

Original Article

Education alone is not enough in ventilator associated pneumonia care bundle compliance

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ABSTRACT

Objective: Ventilator-associated pneumonia (VAP) described as a secondary and preventable consequence in mechanically ventilated patients, emerges 48 h or more after patients intubation. Considering the high morbidity and mortality rate of VAP and the fact that VAP is preventable, it seemed necessary to evaluate care bundle compliance rate and effect of education on its improvement.

Methods: This observational study was conducted on 10 Intensive Care Units (ICUs) of four university affiliated hospitals in three steps. In the first step, VAP care bundle compliance including head of bed (HOB) elevation, endotracheal cuff pressure (ETCP), mouthwash time, utilizing close suction systems, subglottic secretion drainage, type of suction package, and hand wash before suctioning was evaluated. In the second and third steps, ICU staffs were trained and its effect on VAP care bundle compliance was investigated. Finally, an inquiry from nurses was conducted to evaluate the obtained results.

Findings: A total of 552 checklists consisting of 294 observations in the pre-education group and 258 observations in the posteducation group were filled. Mean VAP care bundle compliance in pre-education and posteducation stages was 36.5% and 41.2%, respectively ($P > 0.05$). Except for patients' mouth washing, there were no improvement in HOB elevation ($>30^\circ$), hand washing and ETCP after education. Based on the results of questionnaire received from nurses at the end of study, more than 90% of nurses believed that lack of rigid monitoring of VAP care bundle is a main reason of low adherence for VAP care bundle compliance.

Conclusion: The adherence to VAP care bundle was inappropriate. Education seems to be ineffective on improving VAP care bundle compliance. Frequent recall of the necessity of the VAP care bundle and the continuous supervision of ICU staffs is highly recommended.

Keywords: Compliance; education; Ventilator-associated pneumonia (VAP); VAP care bundle

INTRODUCTION

Ventilator-associated pneumonia (VAP), described

as a secondary and preventable consequence in mechanically ventilated patients, emerges 48 h or more after a patient's intubation. It is also described as early onset VAP if it appears <5 days and late onset VAP if it appears more than 5 days after intubation.^[1]

Considering the high morbidity and mortality rates of VAP and the fact that VAP is preventable, it seemed necessary to suggest a VAP care bundle and evaluate its compliance rate.^[1] The VAP care bundle procedures include:^[2] maintaining endotracheal cuff pressure (ETCP) within the range of 20-30 cm of

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water, washing hands before and after contact with patient, elevating the head of bed (HOB) to within the range of 30-45°, use of closed suction system, employing subglottic secretion drainage (SSD), use of a specially designed endotracheal tube with a separate dorsal lumen in order to suction subglottic secretion, and mouth washing with chlorhexidine as part of daily care.^[3] These elements have been demonstrated to reduce ventilator days or the risk of VAP in well-conducted randomized controlled trials and compliance to ventilator bundle has been introduced as an effective intervention for VAP prevention.^[3] This study aims to determine the compliance rate of the VAP care bundle and evaluate the effect of nurses' education on it.

METHODS

This observational study was conducted on 10 Intensive Care Units (ICUs). Three surgical ICUs, three general ICUs, two pulmonary ICUs, one neurosurgical ICU and one neurology ICU were selected from four university affiliated hospitals. This study approved by research ethical review board of Tabriz University of Medical Sciences, Tabriz, Iran.

The study was performed on adult intubated patients admitted to the ICU for 48 h or more. To decrease possible errors arising from confounders, evaluations for all ICUs were repeated 3 times. Times for observation and data collection were selected randomly. Observational hours were between 8:00 AM and 8:00 PM.

This study was conducted in three steps. In the first step, demographic data about the patients and ICU nurses were gathered and VAP bundle care compliance was measured. Nurses' ICU work experience, educational history about infection control especially VAP control and the nurse/patient ratio were recorded. Medical care assessed included HOB elevation, ETCP, mouthwash time and type, utilization of close suction systems and SSD, type of suction package, and hand washing before suctioning. ETCP was measured by manometer (Fujinon LT-7, Japan). Two ICUs equipped with beds contained angle indicators, which facilitated HOB elevation measurements. In the remaining ICUs, HOB elevation was measured using a 30° handmade rule which allowed the researcher to document HOB elevations of more or <30°. Contraindications based on patient diagnosis and special situations, such as patients having undergone a major operation in the head or neck, or patients suffering from a hemodynamic disorder, were considered in data collection. The other

