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Comprehensive Oral Care Program for Intubated Intensive Care Unit Patients

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Abstract

Background
VAP is among the most widespread intensive care unit nosocomial infection; it can be prevented by oral care.
Aim
To explore the impact of implementing American Association of Critical Care Nurses Endotracheal Tube and Oral Care procedure (AACN ETT& OC) on the rate of Ventilator-associated pneumonia (VAP) development in Jordanian mechanically ventilated patients.
Methods
A quasi-experimental design with control group was used.
Results
VAP was statistically significantly higher among the control group, as compared to the intervention group (12.5% and 4% respectively, P <0.01). In the intervention group, the VAP rates decreased by 50% and the mean length of mechanical ventilator usage decreased from 7.3 to 5 days. The mean time to start VAP was extended from 2.3 days in the intervention group to 4.9 days in the control group. A significant decrease was found in mortality rates; from 20% (15/72) in the control group to 13.9% (10/75) in the intervention group, P <0.01.
Conclusion
Implementation of this procedure reduces hospitalization, morbidity, mortality

and improves quality of care.
Implications for nursing and health policy
The implementation of an AACN ETT& OC can significantly reduce VAP rates, and encourages health policy makers to adapt evidence-based oral and ETT care.

Keywords: educational program, endotracheal tube, intensive care units, Jordan, oral care, ventilator-associated pneumonia

1. Introduction

Ventilator-associated pneumonia (VAP) represents pneumonia that develops during mechanical ventilation (MV) after 48 hours of intubation and is characterized by the presence of a new or progressive infiltrate on the chest radiograph, and at least two of the following: hyperthermia, pussy secretion and leukocytosis or leukopenia (American Thoracic Society, 2005). VAP has a negative impact on patients and health agencies in terms of increasing morbidity, mortality rate and the cost of health care in intensive care units (ICUs) (Perrie et al., 2011).
Treatment with MV is used to save the patients' life (ALBashtawy et al., 2014, Alhalaiqa et al.). However, the natural defense mechanism of the body against microorganisms decreases, mainly due to bypassing the endotracheal tube (ETT) through the epiglottis. Therefore, these patients will be more liable to succumb to VAP (Cook et al., 2010).
Oral and ETT care has been recognized as an essential factor in the protection against VAP (Hillier et al., 2013). It is also a key component of nursing practice (Zurmehly, 2013). However, oral and ETT care has been considered as a low concern technique in ICUs. The frequency of doing these procedures is more inconsistent and infrequent than normal (Perrie et al., 2011); it is usually considered as an intervention for patients' comfort rather than clinical health (Perrie et al., 2011).
One of the studies evaluating the effect of different solutions on oral-care using a quasi-experimental design was conducted by Rida et al. (2006). According to the results of this study hydrogen peroxide (H_2O_2) solution improved all items of oral health, while sodium bicarbonate improved teeth and saliva conditions only. Hossainian et al., (2011) found that H_2O_2 reduce gingival redness.
The findings of several clinical trials, focusing on oral care protocols on mechanically ventilated patients conducted globally (Bopp et al., 2006; Jingyu et al., 2011; Cuccio et al., 2012; Prendergast et al., 2012). The most widely accepted and followed protocols are those of the American Association of Critical Care Nurses Endotracheal Tube and Oral Care (AACN ETT& OC) procedure (Scott et al. 2011). The AACN ETT & OC procedure offers the most current, evidence-based oral care protocols which can be utilized by health care providers to conduct oral care. The AACN ETT& OC guidelines for oral care in mechanically ventilated patients have also been utilized widely in many studies

(Feider et al. 2010; Batiha et al., 2013; Bashayreh et al. 2013). It has a list of recommendations: for example brushing teeth twice daily, using oral swabs with 1.5% H_2O_2 solution to clean oral cavity every 2 to 4 hours and assessing the oral cavity and lips at least every 8 hours (table 1).

In Jordan, hospitals have not yet adopted a specific protocol or guidelines to enhance oral care to mechanically ventilated patients, despite the high prevalence of VAP in the country (Batiha et al. 2013, Batiha 2013, Obead et al. 2014). Therefore, a lack of specific guidelines about oral care leads to differences in the application of this procedure, between nurses and patients, which could be a significant cause of VAP development.

A well designed and evidence-based ETT & OC procedure, informed by the AACN manual could provide the necessary information and skills needed to effectively provide oral care to mechanically ventilated patients in Jordan. Therefore, this research was performed to explore the impact of implementing the AACN ETT & OC procedure on the rate of VAP development in Jordanian mechanically ventilated patients.

