airway. Endotracheal intubation prevents effective coughing and loss of mucociliary function causing accumulation of secretions in the airway. Thus, ETS becomes an essential component of care for these patients. Nursing management of these patients requires high technical skills in suctioning as it has been identified as a potentially harmful procedure associated with various complications such as trauma, bronchoconstriction, hypoxemia, cardiac arrest, and death.[1] It is estimated that about 30–40% of these patients are not receiving care based on the current research recommendations, and about 20% or more receive care that is potentially harmful.[2] Hence, there was a need felt by the researchers to review the existing practices and knowledge of nurses related to ETS practices and thus recommending guidelines related to effective and safe practice. These guidelines would further have a positive impact on improving patient's outcomes, reduce the healthcare costs, and promote safe patient care.

Materials and Methods

Design

This review was conducted according to the guidelines described in the preferred reporting items for systematic reviews and meta-analyses (PRISMA).

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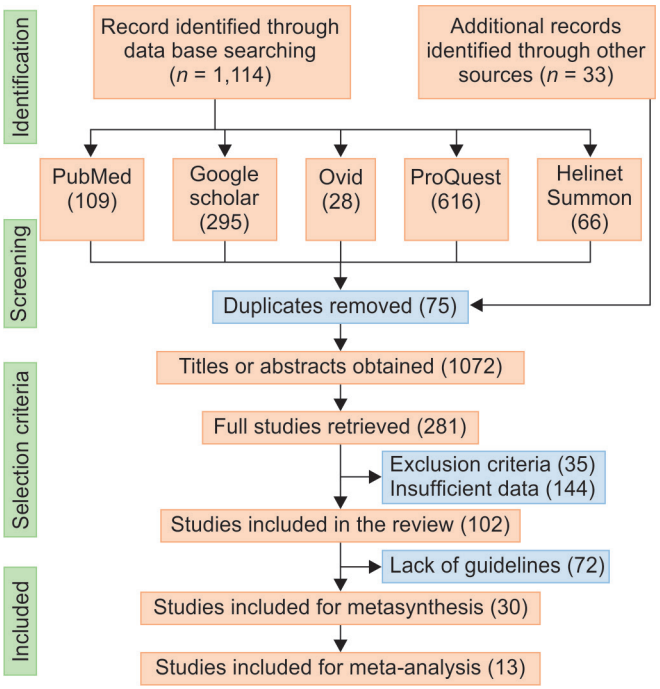
Literature Search Strategy

A comprehensive electronic search was conducted in Google Scholar (advanced search), PubMed, ProQuest, Ovid, and Helinet Summon using the predefined keywords. Full-text articles published between 2002 and 2016 were selected for the review. The following keywords were utilized for the search: "Knowledge" on ETS among nursing professionals, "Practices" on ETS among nursing professionals, "Knowledge" and "Practices" of ETS among nursing professionals, "Knowledge" or "Practices" of ETS among nursing professionals, "Protocols" on ETS, "Guidelines" for ETS, "Knowledge" of nursing professionals on "Protocol" of ETS,

Flowchart 1: PRISMA flow diagram of article selection process



"Guidelines" for nursing professionals to practice ETS, "Protocols" for nursing professionals to practice ETS, "Knowledge" of nursing professionals on "Guidelines" for ETS. The review was limited to relevant articles published in English language and adult population only. The details of the selected studies and their database are depicted in Flowchart 1.

Inclusion Criteria

The selection criteria given below were considered for inclusion of studies in the review:

Type of Studies

Descriptive (cross sectional) randomized controlled trials (RCTs) and quasi-experimental (pretest–posttest) studies, narrative reviews, systematic reviews, and teaching notes, which addressed practices of ETS were all included in the systematic review.

It included the studies conducted on adult patients who underwent open system of suctioning and studies on protocol based ETS. The studies published during the period of 2002–2016 were included in this review.

Type of Intervention

Endotracheal suctioning.

Type of Participants

Nurses performing ETS on adult patients.

