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RESEARCH ARTICLE

INTENSIVE CARE NURSES' KNOWLEDGE OF EVIDENCE-BASED PRACTICES REGARDING THE PREVENTION OF VENTILATOR-ASSOCIATED PNEUMONIA IN TURKEY

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ABSTRACT

Objectives: The aim of this study was to evaluate nurse's knowledge of evidence-based practices (EBPs) regarding the prevention of Ventilator-associated pneumonia (VAP) in ICU.

Background: Ventilator-associated pneumonia rates are regarded as the most important indicator of quality of care in hospitals.

Methods: A cross-sectional survey was conducted in seven hospitals in Turkey. A questionnaire consisting of 9 closed questions was used following the VAP prevention guideline of Dodek et al. (2004).

Results: Results of the study found the nurses' knowledge of EBPs regarding the prevention of VAP was low. In addition, there were no significant differences in mean knowledge by sociodemographic variables except for age and gender.

Conclusion: Knowledge levels were not affected by years in ICU, years in the profession, and ICU certification. Results of the study suggested ICU nurses should have a certificate and in service training. However, the clinical guidelines and care protocols for prevention of VAP have been updated and implemented as a standard care for patients on ventilators in the ICU.

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INTRODUCTION

Ventilator-associated pneumonia (VAP) is the second most common nosocomial infection in intensive care units (ICUs) (Yüceer and Bulut, 2010). The incidence of VAP ranges from approximately 6% to 67% (Labeau et al., 2007; Cason et al., 2007; Joseph et al., 2010). The Ministry of Health in Turkey announced that the rate of development of VAP ranged from 6.0 to 17.3/10³ ventilator days in 2013 (National Nosocomial Infection Surveillance [NNIS] Network, 2015). Rosenthal et al. (2006) conducted a prospective study on invasive device-associated infections (IDAI) in eight developing countries, including Turkey, using the Centers for Disease Control and Prevention (CDC)-NNIS criteria. These authors reported that the greatest risk of infection was posed by VAP (Rosenthal et al., 2006). VAP not only increases morbidity and mortality but also can lead to functional impairment, emotional stress and reduced quality of life. Furthermore, VAP increases the economic burden due to prolonged hospitalization, workforce loss, and increased medication use (Labeau et al., 2007; Dodek et al., 2004; Blot et al., 2007; Tolentino-DelosReyes et al., 2007).

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The CDC reported that nosocomial infections can be prevented and that the incidence of VAP infection can be reduced through the use of evidence-based practices (EBPs) (Tolentino-DelosReyes et al., 2007). Labeau et al. (2007) reported that although the EBP guidelines for the prevention of VAP were available, nurses did not put these guidelines into practice (Labeau et al., 2007). However, implementation of EBPs in ICUs is very important for the safety of patients and staff (Jansson et al., 2013;). VAP rates are regarded as the most important indicator of quality of care in hospitals (Juneja et al., 2011; Mietto et al., 2013). Therefore, to deliver quality health care and to prevent adverse effects of infections, it is extremely important to prevent infections from developing (Dodek et al., 2004; Jam Gatell et al., 2012). Importantly, both American and European scientific societies have published EBPs for VAP prevention (Torres and Carlet, 2001). Although EBP guidelines regarding the prevention of VAP have been developed, there are obstacles preventing health workers from using these guidelines (Blot et al., 2007). These obstacles include varying education levels of health workers, a lack of hospital protocols to implement these guidelines, an inability to perform surveillance studies, lack of timely information for health workers regarding recent developments and lack of satisfactory observation of these developments (Labeau et al.,