Table 1. American Association of Critical Care Nurses Endotracheal Tube and Oral Care [a]

1.	Washed Hands, and don personal protective equipment.
2.	Ensure that endotracheal tube is connected to ventilator using a swivel adapter.
3.	Support the endotracheal tube and tubing as needed.
4.	If suctioning is clinically indicated hyperoxygenate and Suction endotracheal tube.
5.	Loosen and remove old tape and ties.
6.	If patient is nasally intubated, clean around endotracheal tube using saline-soaked gauze or cotton swabs .Proceed to step 8.
7.	If patient is intubated orally, remove bite-block or oropharyngeal airway (acting as bite-block). Proceed to step 8.
8.	Perform oral hygiene, using Pediatric toothbrush or Adult (soft) toothbrush at least twice a day. Gently brush patient's teeth to clean and remove plaque from teeth. (Level IV: Limited clinical studies to support recommendations.)
9.	In addition to brushing twice daily, use oral swab with 1.5% (H_2O_2) solution to clean mouth every 2 to 4 hours. With each cleansing, applying a mouth moisturizer to the oral mucosa and lips to keep tissue moist. (Level IV: Limited clinical studies to support recommendations.)
10.	Suction oral cavity/pharynx frequently.
11.	Move oral tube was to the other side of the mouth. Replace bit-block or oropharyngeal airway (to act as bite-block) along the endotracheal tube if necessary to prevent biting, minimize pressure areas on lips, tongue, and oral cavity.
12.	Ensured proper tube cuff inflation using minimal leak volume or minimal occlusion volume.
13.	Reconfirm tube placement, and note position of tube at teeth or naris *(common tube placement at teeth is 21 cm for women and 23 cm for men).*

Table 1. (Continued): American Association of Critical Care Nurses Endotracheal Tube and Oral Care [a]

14. Secure the endotracheal tube in place (according to institutional standard) *(to prevent inadvertent dislodgment of the tube)*

Patient Monitoring and Care

1. Keep the head of the bed elevated at least 30 degree unless contraindicated.
2. Suctioning endotracheal tube if clinically indicated.
3. The nurse monitored the amount, type and color of secretions.
4. If patient is nasally intubated, the nurse monitor for nasal drainage.
5. Assesses the oral cavity and lips at least every 8 hours, and perform oral care (as outline in step 8 and 9) every 2 to 4 hours and as needed.
6. With oral care, assess for buildup of plaque on teeth or potential infection related to oral abscess.
7. Reconfirm tube placement, and note position of tube at teeth or naris. Retape or secure endotracheal tube every 24 hours and as needed for soiled or loose securing devices.

[a] Scott & Vollman (2011)

2. Method

2.1. Study design

In this study, a quasi-experimental research design, with control group, was used.

2.2. Setting and participants

The study was conducted at two critical care units (ICU, CCU) of a teaching hospital in northern Jordan over a period of 16 months (from March 2011 to June2012). Patients were qualified for possible enrollment in this study if they were aged 18 or more and were intubated for more than 48 hours during the study period. This timeframe was chosen because VAP is most likely to develop after 48 hours of a patient's intubation; the oral cavity may not be influenced by the oral care if the duration of remain was less than 48 hours (Ames et al., 2011). Patients were followed-up until they were weaned from MV in the critical care units, after being transferred from the critical care units within 48 hours, were still on MV or until they died.

To reduce the effect of confounding influences, clients were excluded from the study if they were:

1- Less than 18 years old.

2- Had a modified Clinical Pulmonary Infection Score (CPIS) of 6 or greater (diagnosed as VAP)

3- Having oral trauma, fracture, or edentulous because of the previous danger of oral care and the gross difference in oral environment in the potential for complications.

4- Known to be allergic to H_2O_2, which was used as part of the oral care procedure.

2.3. Ethical consideration

Approval of the study was obtained from Jordan's Ministry of Health and the designated teaching hospital review board; so allowing the research team to apply the necessary interventions and collect the data needed from the two critical care units. Written informed consent was obtained from the patients who agreed to join in this study, or from patient's family, so ensuring the confidentiality, dignity, and avoidance of any harm to the patients depending on the Helsinki Declaration of 2008.

2.4. Data collection

The research was analyzed and accepted by the Institutional Review Board at the Ministry of Health, Jordan. After obtaining approval to conduct the study, the investigators recruited six research assistants (RAs) (4 nurses present in unit; one medical doctor and one pulmonary specialist). The RAs were briefed on the study's purpose, procedures, instruments, research ethics and consent process.
The study consisted of 4 phases over 16 months: baseline (six months), education program (two months), confirmatory period (two months), and intervention (six months).