Type of Outcome

Primary
Knowledge
Practices

Exclusion Criteria

Pilot studies, studies conducted among pediatrics, case reports, case series and animal studies

Data Extraction

Predefined keywords were entered into different databases, and yearwise search was conducted to identify the studies. The results obtained were further scanned for outcomes by the two reviewers simultaneously. Any disagreements were cross-verified with the third reviewer. A common understanding about the screening criteria was made in advance, and the decision to whether accept or reject the studies was made during this process. Titles or abstracts were screened for the content that was found to be valid. The full manuscripts of the valid studies were obtained. Some of the additional studies had been obtained without the use of predefined database. All the downloaded articles were studied and subjected for eligibility criteria, and a list of selected studies were obtained. Selected studies were further subjected for inclusion and the relevant data were extracted using a predesigned data extraction form, which was subjected for analysis (Table 1).

Data Synthesis

The qualitative evidence available had been subjected for meta synthesis. Quantitative data were subjected to meta-analysis and subgroup analysis. Odds ratio with 95% confidence interval was obtained. Heterogeneity among the studies was assessed by using Chi-square and I^2 statistics. Forest plots were generated to present the findings. Statistical analysis was performed using the Review Manager Software (RevMan 5.3, Cochrane Collaboration, Oxford, England).

Results

For this review, 1,114 titles or abstracts had been obtained from the databases by using predefined keywords. Thirty-three records were obtained from additional sources. Out of these, 281 full studies were retrieved. Based on the inclusion and exclusion criteria, 35 studies were excluded and 144 rejected due to insufficient data. As 72 studies lacked guidelines of ETS, only 30 were included for the metasynthesis (Flowchart 1).

Among the 30 studies 17 were descriptive, 4 were teaching notes, 3 were quasi-experimental and narrative reviews each, 2 were RCT, and 1 was a systematic review.

Characteristics of Included Studies

Among the 30 studies included for metasynthesis, 4 were teaching notes which addressed practices of ETS and were excluded from Table 2 because the materials and methods were unstructured in nature. Eleven studies involved 896 nurses.[2,5,11–13,18–20,25–27] Six studies observed nurses practices related to ETS on 426 patients admitted in critical care areas.[3,4,7,16,17,22] Five studies included observed practices of registered nurses (RNs), physiotherapists as well as respiratory therapists on ETS.[6,10,14,15,24] Sixteen studies evaluated the knowledge and practices of nurses with regard to ETS.[2,5,6,10–15,18,19,24–27]

Quality Assessment

All the included studies were subjected for methodological quality appraisal using a critical appraisal tool, which is endorsed by the Joanna Briggs Institute.[28] The tool is designed separately for descriptive studies (Table 2), quasi-experimental (Table 3), RCTs (Table 4), and systematic review (Table 5). Each criterion was appraised by two reviewers independently as "yes," "no," "unclear," and "not reported." The missed or partially matched appraisals were further scrutinized by the reviewers simultaneously, with the

Table 1: Characteristics of included studies

			Design	*Sample size*	
Study	*Quality score*	*Objective of the study*	*Sampling method*	*Setting*	*Outcome*
Abbasinia et al.[3]	8	To evaluate the effect of shallow and deep suctioning practice of nurses	RCT	74	RR, arterial blood SPO_2
			Random sampling	ICU	Frequency of suctioning
Akgul[4]	6	To determine the effects of saline solution administered prior to ETS	Cross-sectional	20	Oxygenation, HR, long-term pulmonary hygiene
			Purposive sampling	ICU	
Ansari et al.[5]	5	Assessing gap between the knowledge and performance of nurses in tracheal suctioning	Cross-sectional	44	Knowledge and practices
			Purposive sampling	ICU	
Baker et al.[6]	6	To evaluate an innovative interprofessional simulation educational module for prelicensure healthcare students on adult suctioning skills	Action research	91	Suctioning skills
			Purposive sampling	Not mentioned	
Bourgault et al.[7]	9	To compare open and closed suctioning	Quasi-experimental	18	HR, systolic blood pressure, arterial oxygenation tension
			Purposive sampling	ICU	
Dawson et al.[8]	–	To guide the nurse caring for a tracheostomy patient	Narrative review	Not mentioned	Guidelines on adult suctioning
Day et al.[9]	–	To identify current suctioning recommendations for safer suctioning practices	Narrative review	Not mentioned	Guidelines on suctioning
Day et al.[10]	8	To determine whether individualized performance feedback improved nurse's and physiotherapist's knowledge and practice of tracheal suctioning	RCT	95	Knowledge and practices on tracheal suctioning
			Stratified random sampling	General and high-dependency units of a hospital	
Frota et al.[11]	5	To evaluate the knowledge of nursing professionals about endotracheal aspiration (ETA) for open system	Exploratory descriptive study	27	Knowledge on open system of ETS
			Purposive sampling	ICU of two university hospitals	
Frota et al.[12]	5	To investigate the practices of nursing professionals working regarding open system of ETS	Exploratory descriptive cross-sectional study	34	Practices of ICU professionals on open system of ETS
			Purposive sampling	ICU	
Geoghan[2]	6	To explore specific factors that may be associated with nurses "adoption of EBP"	Cross-sectional survey	99	Knowledge and practices on ETS
			Purposive sampling	Critical areas of three Midwestern hospitals	
Kelleher et al.[13]	6	To investigate open system ETS practices and compare with recent research recommendations	Nonparticipant structured observational study	45	Practices of ETS
				Two adult ICUs	

