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Major Article

# Prevention of ventilator-associated pneumonia: Use of the care bundle approach

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***Background:*** The ventilator-associated pneumonia (VAP) care bundle consists of evidence-based practices to improve the outcomes of patients receiving mechanical ventilatory therapy. This study aimed to investigate the implementation of the care bundle on VAP rates in this quasiexperimental study.
***Methods:*** The protocol of this study consisted of 3 phases. In the initial phase, observations were made to determine the VAP care bundle adherence of intensive care unit (ICU) nurses. In the second phase, education was provided to ICU nurses on the subject of the VAP care bundle. For the third phase, the effect of VAP care bundle adherence on the VAP rates after education was investigated.
***Results:*** The nurses' VAP care bundle adherence improved after education from 10.8% (n = 152) to 89.8% (n = 1,324) and showed statistically significant improvement ($P = .0001$ and $P < .05$). In this study, the VAP rates were determined as 15.91/$10^3$ ventilator-days before education and 8.50/$10^3$ ventilator days after education. It was found that the VAP rates after the education period were significantly lower than the VAP rates before education.
***Conclusion:*** VAP care bundle implementation with education prepared according to evidence-based guidelines decreased VAP rates. Thus, implementation of the VAP care bundle on mechanically ventilated patients care is recommended.


Ventilator-associated pneumonia (VAP) is defined as pneumonia occurring later than 48 hours following endotracheal intubation. VAP is among the most common nosocomial infections for critical care patients that contributes to mortality and morbidity.[1-3] VAP rates vary depending on the type of intensive care unit (ICU), hospital, and country.[2] The Centers for Disease Control and Prevention reported that the VAP incidence ranged from 0.0-4.4/$10^3$ for various types of hospital units in 2012.[4] The Turkish Ministry of Health reported that the VAP rates varied from 0.7/$10^3$-14.2/$10^3$ ventilator-days in 2014.[5]

Although there are many evidence-based clinical practice guidelines for preventing VAP, only approximately 50% of patients received evidence-based recommended care.[6-8] For this reason, the care bundle approach was introduced by the Institute for Healthcare Improvement (IHI). A care bundle is defined as the implementation of a set of evidence-based practices such that when each element is executed individually, it improves the patient recovery process and outcomes; when all of the practices are executed together, they provide better outcomes than when implemented individually.[8-11]

Ventilator and central line bundles were the first 2 bundles developed by IHI.[11] The ventilator care bundle consists of 5 interventions: head of bed elevation, daily sedative interruption and daily assessment of readiness to extubate, peptic ulcer prophylaxis, deep vein thrombosis prophylaxis, and daily oral care with chlorhexidine. However, many researchers have added evidence-based interventions to the IHI VAP bundle and created their own customized VAP bundle for decreasing VAP rates. Recent studies have shown that the implementation of a customized VAP bundle results in better patient and clinic outcomes.[12-19] Of the many factors associated with VAP, hand hygiene and endotracheal tube cuff pressure monitoring are the most inexpensive and effective interventions for preventing VAP. Despite these factors, the effect of hand hygiene and endotracheal tube cuff pressure monitoring in addition to the IHI VAP bundle is lacking. Thus, this research study was designed to investigate the effect of using the care bundle with the inclusion of hand hygiene and endotracheal tube cuff pressure monitoring on VAP.

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## MATERIALS AND METHODS

This quasiexperimental study was performed to investigate the effect of using the care bundle on VAP rates. We hypothesized that the implementation of the VAP bundle would decrease the VAP rates of our ICU.

### *Sample*

All patients older than age 18 years receiving invasive mechanical ventilatory therapy at the Ege University Hospital Anesthesiology ICU between April 7 and October 31, 2014, who were allowed by their relatives to participate were included in the study. During the data collection, a total of 222 patients were admitted to the ICU. One hundred twenty-eight of these patients met the research inclusion criteria. Patients who had a contraindication to head of bed elevation, were diagnosed with VAP before the study, were long-term or chronically ventilated, were receiving noninvasive mechanical ventilatory therapy, were younger than age 18 years, and those who refused to participate were excluded from the study.

### *Setting*

The Ege University Hospital Anesthesiology ICU has a 27-bed capacity and cares for approximately 450 patients annually. During the study period, there were 54 nurses working in the ICU. The VAP rate of our ICU was 16.21/$10^3$ ventilator-days in 2012 and 13.56/$10^3$ ventilator-days in 2013, according to the surveillance data of the infection control committee of Ege University Hospital.