2.4.1. Baseline (before intervention)

Studying the control group took six months (from March 2011 to August 2011).This phase was a follow up to a previous observational study (Batiha et al., 2013). This study could be considered as a basis for determining the actual practices and needs of oral care practice among Jordanian nurses.

In this phase the control group received routine hospital oral care. The demographic and clinical characteristics (including age, gender, reasons for admission to ICU) were noted, as was antibiotic use before intubation, which was recorded daily. Researchers collected the data and performed oral assessment for each shift of nurses duty, (there was different researchers to cover all shifts) based on a standard form called the Beck Oral Assessment Scale (BOAS) (Beck, 1979). BOAS was used to assess and guide oral care and make a base line comparison between two groups before interventions. BOAS scores ranged from 5-20: 5 (No dysfunctions with minimum care every 12 h); 6-10 (Mild dysfunctions with minimum care every 8-12 h); 11-15 (Moderate dysfunctions with minimum care every 8 h); 16-20 (Severe dysfunction with minimum care every 4 h). Acute Physiology and Chronic Health Evaluation II (APACHE II), adopted from Knaus et al., (1985), was used to evaluate the intensity of illness, which is regarded as one of the variables linked with the development of VAP (table 2). The APACHE II score was documented at the time of entrance to ICU. In ICU log was used to

record the information needed to calculate the length of stay. Date of intubation, extubation and admission to ICU, days of MV, transfer, or death, chest X- ray results, temperature, elevation of white blood cells, and sputum culture results were recorded. The patients' profile did not contain any information about his/her group's assignment (control or study group).

2.4.2. Educational program

Theoretical lectures and practical demonstrations were performed over two months (from September 2011 to October 2011) by the researchers, targeting all nurses who worked in the two critical care units (n= 31). The topics included ETT & OC procedures as recommended by AACN (Scott et al., 2011). This information took the form of a checklist of 17 items of ETT and oral care procedures, together with 7 items of patient monitoring and care (table 1). Also included were the recommendations for avoiding health care-associated pneumonia, as recommended by the Center for Disease Control and Prevention (CDC, 2004). Lectures, demonstrations and re-demonstrations were continued until all the team members were competent to perform ETT & OC procedures as recommended by AACN.

2.4.3. Confirmatory phase

The researchers took two months as a confirmatory period (from November 2011 to December 2011). During this period, investigators wanted to be sure that the staff nurses in ICU were performing the AACN protocol consistently over time. To do this, feedback was given until all staff members were competent to meet this goal. Determination of staff competence was assayed by pretest-posttest (written and practical). Ability to follow the ETT and oral care checklist successfully and consistently was required: a score of 90 or more was considered competent. And finally, by clinical observation, the inter-rater reliability assessment was done by observing the nurses' performance. Additionally the researcher reviewed the patients' flow sheets, and then a feedback was given to the nurses until the consistency between staff performance and AACN standards was obtained. Statistical results were not gathered during this period.

2.4.4. Intervention phase

The intervention was conducted over six months (January 2012 to June 2012) for study group members. Critical care nurses were instructed to follow the AACN ETT& OC procedure (Scott et al., 2011) (Table 1) for all mechanically ventilated patients. Follow up assessments were done in this phase regarding baseline demographic and clinical characteristics of intervention group patients which included: BOAS score, reason for ICU admission, APACHE II score, CPIS, and antibiotic use before intubation. All necessary tools for oral care tasks were provided, as outlined in the AACN ETT& OC procedure.

2.4.5. Outcomes measures

The study's primary outcome was the VAP rate. A VAP case was defined according to a modified CPIS, which did not contain microbiological results. Total CPIS 10 during follow-up of VAP was diagnosed if CPIS was greater than 6 (Table 2). CPIS has a sensitivity of 97.44% and a specificity of 100% for diagnosing VAP (Celik et al. 2014). Harde et al., (2013) found that a CPIS score can be an appropriate method to diagnose VAP in critically ill neurological patients. CPIS was assessed every day. The secondary outcomes were length of stay in the ICU, duration of MV, and ICU mortality rate.

Table 2. Clinical Pulmonary Infection Score (CPIS) [a]

Variable	Value	Score
Body temperature, ºC	36.5 - 38.4	0
	38.5 - 39.0	1
	>39.0	2
White blood cell count, x1000/μL	4-11	0
	11 - 17	1
	>17	2
Secretions	+	0
	++	1
	+++	2
PaO_2/fraction of inspired oxygen	>200	0
	<200	2
Infiltrates on chest radiograph	Clear	0
	Patchy	1
	Localized	2

Score ≥6 = VAP.

