

## Original Article

# Evidence-Based Practices for Preventing Ventilator-Associated Pneumonia in Intensive Care Nursing: Knowledge and Practice

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## Abstract

**Background:** Ventilator-associated pneumonia (VAP) is one of the most serious hospital-acquired pneumonia in intensive care units (ICUs).

**Objective:** This study aimed to determine the ICU nurses' knowledge and implementation of evidence-based practices for the prevention of VAP.

**Method:** The data of this descriptive study was collected between February 28 and June 30, 2017, in the departments of internal medicine ICU, anesthesia ICU, pulmonary ICU of one university and two training and research hospitals in Izmir, Turkey. The study included 102 nurses with at least six months or more work experience in the ICU and full responsibility in patient care. Three data sheets were used to collect data: Identification Form for ICU Nurses, Questionnaire for Evidence-Based Practices in Preventing VAP, and Questionnaire for Nursing Practices. Data were collected by face-to-face interview method.

**Results:** The most commonly known practices recommended for the prevention of VAP were the selection of orotracheal method for intubation (87.3%) and the use of heat-moisture exchangers for humidity control (84.3%); the least known recommended practices were the use of kinetic beds (51.0%) and the use of endotracheal tubes with extra lumen for the aspiration of subglottic secretions (52.9%). The most commonly implemented recommendations were hand hygiene (98.0%), using heat-moisture exchangers (100.0%), and maintaining the head height of the patients at 30-45 degrees (98.0%) when there is no contraindication; the least commonly implemented recommendation was getting vaccinated for seasonal influenza (57.8%).

**Conclusion:** The study found that the ICU nurses had insufficient knowledge about the use of kinetic beds, the use of endotracheal tubes with extra lumen for aspiration of subglottic secretions, and getting seasonal influenza vaccination for the prevention of VAP.

**Keywords:** intensive care; ventilator-associated pneumonia; evidence-based practices

## Introduction

Hospital-acquired pneumonia (HAP) stems from the factors related to the hospital environment and is one of the significant health problems worldwide although preventable. Annually, 1.7 million hospitalized patients develop infections related to the healthcare, and more than 98,000 of these patients die according to data from the United States Center for Disease Prevention and Control (CDC) (Haque et al., 2018). Intensive care units (ICUs) are high-risk areas for serious infections. Ventilator-associated pneumonia (VAP) is one of the most serious HAP infections in

ICUs. VAP has been defined as pneumonia that develops 48 hours after the intubation in a patient who underwent invasive mechanical ventilation. VAP results in prolonged mechanical ventilation and hospital stay and increased healthcare cost and has a mortality of 8.1-31.9% (Keyt et al., 2014; Solak Grassie et al., 2016). Approximately 90% of pneumonia developed in ICUs is observed in patients under mechanical ventilation. The risk of developing VAP is 6 to 21 times higher in patients intubated for more than 24 hours compared to others, and the risk increases with the duration of mechanical ventilation

increases (Kapucu & Ozden, 2014). Risk factors related to the development of VAP can be classified as preventable (supine position, enteral nutrition, inadequate subglottic aspiration) or non-preventable risk factors (age, gender, underlying diseases) (Kapucu & Ozden, 2014). Preventing the development of VAP by controlling preventable risk factors is much more cost-effective than treatment of the disease. Studies have reported that the incidence of VAP is reduced through the precautions suggested by the related guidelines (Kapucu & Ozden, 2014; Pe´rez-Granda et al., 2013). Nosocomial infections that lead to the development of VAP have been reported to be associated with inappropriate practices in hand hygiene, oral care, and aspiration. It has been indicated that the main reason for the development of VAP is healthcare professionals' lack of knowledge about and insufficient compliance with the recommendations in related guidelines. ICU nurses play a key role in the implementation of evidence-based practices recommended by the guidelines for the prevention of VAP (Augustyn, 2007; Meherali et al., 2011; Salahuddin et al., 2004). This study aimed to determine the ICU nurses' knowledge and implementation of evidence-based practices recommended by the guidelines for the prevention of VAP.

**Materials and Methods:** The universe of this descriptive cross-sectional study consisted of nurses working in the internal medicine ICU, anesthesia ICU, and pulmonary ICU of one university and two training and research hospitals in Izmir between February 28 and June 30, 2017. The sample of the study consisted of 102 nurses who had full responsibility in patient care and had work experience of at least six months in ICU.

**Data collection tools:** Three data sheets were used to collect data: Identification Form for ICU Nurses (IFN), Questionnaire for Evidence-Based Practices in Preventing VAP (QVAP), and Questionnaire for Nursing Practices (QNP). These questionnaires were prepared by the researchers based on the data reported in previous studies on nurses' knowledge and implementation of evidence-based practices for the prevention of VAP (Augustyn, 2007; Kapucu & Ozden, 2014; Kapucu & Ozden, 2017; Pe´rez-Granda et al., 2013; Labeau et al., 2007). Two faculty members and two ICU nurses were consulted to evaluate the clarity of the forms; the forms were revised and finalized per their recommendations. Data were collected by face-to-face interview method and each interview lasted 15-20 minutes. The IFN consisted of 10 items and recorded the descriptive data for the nurses such as age, gender, graduation, work experience, weekly work hours. The QVAP consisted of 10 items and recorded nurses' knowledge of the guidelines for the prevention of VAP. The QNP consisted of 13 items and recorded nurses' practices to prevent the development of VAP.