Contd…

Contd…

			Design	*Sample size*	
Study	*Quality score*	*Objective of the study*	*Sampling method*	*Setting*	*Outcome*
Kjonegaard et al.[14]	6	To determine current practice and differences in practices between RNs and respiratory therapists in managing patients receiving mechanical ventilation	Descriptive comparative purposive sampling study	41 nurses 25 respiratory therapists Surgical ICU	Airway management practices, suctioning techniques
Leddy et al.[15]	4	To examine the suctioning practices of RNs and registered respiratory therapists with special attention devoted to the use of normal saline instillation (NSI)	Survey design Purposive sampling	170 ICUs of 6 hospitals	Practices of ETS and practices of NSI during ETS
Maggiore et al.[16]	8	To study the incidence and risk factors of ETS and to evaluate the effect of suctioning practice guidelines before and after the implementation	Quasi-experimental study Purposive sampling study	79 (11 lost to follow-up) 26 bedded medical ICU	Adverse effects of ETS
Morris et al.[17]	7	To determine the incidence of cuff over inflation in the contemporary American ICU	Prospective observational study Convenience sampling	115 ICU patients Two tertiary care teaching hospitals	Overinflation of the cuff pressure
Negro et al.[18]	6	To evaluate the knowledge of the American Association of Respiratory Care (AARC, 2010) evidence-based guidelines on the ETS technique by Italian intensive care nurses in different hospitals	Cross-sectional survey Convenience sampling	247 11 hospitals	Knowledge on American Association of Respiratory Care (AARC, 2010) guidelines
Nishamol[19]	5	To identify the knowledge of ETS among nurses	Survey design Purposive sampling study	30 Neuro medical ICU	Knowledge and practice of nurses on ETS
Overend et al.[20]	9	To update a previous clinical practice guideline on suctioning in adult patients	Systematic review	Not mentioned	Clinical guidelines on adult suctioning
Ozden et al.[21]	4	To determine the knowledge and practice of nurses before and after training and the development of standard practice guidelines for open and closed system suctioning methods in patients with ETTs	A nonparticipant structured observational design Purposive sampling	48 Cardiac surgical ICU	Knowledge and practices
Ozden et al.[22]	9	To determine the effects of open and closed suction systems on hemodynamic parameters of the patients who underwent open heart surgery	Quasi-experimental design	120	HR, arterial blood pressure, and ABGs

Contd…

Contd…

Study	Quality score	Objective of the study	Design / Sampling method	Sample size / Setting	Outcome
			Purposive sampling	Cardiac surgical ICU	
Pedersen et al.[23]	–	To review the available literature regarding ETS of adult intubated intensive care patients and to provide evidence-based recommendations	Narrative review	Not mentioned	Evidenced-based recommendations
Sole et al.[24]	7	To describe current practices for airway management of intubated patients and determine whether practices differ between RNs and respiratory care practitioners	Descriptive comparative design	85	Practices of airway management
			Purposive sampling	4 ICU	
Sreeja[25]	5	To assess the knowledge of nurses about tracheostomy care and find out relationship between nurses knowledge about tracheostomy care and selected variables	Descriptive survey approach	30 nurses	Knowledge of nurses on tracheostomy care
			Purposive sampling	Neuro ICU	
Stevens[26]	5	To describe current preoxygenation practices of nurses who perform tracheal suctioning in individuals with spinal cord injury	Descriptive exploratory study	242 nurses	Preoxygenation practices
			Purposive sampling	Not mentioned	
Varghese[27]	5	To assess the knowledge and skill of the critical care nurses on ETS	Descriptive exploratory design	50 nurses	Knowledge of nurses on tracheostomy care
			Convenient sampling	Eight ICUs	