2007; El-Khatib *et al.*, 2010). In one previous study, Blot *et al.* (2007) emphasized that nurses' knowledge of EBPs regarding the prevention of VAP was insufficient and that they needed relevant support (Blot *et al.*, 2007). In a similar study performed by Akin Korhan *et al.* (2013), it was reported that nurses' knowledge of how to prevent VAP was not satisfactory and that the type of hospital they worked in and the inadequacy of in-service training programs they were offered affected their knowledge levels (Akin Korhan *et al.*, 2013). However, in several studies, it has been reported that the incidence rate of nosocomial infections decreases after health professionals are trained on the prevention of infections (Labeau *et al.*, 2007; El-Khatib *et al.*, 2010). Article 1 of the Nursing Regulations published in Turkey in 2010, which defines nurses' tasks, requires that nursing care should be evidence-based (Nursing Regulations, 2010). However, this legislation has not yet been implemented. In Turkey, an important factor that complicates the implementation of evidence-based healthcare is that nurses have four different levels of education. In Turkey, while some nurses graduate from vocational high schools, others may have an associate's degree, a bachelor's degree or a master's degree, and nurses of all levels provide clinical services. Moreover, few undergraduate and master programs have an evidence-based nursing education program. Therefore, to make evidence-based care practices more widespread, greater attention should be paid to this issue during nursing education, and related data should be updated after graduation.

Purpose of the study

The aim of the present study was to determine ICU nurses' knowledge of evidence-based practices regarding the prevention of VAP.

MATERIALS AND METHODS

Design

This cross-sectional study was conducted with intensive care nurses in general ICUs between March 2014 and June 2014.

Data collection

Study data were collected from two university hospitals and five training and research hospitals in the third largest metropolis in Turkey. Data were collected by administering questionnaires to nurses working in ICUs regarding their socio-demographic and work characteristics and their evidence-based knowledge about the prevention of VAP.

Instruments

Socio-demographic and work characteristics questionnaire

This questionnaire was developed through review of the pertinent literature (Blot *et al.*, 2007; Tolentino-DelosReyes *et al.*, 2007; Akin Korhan *et al.*, 2013; Akinci *et al.*, 2010), and it includes items regarding nurses' age, education level, gender, years in the profession, years in the current ICU, the setting of the current ICU the number of beds in the current ICU and whether they had a certificate in intensive care nursing.

Questionnaire of evidence-based knowledge about the prevention of VAP

This questionnaire was developed following the VAP prevention guidelines of Dodek *et al.* (2004) and consisted of 9 closed questions with four possible answers and a single correct answer (Dodek *et al.*, 2004). The questionnaire was subsequently validated by a group of experts. The questionnaire validation and development processes have been described by Labeau *et al.* (2007) (Table 1). Each correct answer was given one point, and wrong answers did not negatively affect the global score, which ranged from a minimum of 0 points to a maximum of 9 points. The questionnaire was adapted for the Turkish language and culture by Akin Korhan *et al.* 2014.

Data analysis

Analysis of data using the Kolmogorov-Smirnov test indicated a non-normal distribution, and therefore non-parametric tests were used. Data were analyzed using counts, percentage distribution, means, the Mann-Whitney U test and the Kruskal-Wallis test. The statistical significance level was set at $p < 0.05$ for the analysis conducted using the Mann-Whitney U test and the Kruskal-Wallis test and at $p < 0.02$ for the three pairwise comparisons and $p < 0.01$ for the six pairwise comparisons performed with the Bonferroni-corrected Mann-Whitney U test. All analyses were performed using SPSS (Chicago, Illinois) for Windows version 22.0.

Limitations

The questionnaire used in this study to assess knowledge of evidence-based practice guidelines for the prevention of VAP only measured the nurses' theoretical knowledge. Thus, whether the nurses put their knowledge into practice was not assessed. Evaluation in future studies of both theoretical knowledge and practice will reveal more insightful results.

Ethical considerations

Necessary written permissions were obtained from the local ethics committee (IRB approval number: 66499490-009/2014), the hospitals where the study was conducted, and the nurses who voluntarily agreed to participate in the study.