**Ethical considerations:** The study commenced following the approvals from the local ethics committee and written permissions from hospital administrations, the General Secretariat of the Public Hospitals, and the university administrations. Informed consent was obtained from the nurses participating in the study.

**Data analysis:** The data were analyzed in SPSS 21.0 (SPSS Inc., Chicago, USA). The data were presented as a number, percentage, mean, standard deviation, median, maximum, and minimum values.

## Results

Of the participants, 83.3% were female, and 66.7% had a bachelor's degree. The mean age was  $32.5 \pm 5.8$  years, mean work experience was  $9.1 \pm 5.8$  years, and average work experience in the ICU was  $4.7 \pm 3.5$  years. Of the nurses, 56.9% did not participate in an ICU training program. Nurses' responses to questions about the recommendations for the prevention of VAP were presented in Table 1. Practices implemented by the ICU nurses were presented in Table 2. Among evidence-based practices recommended for the prevention of VAP, 87.3% of the nurses knew that the orotracheal method should be used for intubation, 66.7% knew about the period of changing mechanical ventilator circuits, 84.3% knew that heat-moisture exchangers should be used for humidity control, 65.7% knew about the period of changing the humidifiers, 65.7% knew that closed aspiration systems should be used, 71.6% knew about the period of changing the aspiration systems, 52.9% knew that endotracheal tubes with extra lumen should be used for aspiration of subglottic secretions, 51.0% knew that kinetic beds were recommended, 67.6% knew that semi-recumbent patient position was recommended, and 73.5% knew that oral antiseptics with chlorhexidine were recommended for oral care (Table 1).

The study found that 98.0% of nurses maintained hand hygiene, 96.1% aspirated subglottic secretions regularly, 71.6% did not change mechanical ventilator circuits routinely, 97.1% discharged the fluid accumulated in the breathing circuits regularly, 81.4% used sterile water in humidifier containers and did not add water when the water in the humidifier containers decreased, 100.0% used heat-moisture exchangers instead of heated humidifiers, 94.1% used sterile catheters at all times for patients undergoing open aspiration, 95.1% maintained the endotracheal tube cuff pressure above 20 cmH<sub>2</sub>O, 98.0% ensured that the patients had a head height of 30–45 degrees unless there was a contraindication, 81.4% preferred enteral nutrition, 88.2% used chlorhexidine solution for patient's oral care, 93.1% cleaned the tracheostomy stoma with saline solution and dried with a sterile gauze, and 57.8% did not have seasonal influenza vaccination (Table 2).

**Table 1. Nurses' responses to questions about the recommendations for the prevention of VAP.**

<b>Question about the prevention of VAP (select one)</b>	<b>Answer (%)</b>
1. Selection of endotracheal intubation method	
Orotracheal intubation method is recommended	87.3*
Nasotracheal intubation is recommended	12.1
Both methods are recommended	0.6
I do not know	0
2. Mechanical ventilator circuit change	
Change is recommended every 48 hours	21.1
Change is recommended every 72 hours	7.3
Change is recommended for each new patient (not routinely)	66.7*
I do not know	4.9
3. Humidifier use	
Heated humidifiers are recommended	10.1
Heat-moisture exchangers are recommended	84.3*
Both are recommended.	5.6
I do not know	0
4. Humidifier change	
Change is recommended every 48 hours	65.7
Change is recommended every 72 hours	12.8
Change is recommended every week	20.8*
I do not know	0.7
5. Selection of the aspiration system	
Open aspiration system is recommended	3.1
Closed aspiration system is recommended	65.7*
Both methods are recommended	25.3
I do not know	5.9
6. Aspiration system change	
Daily change is recommended	71.6
Weekly change is recommended	17.1
Change is recommended for each new patient	11.3*
I do not know	0
7. Use of endotracheal tubes with extra lumen for the aspiration of subglottic secretions	
Use of these endotracheal tubes reduces the development of VAP	52.9*
Use of these endotracheal tubes increases the development of VAP	5.7
Use of these endotracheal tubes does not affect the development of VAP	27.8
I do not know	13.6
8. Selection of patient bed	
Kinetic beds increase the development of VAP	12.3
Kinetic beds reduce the development of VAP	51.0*
Kinetic beds do not affect the development of VAP	21.9
I do not know	14.8
9. Patient position	
The supine position is recommended	2.4
Semi-recumbent position (30-45 degrees) is recommended	67.6*
The patient position does not affect the development of VAP	12.4
I do not know	17.6
10. Use of oral antiseptics with chlorhexidine for oral care	
Use of this solution reduces the development of VAP	73.5*
Use of this solution increases the development of VAP	4.7
The effect of this solution on the development of VAP is not known	21.3
I do not know	0.5