help of the third reviewer. A credit point of "one" was assigned for "+" and "zero" for "–." Total counts of all the points were obtained. The score of >5 was considered as high-quality studies. Among the 17 descriptive studies, two studies[17,24] had a score of seven, six studies[2,4,6,13,14,18] had a score of six, and six studies had a score of five.[5,11,19,25–27] The score ranged from 4 to 7 with a mean ± SD of 5.5 ± 0.87, and median of 6 with IQR 5–6 (25th–75th percentile). The appraisal scores for two RCTs were 8 (Table 3). Among the three quasi-experimental studies, two had a score of nine and one study had a score of 8 (Table 4). The score ranged between 8 and 9 with a mean ± SD of 8.66 ± 0.57, and median of 9 with IQR 8–9 (25th–75th percentile). There was one systematic review, which had an appraisal score of 10.

Risk of Bias

Among 17 descriptive studies, 11 studies had a clearly defined inclusion criteria. The outcomes of all the descriptive, quasi-experimental, and RCTs were assessed and measured using objective criteria with an appropriate statistical analysis. Among the two RCTs, the study groups in both studies were homogenous, and random assignment of subjects was followed. One study reported a blinded treatment allocation.

Outcome Measurements

Primary outcome of the study included assessment of knowledge and practices of nurses regarding ETS.

Knowledge on Suctioning among the Nurses

Two descriptive studies conducted on 94 nurses revealed an average level of knowledge of nurses on adult suctioning. The tool utilized was a structured knowledge questionnaire.[5,27] Another two descriptive studies conducted among 60 critical care nurses reported that most of the nurses had knowledge on the complication of hypoxia arising due to absence of hyperinflation prior to suctioning. It also highlighted that majority of the nurses were aware that suctioning should be performed for 15 seconds only and when necessary and during withdrawal of the catheter. The study also reported that nurses knew the recommended suction pressure of 80–120 mm Hg and had knowledge that the suction catheter has to be changed after every suctioning attempt.[19,25] One descriptive study disclosed that 73% of the nurses identified the appropriate catheter size for suctioning and that 67% nurses were aware that instilling sodium bicarbonate prior to suctioning was not a recommended practice.[25] One randomized controlled study conducted among healthcare professionals (nurses and physiotherapists) in clinical and simulation setting of the two acute hospitals reported that among the 39 participants from the simulation setting, 21 (51%) were unaware of no use of saline prior to suctioning and 18 (46%) knew the recommendation to keep suctioning pressure below 19.8 kilopascals. In the clinical setting among 56 nurses, the knowledge of noninstillation of saline was identified among 24 (43%) participants and suction pressure among 18 (32%). The mean knowledge score in the simulation group (15.56 ± 1.95 SD) was higher compared to the clinical group (14.15 ± 2.63 SD).[9]

It was evident through another descriptive review on knowledge of 27 ICU nurses on ETS including infection control practices that 96% reported knowledge on identifying the clinical indicators prior to suctioning and monitoring of pulse oximetry

Table 2: Appraisal of the descriptive studies

	Random or pseudo-random sampling	*Criteria for inclusion in the sample clearly defined*	*Confounding factors identified and strategies to deal with them stated*	*Outcomes were assessed using objective criteria*	*Comparisons are being made, were there sufficient descriptions of the groups*	*Follow-up carried out over a sufficient time period*	*Outcomes of people who withdrew described and include in the analysis*	*Outcomes measured in a liable way*	*Appropriate statistical analysis used*	*Sample size estimated*
Akgul et al.	–	+	–	+	+	+	–	+	+	–
Ansari et al.	–	–	+	+	–	+	–	+	+	–
Baker et al.	–	+	–	+	+	+	–	+	+	–
Geoghan et al.	–	+	–	+	–	+	–	+	+	+
Kelleher et al.	–	–	+	+	–	+	–	+	+	+
Kjonegaard et al.	–	+	–	+	+	+	–	+	+	–
Leddy et al.	–	–	–	+	–	+	–	+	+	–
Morris et al.	–	+	+	+	+	+	–	+	+	–
Negro et al.	–	+	–	+	–	+	+	+	+	–
Frotci et al.	–	–	–	+	–	+	–	+	+	+
Nishamol	–	+	–	+	–	+	–	+	+	–
Frota et al.	–	+	–	+	–	+	–	+	+	–
Ozden et al.	–	–	–	+	–	+	–	+	+	–
Sole et al.	–	+	–	+	+	+	–	+	+	+
Sreeja	–	+	–	+	–	+	–	+	+	–
Stevens	–	+	–	+	–	+	–	+	+	–
Varghese et al.	–	–	–	+	–	+	+	+	+	–