[a] Data from Fartoukh et al.

2. 5. Statistical analysis

Data obtained from the participants was analyzed using descriptive statistics. Variables in both groups are stated in terms of the mean value and standard deviation (SD). The researchers used an unpaired t-test to compare between groups and 2-tailed test to establish the significance of results. A student t test (for APACHE II scores) and the normal distribution were evaluated. The Mann-Whitney test was used for variables with non-normal distribution. A (2 x 2) contingency table was used for mortality data analysis. The VAP rate was measured as 'incidents of VAP per 1000 ventilator days (VD)'. Data were examined using SPSS Version 17.0 (SPSS Inc, Chicago, Illinois). The significance level was set at $p \leq 0.05$ for all statistical tests.

3. Results

3.1. Baseline characteristics of both groups

Of 177 eligible participants, 14 patients (7.9%) before intervention and 16 (9%) during intervention were excluded, because they had one or more of the preset ex-

clusion criteria. A total of 147 patients were included in the study, 72 in the control group and 75 in the intervention group.

Most of the nurses applied a mouth wash using normal saline 0.9% via a syringe and removing it by suction tube. The staff used a tongue depressor wrapped in gauze with Chlorhexidine, or any other available mouthwash, to clean invisible areas once or twice daily. When available, mycoheal mouth gel was applied to maintain healthy lips. No statistically significant differences were found between the two groups in relation to age, sex, BOAS, reason for admission, APACHE II scores, CPIS, and antibiotics used before intubation (Table 3). Regarding the reason for admission in both groups, the most common cause was acute respiratory failure followed by cardiovascular diseases. The mean age for both groups was 58 years. The number of male participants was greater than female in both groups (Table 3).

Table 3. Baseline demographic and clinical characteristics of both groups

Characteristic	**Control group (n=72) (Before intervention)**	**Intervention group (n=75) (During intervention)**	**P**
Age, mean (SD), y	59 (10)	58(8)	0.91
Sex			
Male	42	44	0.84
Female	30	31	0.83
BOAS score, mean (SD)	10.8 (3.44)	10.1 (3.52)	0.89
Reason for ICU admission, No. (%)			
Acute respiratory failure	37 (51)	31 (41)	0.62
Cardiovascular disease	10 (14)	14 (19)	0.45
Gastrointestinal disease	8 (11)	9 (12)	0.82
Renal disease	7 (10)	6 (8)	0.86
Sepsis	5 (7)	4 (5)	0.87
Trauma	3 (4)	6 (8)	0.75
Neurological disease	1 (1.5)	2 (3)	0.80
Other	1 (1.5)	3 (4)	0.75
APACHE II score, mean (SD)	22 (7)	20 (6)	0.78
CPIS, mean (SD)	2.7 (1.36)	2.9 (1.66)	0.87
Antibiotic use before intubation			
Yes	13 (18)	14 (18.7)	0.85
No	59 (82)	61 (81.3)	0.76

Note. BOAS = Beck Oral Assessment Scale; APACHE = Acute Physiology and Chronic Health Evaluation; CPIS = Clinical Pulmonary Infection Score.

3.2. Confirmatory period

Staff compliance with the new protocol reached more than 90% of all components of the protocol during the confirmatory period. This was confirmed by the results of the posttest (written and practical) exams.

3.3. Outcome measures

The incidence of VAP was significantly higher among the control group compared to the intervention group (12.5% (9/72) and 4% (3/75) respectively, P <0.01) (Table 4). During the intervention period, VAP rates decreased by 50%, with a statistically significant difference between control and study groups (16 vs. 8 cases per 1000 ventilator days (VD), P< .001). The mean time for starting VAP was 2.3 days before the intervention and 4.9 days during the intervention (P< .001). A significant decrease was found in mortality rate from a level of 20% (15/72) in the control group to 13.9% (10/75) in the intervention group (P<0.01).