\*Correct answer

**Table 2. Practices implemented by ICU nurses.**

Practice	Right (%)	Wrong (%)
1. Ensuring hand hygiene (in and out of the ICU, before and after drug preparation, before and after all invasive procedures, etc.)	<b>98.0</b>	2.0
2. Ensuring regular aspiration of subglottic secretions	<b>96.1</b>	3.9
3. Routine change of mechanical ventilator circuits at regular intervals in absence of visible contamination or mechanical dysfunction	<b>71.6</b>	28.4
4. Ensuring the regular discharge of liquid accumulated in the breathing circuits	<b>97.1</b>	2.9
5. Use of sterile water in humidifier containers, not adding water to humidifier containers	<b>81.4</b>	18.6
6. Use of heat-moisture exchangers instead of heated humidifiers	<b>100.0</b>	0
7. Use of a new sterile catheter for each aspiration in patients undergoing open aspiration	<b>94.1</b>	5.9
8. Maintaining the endotracheal tube cuff pressure above 20 cmH <sub>2</sub> O	<b>95.1</b>	4.9
9. Maintaining the head height of each patient in mechanical ventilation support at 30–45 degrees unless there are any contraindications	<b>98.0</b>	2.0
10. Preferring enteral nutrition over parenteral nutrition	<b>81.4</b>	8.6
11. The use of chlorhexidine solution in the oral care of the patient in mechanical ventilation support	<b>88.2</b>	11.8
12. In tracheostomy stoma care, wiping stoma circumference with saline solution and drying with sterile gauze	<b>93.1</b>	6.9
13. Getting a seasonal influenza vaccine every year	42.2	<b>57.8</b>

## Discussion

This study investigated the ICU nurses' knowledge and implementation of evidence-based practices recommended for the prevention of VAP. Nurses' level of knowledge and execution of the recommended practices was above the intermediate level. The majority of nurses were found to have knowledge of the recommendations related to *the selection of endotracheal intubation method, mechanical ventilator circuit change, humidifier use, selection of the aspiration system, selection of patient bed, use of endotracheal tubes with extra lumen for the aspiration of subglottic secretions, patient position, and use of oral antiseptics with chlorhexidine for oral care*. On the contrary, previous studies have found nurses to have a lower level of knowledge on the subject (Al-Sayaghi, 2014; Hassan & Wahsheh, 2017; Ozen & Armutcu, 2018; Blot et al., 2007).

Although guidelines recommend humidifiers to be changed weekly or as clinically needed, 65.7% of nurses thought that humidifiers were recommended to be changed every 48 hours. In a study by Blot et al. (Blot et al., 2007), ICU nurses indicated that humidifier changes should be done every 48 hours. Rello et al. (Rello et al., 2002) and Ricart et al. (Ricart et al., 2003) reported that nurses often changed humidifier daily. In another study conducted with ICU nurses from 22 European countries, it was found that only 21% of nurses knew that humidifier changes should be done weekly (Labeau et al., 2008). The results from our study and previous studies consistently suggest that there is a need for training about this subject.

Guidelines recommend the use of a closed aspiration system and changing the aspiration system for each new patient or as clinically needed (Dodek et al., 2004). However, the majority of the nurses in this study indicated that daily change of closed aspiration systems is recommended (71.6%). Results suggest that there is also a need for training on this subject. A previous study found that the ICU nurses had the least knowledge about mechanical ventilator circuit change (17.3%), humidifier change (3.8%), and aspiration systems change (13.5%) (Bagheri-Nesami & Amiri, 2014). These findings were in line with the results of our study.

The study found that the majority of ICU nurses performed the recommended practices to prevent the development of VAP during the care process. However, 57.8% of the nurses had not been vaccinated for seasonal influenza; awareness about the necessity of vaccination was found to be insufficient. Influenza-associated pneumonia is an important cause of mortality and morbidity, and seasonal vaccination has been shown to reduce related mortality and morbidity. Influenza vaccination was reported to contribute to the prevention of pneumonia. Therefore, seasonal influenza vaccination is recommended especially for individuals aged 65 years and over, immunosuppressed patients, individuals with a chronic disease, and patients with extended hospital stay (Tessmer et al., 2011). In addition, influenza vaccine should be administered to health personnel providing health care services to patients (Kapucu & Ozden, 2014). It was reported that seasonal influenza vaccine has a significant role in the protection of health personnel and prevention of

nosocomial infections transmitted through the personnel.

### Conclusion

The findings of this study were in line with those from previous studies and indicated that the ICU nurses had inadequate knowledge about the recommendations for the prevention of VAP. VAP is a preventable condition that has a significant impact on mortality and morbidity. Together with other healthcare professionals, nurses play a key role in preventing VAP. The majority of the recommended practices to prevent the development of VAP are a part of routine nursing care. It is necessary to train healthcare workers to maintain effective infection control programs in healthcare institutions. The training programs for the prevention of VAP should include ICU nurses. Training sessions should emphasize the areas where nurses were found to have inadequate knowledge such as the recommendations related to changing the humidifiers and closed aspiration systems or having seasonal influenza vaccination. Training programs should incorporate current research including evidence-based practices and should be repeated at regular intervals; the effectiveness of training programs and their impact on the implementation of recommendations should also be evaluated.

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