Table 3: Appraisal of the quasi-experimental studies

	Bourgault et al.	*Maggiore et al.*	*Ozden et al.*
"Cause" and "effect" is clear	+	+	+
Participant comparisons are homogenous	+	+	+
Received similar treatment/care other than the exposure or intervention of interest	+	+	+
Control group included	+	–	+
Pre- and postintervention/exposure with multiple measurements	+	+	+
Lost to follow-up reported	+	+	+
Outcomes measured uniformly for comparison	+	+	+
Measurements were reliable	+	+	+
Appropriate statistical analysis was used	+	+	+
Sample size was estimated	–	–	–

Table 4: Appraisal of the randomized control trials

	Abbasinia et al.	*Day et al.*
Assignment to the treatment groups was truly random	+	+
Participants blinded to the treatment allocation	+	–
Allocation to the treatment groups was concealed from the allocator	–	–
Outcomes of the people who withdrew was described and included in the analysis	–	+
Outcomes are blinded according to the treatment	–	–
Control and treatment groups comparable at entry	+	+
Groups treated identically	+	+
Outcomes measured in the same way for all the groups	+	+
Measurements were reliable	+	+
Appropriate statistical analysis used	+	+
Sample size estimated	+	+

Table 5: Appraisal of the systematic reviews

	Overend et al.
The review question was clearly and explicitly stated	+
Appropriate search strategy was used	+
Sources of the studies were adequate	+
Inclusion criteria was appropriate	+
Criteria for appraising studies was appropriate	+
Critical appraisal conducted by the reviewers independently	+
Methods used to minimize error in data extraction were appropriate	–
Methods used to combine studies was appropriate	+
Recommendations were supported by the reported data	+
Specific directives for new research was stated	+
Review question was clearly and explicitly stated	+

during suctioning. Ninety-three percent had knowledge on explanation of the procedure prior to suctioning. Only 63% were aware of the preoxygenation practices to prevent hypoxemia and 59% reported knowledge on appropriate diameter of the suction catheter. Only 33% were aware of maximum duration of suctioning.[11]

Practices of Nurses Related to ETS

Six studies identified practices of nurses on suctioning, which is summarized in Table 6.[2,7,11–13,19,22] The practices were observed by observational checklist.

The most common practices of suctioning identified among the nurses were use of personal protective equipments (PPEs) ($n = 149$), maintenance of catheter sterility ($n = 129$), preoxygenation ($n = 121$), and patient preparation ($n = 113$). The less-frequent practices were with regard to assessment ($n = 25$) and reassessment after suctioning ($n = 30$), documentation ($n = 33$), postoxygenation ($n = 42$), and the use of appropriate catheter size ($n = 50$).

Validity and Reliability

The tools used in the reviewed studies for assessing the knowledge and practices were found to be valid and reliable.[2,5,6,10,11,13–15,18,19,21,24–27]

Discussion

Endotracheal suctioning is an invasive procedure with a greater risk of developing complications. Hence, assessing the need for suctioning is important prior to suctioning. Reviews have related that many nurses are unaware of the importance of assessing the need for suctioning; they fail in performing a comprehensive assessment of the patient's respiratory status, which mainly includes chest auscultation.[9,27,31] It is reported that nurses depend on clinical indicators such as noisy breathing or visible secretions in the airway.[27] Reviews have explored several other indicators