### *The VAP bundle*

The VAP bundle used in this study was retrofitted from the IHI bundle. Our bundle consisted of head of bed elevation (30°-45°), daily sedative interruption and daily assessment of readiness to extubate, peptic ulcer prophylaxis, deep vein thrombosis prophylaxis, daily oral care with chlorhexidine, hand hygiene, and endotracheal tube cuff pressure monitoring. Although the VAP bundle was not implemented in our ICU at the beginning of the study, daily sedative interruption and daily assessment of readiness to extubate, peptic ulcer prophylaxis, and deep vein thrombosis prophylaxis were already in use. The other elements of our VAP bundle had some breakdowns.

### *Intervention*

This study consisted of 3 phases: the preimplementation period (April 7-June 30, 2014), implementation period (July 1-August 31 2014), and postimplementation period (September 1-October 31, 2014).

During the preimplementation period, VAP bundle compliance was evaluated to determine the current status. We did not implement any changes during this period. The VAP bundle elements were observed daily by the researchers to determine compliance rates. During this period, the researchers observed a total of 1,409 ventilator-days.

During the implementation period, the researchers implemented the VAP bundle by educating the nursing staff. The education program included an introduction to the VAP and care bundle, importance of the VAP and care bundle, and elements of the VAP bundle. The compliance rates of the preimplementation period were fed back to the nursing staff. Attendance at these education sessions was mandatory for the nursing staff. Written material was delivered to encourage self-study. In total, 54 ICU nurses were educated across 11 education sessions. During the implementation period, researchers also evaluated compliance with the VAP bundle. The researcher interfered in the noncompliance bundle elements and provided prompt feedback to nurses about their performance. Thus, compliance was improved. In addition, posters were provided in the ICU to facilitate remembering the VAP bundle elements and to increase compliance with the VAP bundle.

During the postimplementation period, the researchers monitored compliance to the VAP bundle. To avoid any potential effect on compliance with the VAP bundle the researchers only observed and recorded the VAP bundle elements and did not interfere with the process during this period.

For all periods of study, compliance with the VAP bundle was evaluated via observations during daily rounds at variable times. One of the researchers who was not hospital staff was elected as observer. The same observer collected the data across the duration of study. The observations were done equally on early and late shifts. The observer stood near the ICU desk, where high-level field of vision to the area of patient care was provided. Every day approximately 2 hours were spent observing nurses. The observer directly watched ICU nurses as they performed their routine care activities every day. Therefore, the observer was allowed to see whether nurses were compliant with the VAP bundle. The researchers performed daily written assessments to determine whether the VAP bundle was being followed. Compliance was recorded for each bundle element daily. If the bundle element was performed, it was recorded as "yes," whereas if the bundle element was not performed, it was recorded as "no." Next, the entire bundle was evaluated as compliant for the day if all 7 elements were performed.

### *VAP definitions*

At Ege University Hospital VAP is defined based on Centers for Disease Control and Prevention definitions during daily surveillance rounds by trained infection control committee members. The infection preventionists (IPs) verified all suspected VAP cases with radiographs and microbiologic analyses confirming VAP diagnosis. The VAP cases were obtained from infection control committee members for the duration of study for minimizing diagnosis bias. The same IPs diagnosed the VAP cases for the duration of the study. None of the researchers was an infection control committee member. In addition, the infection control committee members were not informed about the study. The IPs were blinded to the study to avoid bias. The VAP rates were expressed as cases of VAP per $10^3$ ventilator-days. The VAP rate during the preimplementation period was compared with the VAP rate during the postimplementation period.

### *Ethical issues*

This study was approved by the Clinical Research Ethics Committee of Ege University Medical Faculty. Written permission to perform the study was obtained from the institution in which the research would be conducted. In addition, the relatives of patients were informed about the details and purpose of the study, and verbal consent from all of the volunteer relatives of patients was obtained.

### *Statistical analyses*

The study data were analyzed by the Ege University Department of Biostatistics and Medical Informatics using the Statistical Package for the Social Sciences for Windows version 21.0 (IBM-SPSS Inc, Armonk, NY). Descriptive data on patients were expressed as numbers, percentages, and mean and median values. For numerical variables, the fit to the normal distribution of the data was assessed using the Shapiro-Wilk test. For the nominal and ordinal variables, Fisher exact test was performed. For variables that did not