elements of VAP bundle were checked and recorded by observation. The first step was carried out in 45 days. In the second step, researchers prepared educational pamphlets containing the results of VAP bundle care compliance in each ICU and VAP bundle control guidelines and delivered them to each nurse whose practice was evaluated. Researchers attended all work shifts of the observed ICUs and explained the study results and appropriate practices of VAP bundle guidelines. After this education, all nurses and ICU staff were requested to explain the VAP prevention bundle to ascertain the effectiveness of the education. In the third step, conducted 1 month after the second step was concluded, VAP bundle care compliance in the ICUs was once again evaluated as described in the first step. Patient confidentiality was strictly maintained. At the end of this study, the results presented to the nurses of evaluated ICUs and requested to explain the reasons of low adherence for HOB elevation, hand washing and ETCP in an open format questionnaire.

Collected data were analyzed using SPSS 16 software (SPSS Inc., Chicago, USA). The Student's *t*-test and the Chi-square test using a 95% confidence interval (CI) were used to compare pre-and posteducation numeral and ordinal data, respectively. $P < 0.05$ were considered as significant.

RESULTS

A total of 552 checklists consisting of 294 observations in the pre-education group and 258 observations in the posteducation group were completed. A total of 143 nurses work in 10 evaluated ICUs, of them 127 (89%) ones were female. The mean \pm standard deviation of nurses' age were 33 ± 5 with 10 ± 4 years of work experience in ICUs. In pre- and post-education steps the adherence of 112 and 101 nurses to VAP care bundle were evaluated respectively. The sex, age, and work experience of nurses were not different significantly ($P > 0.05$) in pre- and post-education steps [Table 1]. All suction sets in both the pre- and post-education groups were single use type. Close suction systems were not utilized in any of the ICUs. SSD using a special tracheal tube was performed in only one ICU. The data for VAP bundle compliance in pre- and post-education groups are summarized in Table 1.

About 26.5% of patients in the pre-education group and 45% of patients in the posteducation group had an ETCP <20 cm water. Only mouth washing improved significantly in posteducation step.

From 143 nurses who requested to explain the reasons of low adherence for HOB elevation, hand washing and ETCP, 121 ones state their opinions. Some of

Table 1: Comparison of pre- and post-education data regarding VAP bundle compliance among ICU nurses

Characteristic	Pre-education (n=294)	Post-education (n=258)	P value
Nurses	112 (78)	101 (71)	0.4
Sex (female)	102 (91)	95 (94)	0.8
Age (years)	32±4	30±6	0.34
Work experience (years)	8±2	9±5	0.09
HOB elevation (>30°)	138 (46.9)	136 (52.7)	0.2
Mouth washing (T.I.D)	224 (76.17)	258 (100)	0.001
Hand washing	24 (8)	31 (12)	0.5
ETCP (cm H ₂ O)			0.006
<20	78 (26.5)	116 (45)	
20-30	98 (33.3)	64 (24.8)	
>30	118 (40.1)	78 (30.2)	

Data presented as number (%) or mean±SD, where applicable. ICU=Intensive care unit, SD=Standard deviation, HOB=Head of bed, ETCP=Endotracheal cuff pressure, T.I.D=Ter in die (3 times a day), VAP=Ventilator-associated pneumonia

them wrote more than one reason. We categorized and summarized 205 explanations in three items as below:

- I am very busy so I focus on main parts of my work, like writing reports and administration of medicines (*n* = 78)
- I do not think maintaining ETCP within the range of 20-30 cm of water and elevating HOB to within the range of 30-45° and hand washing are critical, so I am not strict in adherence to them (*n* = 17)
- The system is not restricting about observing VAP bundle, so I am not strict in adherence to the rules (*n* = 110).

DISCUSSION

In our study, adherence to VAP care bundle was unexpectedly low before and after education steps. Evans showed that a head-of-bed elevation of 45° or greater may be less common in ICUs.^[4] Low levels of backrest elevation may lead to an increase in VAP incidence due to the aspiration of nasogastric secretion.^[5] Table 1 indicates that about one-half of patients had a backrest elevation lower than 30° in both pre- and post-education groups. The low rate of HOB elevation >30° in this study implies that healthcare providers, including specialists, residents and nurses, overestimate HOB elevation. On the other hand, in one ICU which had beds equipped with a protractor, the result for HOB elevation was not different with others. Several manufacturers had placed an indicator at the side of their beds to improve the rate of HOB elevation; however, this attempt was unsuccessful and compliance remains at a low level.^[6]

The preferential use of either a closed or an open tracheal suction system for VAP prevention is considered a controversial subject.^[2] The Canadian Critical Care Trial Groups and the Canadian Critical Care Society concluded that the type of tracheal system (closed or open) has no effect on VAP incidence; however, they encouraged the use of closed suction based on cost.^[7] In 2001, the European Task Force stated that there is limited evidence that tracheal suction system usage decreases VAP incidence, yet increase in cost was clear; therefore, no recommendation for the closed tracheal suction system was made.^[8] In 2003, the American Association for Respiratory Care recommended the close tracheal system be considered as a part of VAP prevention strategy.^[9] None of the ICUs in the current study used the close suction system, because of its higher cost and the controversial evidence regarding its utilization.