Table 4. Outcome measures

Measure	**Control group (n=72) (Before intervention)**	**Intervention group (n=75) (During intervention)**	**p**
Ventilator days (VD)	525	375	< 0.01
VAP, No. (%) of patients	9 (12.5)	3 (4)	< 0.01
VAP rate (per 1000 VD)	16	8	< 0.05
ICU patient days (VD, all patients)	712	525	< 0.05
Duration of ventilation, mean, days	7.3	5	< 0.05
Time to VAP, mean, days	2.3	4.9	< 0.01
Mortality (ventilator patients), No. (%)	15 (20)	10 (13.9)	< 0.01

Note. ICU = intensive care unit; VAP = ventilator-associated pneumonia; VD = ventilator days

4. Discussion

Our findings in this study showed that VAP rate decreased by 50% due to implementing AACN ETT& OC protocol. These results are compatible with Zurmehly (2013) who revealed that after giving education to the critical care nurses who provided care for intervention group, the VAP rate was reduced by 62.5%. On the other hand, Garcia et al. (2009) conducted a 48-month study in two consecutive periods to identify the impact of applying comprehensive oral and dental care on VAP. They discovered that the VAP rate of 12.0 per 1000 ventilator days before the intervention decreased to 8.0 per 1000 ventilator days during the intervention (P = .06). The VAP rate in the control group (before intervention) of the current study (12.5 %) is higher than in Garcia et al. (2009) study (8.5%) because nurses in developed countries are following a specific oral care protocol. In Jordanian hospitals no specific oral care protocols are usually followed, but after intervention both studies reported a significant decrease in the VAP rate.

Our findings are consistent with Ross and Crumpler (2007), who found that VAP rates decreased by 50%, following an evidence-based practice educational program to mechanically ventilated patients. Although our study period was 16 months in total, the findings were consistent with several studies which were conducted over a longer period (Baxter et al. 2005; Hutchins et al. 2009; Jingyu et al. 2011; Sedwick et al., 2012). Hutchins et al., (2009) for example, conducted a study over three years (from 2004 to 2007), which found that 89.7% reduction in the VAP rate among MV patients as a result of using ventilator bundle and oral care protocol. Adherence to oral care procedures was improved when accompanied by recurrent assessment of nursing care (Sona et al. 2009), who reported a 100% adherence rate when nurses were being observed and assessed. Patients' education and assessment of oral cavities were reported to reduce VAP rates (Perrie et al., 2011).

The results of the current study are limited by the nonrandomized design, because the intervention and control groups were not concurrent. The generalizability of this study is also limited since the variability and change over time in patient, care provider and study related factors, as well as the experimental environment. Although an attempt to minimize threats to external validity was made, the bias still could occur because of the knowledge of the nurses of being the subjects of intense monitoring of their oral care during data collection (i.e., the Hawthorne effect), thereby limiting the generalizability of the research findings. Also data were collected only in two critical care units in one hospital in northern Jordan. In addition, the findings are limited by the type of sample (convenience sample) and the short follow-up duration.

There are two notable strengths to this study. First, it highlights the importance of AACN ETT& OC and nurses' activities in Jordan, as it was the first study to be conducted among nurses working in acute care settings and how much knowledge deficiency may significantly affect the practice of nurses. Second, the current study raised the question of cost effectiveness and benefits of running continuing professional developmental programs for nurses in acute care settings. Overall, the current study findings suggest that there remain areas in acute care settings that need to be attended to in order to increase nurses' knowledge and skills pertinent to preventive measures. Intervention to increase knowledge and awareness among health care providers is a necessary step. There is a need for a large sample size randomized controlled trial over a longer period of time, and for a retrospective study in the future to see how the effects implementing AACN ETT& OC protocol have lasted and the total decrease in VAP.

4.1. Implications for nursing and health policy

• Continuous professional development (CPD) of health care professionals (HCPs) in acute care settings is urgently needed through providing them with different courses, programs and other educational activities that enrich their knowledge and skills in their field of practice.

• The CPD programs are likely to be cost effective, less time consuming and can

be implemented in acute care settings.
• The implementation of an AACN ETT& OC can significantly reduce VAP rates, and encourages health policy makers to adapt evidence-based oral and ETT care.
• CPD programs for nurses in acute care settings can be one of the ways to bridge the existing knowledge and skills deficiencies gap.
• When nurses have extra resources for learning oral hygiene they will be more knowledgeable, skillful, and efficient to take care of MV patients. Providing CPD and training for nurses is needed, to encourage them to provide oral care and consequently to improve the quality of health services provided in ICUs.
• Knowledge of the types and the frequency of oral care for MV patients will improve and develop nursing practice. This is expected to positively influence the patients' health outcomes.

5. Conclusion

AACN ETT& OC has positive consequences for MV patients in terms of reducing VAP rate, time of starting VAP, and consequently enhancing mortality rate reduction. The existence of different oral care protocols indicates that there is a need for a standardized oral care protocol.

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