RESULTS

Sample

Among a total of 500 nurses in the ICUs of these hospitals, 341 (68.2%) agreed to participate and were included in the study. Of the nurses, 9 (1.8%) were excluded from the study because they did not fully complete the questionnaires. Therefore, 332 (66.4%) questionnaires were analyzed. The nurses' mean age was 29.50 ± 6.00 years (min = 18, max = 49). Of the respondents, 86.4% were female, 58.4% had a bachelor's degree, 71.6% were working at a training and research hospital, 36.1% had been working as a nurse for 1-5 years, 52.7% had been working in ICUs for 1-5 years, 73.8% did not have a certificate in intensive care nursing, and 53.0% were working in ICUs with more than 15 beds.

Nurses' responses to the knowledge of EBPs in the prevention of VAP questionnaire

Table 1 shows the items of the study questionnaire together with the nurses' responses, as well as the correct answer (*). Based on the analysis of the nurses' responses to the

evidence-based practice regarding the prevention of VAP questionnaire. Aside from gender ($p < 0.02$) and education ($p < 0.01$), there were no significant differences in the mean total knowledge score by sociodemographic variables (all $p > 0.05$). Further analysis revealed that the differences stemmed from nurses who graduated from vocational high schools of health.

Table 1. Nurses' Answers on Multiple-choice Questions Regarding Prevention on VAP (n=332)

Questions	%(n)
1. <i>Oral vs. nasal route for endotracheal intubation</i>	
a. Oral intubation is recommended	47.6 (158)*
b. Nasal intubation is recommended	9.6 (32)
c. Both routes of intubation can be recommended	24.1 (80)
d. I do not know	17.8 (59)
2. <i>Frequency of ventilator circuits changes</i>	
a. It is recommended to change circuits every 48 hours (or when clinically indicated)	10.2 (34)
b. It is recommended to change circuits every week (or when clinically indicated)	29.8 (99)
c. It is recommended to change circuits for every new patient (or when clinically indicated)	52.7 (175)*
d. I do not know	6.9 (23)
3. <i>Type of airway humidifier</i>	
a. Heated humidifiers are recommended	9.9 (33)
b. Heat and moisture exchangers are recommended	40.1 (133)*
c. Both types of humidifiers can be recommended	32.8 (109)
d. I do not know	16.3 (54)
4. <i>Frequency of humidifier changes</i>	
a. It is recommended to change humidifiers every 48 hours (or when clinically indicated)	47.6 (158)
b. It is recommended to change humidifiers every 72 hours (or when clinically indicated)	13.6 (45)
c. It is recommended to change humidifiers every week (or when clinically indicated)	25.3(84)*
d. I do not know	13.0 (43)
5. <i>Open vs. closed suction systems</i>	
a. Open suction systems are recommended	8.4 (28)
b. Closed suction systems are recommended	73.2 (243)
c. Both systems can be recommended	10.5 (35)*
d. I do not know	7.5 (25)
6. <i>Frequency of change in suction systems</i>	
a. Daily changes are recommended (or when clinically indicated)	78.8 (260)
b. Weekly changes are recommended (or when clinically indicated)	7.2 (24)
c. It is recommended to change systems for every new patient (or when clinically indicated)	6.6 (22)*
d. I do not know	7.2 (24)
7. <i>Endotracheal tubes with extra lumen for drainage of subglottic secretions</i>	
a. These endotracheal tubes reduce the risk of VAP	31.6 (105)*
b. These endotracheal tubes increase the risk of VAP	16.9 (56)
c. These endotracheal tubes do not influence the risk of VAP	6.3 (21)
d. I do not know	44.0 (146)
8. <i>Kinetic vs. standard beds</i>	
a. Kinetic beds increase the risk of VAP	6.0 (20)
b. Kinetic beds reduce the risk of VAP	50.0 (166)*
c. The use of kinetic beds does not influence the risk of VAP	18.1 (60)
d. I do not know	24.7 (82)
9. <i>Patient positioning</i>	
a. Supine positioning is recommended	4.5 (15)
b. Semi-recumbent positioning is recommended	73.8 (245)*
c. The position of the patient does not influence the risk of VAP	12.3 (41)
d. I do not know	8.4 (28)