The accumulation of respiratory secretions in the subglottic space has been recognized to be a reason for VAP development. Thus, techniques to avoid leakage between the tube and the tracheal wall were introduced.^[10] The efficacy of SSD in preventing VAP and reducing of antibiotic consumption was shown.^[11,12] Like the close suction system, SSD is also not widely applied. The high cost of SSD has made its utilization controversial. European specialists^[8] believed that utilizing SSD is not cost effective, but the Centers for Disease Control and prevention reported that outcomes are better with SSD usage. They had a proper cost-to-benefit ratio, and thus recommended its use. SSDs are recommended to be used in patients who are going to be under mechanical ventilation for more than 48 h. Therefore, it is not necessary for patients hospitalized in surgical ICUs.

The use of the oral antiseptic chlorhexidine gluconate has been shown to be definitely effective in VAP prevention. Furthermore, safety, feasibility and cost considerations about this strategy are all very favorable. In seven trials with 2144 patients, the application of oral antiseptic decreased VAP incidence (relative risk: 0.56, 95% CI: 0.39-0.81), but was not associated with a reduction in mortality, duration of mechanical ventilation, or duration of ICU stay.^[13] Another randomized controlled trial showed that oral decontamination with 2% chlorhexidine solution is an effective and well-tolerated method in patients receiving mechanical ventilation.^[14] This item was the only one in the VAP prevention bundle which seemed to be improved with education. The researchers randomly attended in ICUs and referred to the nurses' daily reports for data about mouthwash times. Then it seems that the result for moth washing may not be confident. They believe that this item

required closer and more frequent observation in different work shifts.

Hand washing is one of the important parts of the VAP prevention bundle that is not uniformly and consistently implemented. A study performed by Grap and Murno in 1997 showed that 90% of nurses surveyed reported compliance with hand washing, but when the nurses were observed, only 22% were actually compliant.^[15] Unfortunately, hand washing was not performed before suctioning or contact with a patient in the studied ICUs regularly and the difference between expectations and implementation was very clear.

The proper range for ETCP values has not been established, but it is generally suggested that cuff pressure be maintained within the range of 20-30 cm of water.^[2] One study indicated that VAP increased 2.5 fold when the ETCP was maintained below 20 cm H₂O.^[16] In the current study, most ETCP values were out of the normal range, >30 cm H₂O in the pre-education group and <20 cm H₂O in the posteducation group. Tracheal stenosis is a rare but dangerous side-effect of overinflated endotracheal cuffs and should be considered in intubated critical patient care.

The results of this study imply that education is not sufficiently effective in improving VAP prevention bundle compliance among nurses and ICU staff. Only 14% of nurses participated in a poll declared that low adherence to VAP care bundle is because of trivialization of VAP care bundle effect on reduction of VAP. It implies that education step of this study was performed properly and may not be exceptional. It can be concluded that education for nurses and increasing of their awareness is a momentous effort, but it is not really enough. After being educated, most nurses could explain the VAP care bundle and its necessity very well, but in practice a vast difference was not obtained.

More than 90% of nurses asked their opinion about the reasons of low adherence for VAP care bundle stated that lack of rigid monitoring of VAP care bundle is a main reason for the results of this study. When activity in an ICU becomes ordinary or routine, it may lose its sensitivity or importance. This matter seems the most prominent reason for the failure of education.

Evaluated ICUs lost scores in calculating of VAP care bundle compliance because of failure in using close suction and SSD systems which are not under control of nurses or ICU staffs. It seems that insurance and pharmacoeconomic matters play major roles in the decision to use them. Cost-benefit of close suction and SSD systems in VAP reduction needs to be studied.

Finally, researchers believe that frequent recall of the necessity of a VAP care bundle and the continuous supervision of nurses and ICU staff in addition to nurses' education may be more effective. We recommend that the infection control stewardship committee in each hospital take charge for the strict supervision of VAP care bundle compliance.

AUTHORS' CONTRIBUTION

All authors contributed the idea of research, design of study, data analysis and manuscript preparation.

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