Table 6: Practices followed by the nurses on endotracheal suctioning

Practices	*Nurses practiced*	*Total no. of nurses*	*%*	*No. of studies*
Assessment	25	70	36	2
Suctioning when necessary	91	146	62	3
Patient preparation	113	175	65	5
Hand wash prior to suctioning	92	148	62	4
PPE	149	175	85	5
Preoxygenation	121	150	81	4
Appropriate catheter size	50	140	36	3
No use of saline	125	140	89	3
Maintained catheter sterility	129	175	74	5
Suction pressure (80–150 mm Hg)	87	191	46	4
Number of suction passes (≤2)	39	45	87	1
Duration (<15 seconds)	88	150	59	4
Postoxygenation	42	57	74	2
Reassessment	30	30	100	1
Hand wash postsuctioning	75	82	91	3
Documentation	33	55	60	2

to be considered for suctioning patients with endotracheal tube (ETT) such as ineffective cough, high-peak airway pressure on volume control mode or decrease in tidal volume, respiratory distress, increased peak airway pressure on ventilators, oxygenation desaturation, sawtooth pattern on the ventilator display, coarse crackles in the trachea, and rhonchi on auscultation of the lung fields.[16,20,22–24] Two reviews have further strongly recommended that suctioning can be performed only when secretions are present and not as a routine procedure so as to avoid the adverse effects of suctioning.[2,23]

Being informed regarding the procedure done on him is the right of the patient.[11,22] Several reviews have discussed that suctioning is an unpleasant and painful experience to patients[11,22] but yet nurses fail to explain the procedure to the patient prior to suctioning.[27] Hence, appropriate explanation and adequate pain relief can lead to reduction in the stress, anxiety, and pain leading to an effective suctioning.[9]

Two reviews have exposed a lack of adherence to hand washing practices among nursing professionals before suctioning.[11,22] The various factors for nonincorporation of this hand washing practice could be failure to understand the risk of spread of pathogens, excess of activities, lack of resources, and inadequacy of physical structure of the institution.[11] This could also be attributed to lack of stringent organizational policy. In spite of having a better understanding about the consequences of poor practices of hand washing during ETS, the nurses give less importance to hand washing practices. A study reported that with increase rates of hand washing, nosocomial infections could be decreased by 50%, especially among those healthcare staffs who are in direct contact with the patient.[21]

Reviews have also divulged that nursing professionals do not adhere to the use of PPEs prior to suctioning though there is an associated risk with the procedure due to the nature of suctioning.[9,11,23] One review strongly recommended strict adherence of using gloves, mask, and apron during the procedure to prevent infection as well as the cross-infection.[27] Hence, hand washing and the use of PPEs have to be emphasized as a cost-effective and quality control measure to control nosocomial infections in any healthcare organizations.

Suctioning the oxygenated air together with the secretions is a major cause for the development of hypoxia among the patients with endotracheal intubation.[12,26] Hence, preoxygenation or hypeorxygenation is a recommended practice suggested by several reviews.[7,8,24,26] One review reported less practice of hyperoxygenation among nurses who do not work with ventilated patients.[26] Studies have recommended to hyper-oxygenate the patient by delivery of 100% oxygen for a period of 30–60 seconds prior to and after suctioning procedure to prevent hypoxemia among ventilated patients.[9,14,22–24]

The size of the catheter should be determined prior to the suctioning to reduce the risk of trauma.[3,23] The widely accepted formula for calculation of catheter size is [French] = (ET-tube size [mm] − 2) × 2.[9,11,23] Three reviews have recommended that the external diameter of the suction catheter should not exceed half the size of the internal diameter of the ETT, thus facilitating the effective removal of the secretions.[9,19,29] Hence, the size of the suction catheter to be used should be less than 50% of the internal diameter of the lumen of the ETT.

Generally, nurses believe that normal saline dilutes the secretions and eases catheter insertion, induces cough, facilitates secretion removal, and thereby improves the patient's oxygen.[23,24] But there is a lack of evidence that it maintains airway patency, but contributes to adverse effects such as aspiration.[15,24] Two reviews discussed drop in oxygen saturation (SPO_2) levels and arterial blood gas (ABG) results, patient discomfort, and increased heart rate (HR) due to saline instillation prior to suctioning.[4,11,15] Two reviews recommended humidification can be a better way to decrease viscosity of secretions rather than saline instillation.[4,16]

An observational study reported that 88% of nurses apply negative pressure during withdrawal of the suction catheter, which seems to be a very good practice.[11] This prevents tracheal mucosal injury and bleeding. Several reviews have recommended shallow rather than deep suctioning among patients with endotracheal intubation.[8,16]

Reviews have disclosed changes in the respiratory rate (RR) and SPO_2 due to the stimulation of the vagus nerve while suctioning.[3,7,9] Hence, the nurse should continuously monitor the RR and SPO_2 during and after the procedure to prevent further complications.