Table 1 shows the questions and possible answers of the study questionnaire, as well as the answers obtained (as frequency and percentage); the correct answer in each case is marked with an *. VAP: Ventilator-associated pneumonia. Because of missing data and rounding, percentages do not all total 100.

knowledge of evidence-based practice in the prevention of VAP questionnaire, the following proportions of the nurses correctly answered questions regarding a decreased risk for VAP development: endotracheal intubation should be performed orally (47.6%), ventilator circuits should be changed for each new patient (52.7%), heat and moisture exchangers are the recommended type of humidifier (40.4%), closed suction systems should be changed for each new patient 73.2%, the whole aspiration system should be changed for each new patient (6.6%), endotracheal tubes with an extra lumen should be used for the aspiration of subglottic secretions (31.6%), kinetic beds should be used (50.0%) and patients should lie in a semi-recumbent position (73.8%). Table 2 shows the relationship between sociodemographic characteristics and the mean scores from the knowledge of

Given the type of hospitals where nurses worked, significant differences ($p < 0.05$) in the total mean score were found for the following items: frequency of changing the ventilator circuit ($p < 0.05$) and frequency of changing the aspiration system ($p < 0.05$).

DISCUSSION

Evidence-based nursing is the one of essential foundation for improving the quality of nursing care (Wang *et al.*, 2015). In the present study, intensive care nurses' knowledge of evidence-based practices regarding the prevention of VAP was assessed. The mean total knowledge score of the participating nurses was significantly low (2.02 ± 0.47). Llaurado *et al.* (2011) reported that the mean score obtained from 9 questions

administered to nurses in southern European countries was 4.20 (46.6%), while it was 3.99 in the other European countries. The best scores were achieved by Italian nurses (5.24), while Maltese nurses obtained the poorest scores (3.47) (Llauradó *et al.*, 2010).

that nurses' knowledge of evidence-based practices regarding the prevention of VAP increased with increasing education. In Turkey, while some nurses graduate from vocational high schools, others may have an associate's degree, a bachelor's degree or a master's degree.

Table 2. Mean Scores of the 9 Questions According to the Characteristics of the Nurses (n=332)

Characteristics	n (%)	Mean Rank	Mann-Whitney U and Kruskal-Wallis tests	p-value
Gender				
Female	287 (86.4)	165.82	4481.00	0.009*
Male	45 (13.6)	126.21		
Education				
Vocational high schools	60 (18.1)	122.12	11.93	0.008**
Associate's degree	53 (16.0)	171.06		
Bachelor's degree	194 (58.4)	168.91		
Master degree	25 (7.5)	161.98		
Number of beds in the ICN				
<8 beds	33 (9.9)	133.95	3.85	0.146***
8-15 beds	122 (36.7)	156.24		
>15 beds	176 (53.0)	167.29		
Years of experience				
<1 years	35 (10.5)	195.65	7.05	0.133***
1-5 years	120 (36.1)	152.32		
6-10 years	95 (28.6)	161.57		
11-15 years	46 (13.9)	165.21		
>16 years	36 (10.8)	144.09		
Years of ICN experience				
<1 years (n=102)	102 (30.7)	173.74	3.29	0.348***
1-5 years (n=175)	175 (52.7)	152.57		
6-10 years (n=37)	37 (11.1)	161.96		
>11 years (n=18)	18 (5.4)	158.18		
ICN certification				
Yes (n=87)	87 (26.2)	168.85	4530.25	0.308***
No (n=244)	245 (73.8)	156.89		

The table shows the mean rank of correct answers on nine multiple-choice according to the total mean scores or identified subgroups (gender, education, number of beds in the ICN, years of experience, years of ICN experience, ICN certification). The p-value shows how the scores differ according to subgroups. * $p < 0.02$; ** $p < 0.01$; *** $p > 0.05$.