Three reviews have emphasized the need to use the lowest possible suction pressures sufficient enough to clear the tracheal secretions and reduce the risk of atelactasis, hypoxia, and damage to the tracheal mucosa. It is recommended to use a negative pressure of 80–120 mm Hg during suctioning.[19,21,23]

Since suctioning results in hypoxemia reviews have revealed that the suctioning should not last for more than 10–15 seconds[2,9,19,31] and a maximum of three suction passes per procedure with sufficient time period (20–30 seconds) to restore the baseline ventilation and SPO_2 is recommended.[16,21]

The capillary pressure in the tracheal mucosa is 20 cm of H_2O. Thus, a cuff pressure higher than this value can bring about ischemic changes in the tracheal mucosa leading to ulceration, necrosis, and fistula formation.[8,11,24,30,31] One review indicated that nurses lacked knowledge regarding the frequency of monitoring the cuff pressure and the minimum cuff pressure that is required. The study recommended to adjust the cuff pressure at least every 8–12 hours[25] and should be never higher than 34 cm of H_2O.[8,11]

Endotracheal intubation is an invasive procedure. Hence, sterility of the catheter should be maintained by use of a nontouch suctioning technique.[9]

In an open system of ETS, a new sterile disposable suction catheter for every insertion in the tube is extensively recommended. It is also recommended that after suctioning, the catheter is discarded and the suction hose is flushed with tap water from the canister.[24] One review suggested that the suction system can also be washed with distilled water or sodium chloride (NaCl) at the end of the suctioning.[11]

Future Directions

Very few studies are available, which have explored the knowledge and practice gaps of nurses related to ETS practices. Systematic reviews on factors contributing to lack of adherence to standard guidelines related to ETS practices can also be explored. Rigorous reviews of RCTs are required to gather adequate evidences related to poor practices of nurses related to ETS.

Implications for Clinical Practice

There are numerous clinical guidelines identified in this review, which could be utilized as best and safe practices for managing patients with ETS. Competency-based ongoing in-service education programs need to be conducted to update the nurse practitioners of the standard guidelines and protocols related to the management of patients with ETS. Stringent healthcare policies to be implemented in every healthcare organization looking for better quality care outcomes. Hospital accreditations to be conducted periodically to ensure quality healthcare services. Reinforcement, recognition, and rewards for best nursing care practices can be few strategies adopted by healthcare managements to promote manpower productivity and efficiency.

Limitations

Majority of the reviews were descriptive in nature, and hence limits the scope of obtaining objective evidences through meta-analysis. Heterogeneity of samples and small sample size were other concerns of this study. Only articles published in English were considered for reviews, which may have produced language bias regarding the conclusion as there were studies published in other languages.

Conclusion

The above reviews highlight that though nurses had knowledge about importance of use of personal protective devices and hyperoxygenation before, during, and after suctioning, they failed to adhere to these standard practices while handling patients with endotracheal intubation. The reviews have identified the need to enhance the patient assessment and communication skills among nurses. Systematic reviews have disclosed that nurses give less importance to the practice of hand washing and patient education prior to suctioning. But an appropriate explanation prior to suctioning may cause a decreased level of anxiety among these patients. Majority of the studies recommend that hyperinflation, and hyperoxygenation should be delivered via ventilator mode, as this mode can provide 100% oxygenation to the patients than Bag valve mask. Reviews have explored that saline instillation during suctioning does not have any effect on improving patient's outcome. Hence, this practice is potentially unsafe and inappropriate. Suctioning for duration of less than 15 seconds, monitoring cuff pressure, removal of suction in a rotating motion, monitoring the HR and SPO_2 levels, and shallow suctioning are important practices the nurses need to adhere to prevent tracheo bronchial lesions, hypoxemia, and early detection of hemodynamic instability. There is a need for additional research studies with higher methodological quality to validate the practices of nurses related to ETS in India.

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