The results of the present study and those of studies conducted in other countries reveal that nurses' knowledge of evidence-based practices regarding the prevention of VAP is not satisfactory. Intensive care nurses should be aware that ventilator-related infections can be prevented, should be knowledgeable about evidence-based practices related to the prevention and control of infections and should provide the most effective healthcare for patients by integrating this knowledge into practice (Dodek *et al.*, 2004; Akbayrak *et al.*, 2010). In the present study, it was observed that nurses' professional and ICU experiences did not affect their knowledge of evidence-based practices regarding the prevention of VAP. In contrast to the results of studies by Blot *et al.* (2007) and Labeau *et al.* (2007), the knowledge of ICU nurses in the present study did not increase with increasing years in the profession (Blot *et al.* 2007; Labeau *et al.* 2007). Reasons for this lack of knowledge include a lack of in-service training programs organized by the hospitals after graduation and a lack of intensive care nursing certification among nurses. In the present study, 73.8% of nurses did not have a certificate in intensive care nursing. This lack of certification in intensive care nursing and the absence of implementation of evidence-based practices are worrisome because they affect the widespread occurrence of VAP. As noted by Tolentino-DelosReyes *et al.* (2007), hospital staff should be trained on VAP and nursing care for ventilator patients before they start working in the ICU (Tolentino-DelosReyes *et al.*, 2007). In the present study, nurses' education levels affected their knowledge of evidence-based practices regarding the prevention of VAP ($p < 0.001$). This difference also stemmed from the nurses who graduated from vocational high schools of health ($p = 0.008$). The results of the present study indicate

They all provide clinical services. These results also suggest that insufficient attention is paid to this issue during nursing education and after graduation.

Nurses' knowledge regarding VAP guidelines

The nurses in the present study were aware of the importance of oral intubation in the prevention of VAP, and the proportion of nurses with correct knowledge was greater than that in the study by Blot *et al.* (2007), but lower than that reported in the studies by Akin Korhan *et al.* (2013), Akinci *et al.* (2010) and Llaurado *et al.* (2011). The differences found in these studies suggest that implementation of evidence-based practices regarding the prevention of VAP and VAP guidelines by nurses varies among countries. Many nurses stated that heat and moisture exchangers are the recommended type of humidifier. However, only 25.3% were aware that humidifiers should be replaced once per week. Various studies have revealed that approximately 55-63.5% of nurses knew how frequently humidifiers should be replaced (Labeau *et al.*, 2007; Blot *et al.*, 2007; Akinci *et al.*, 2010; Sierra *et al.*, 2005). Based on these results, nurses do not use evidence-based practice guidelines for the frequency of humidifier replacement. There is also evidence to indicate that using the open aspiration system for the aspiration of all secretions and body fluids increases the risk of contamination and that using the closed system reduces the risk of VAP development (Combes *et al.*, 2000). In Canada, the closed system is preferred 88.0% of hospitals, whereas in Spain, the open system is preferred by 96.0% (Sierra *et al.*, 2005; Heyland *et al.*, 2002; Muscedere *et al.*, 2008). The nurses in the present study were aware that the closed aspiration system reduces the

risk of VAP development, and similar results were found in studies by Blot *et al.* (2007) and Akıncı *et al.* (2010). However, these nurses did not know how often these aspiration systems should be changed. In the present study, while 6.6% of the nurses said that changing the aspiration system for each new patient would prevent the development of VAP, 78.8% said that it should be changed every day to prevent the development of VAP. Because guidelines may be revised over time, it is important for nurses to be aware of these developments to effectively use new evidence-based practices. Secretions that accumulate above the cuff of the endotracheal tube can lead to aspiration and subsequently to VAP. If the endotracheal tube has an extra lumen, these secretions can be aspirated continuously (Akıncı *et al.*, 2010). In the present study, the hospital group that nurses worked in was associated with significantly differential knowledge of using an endotracheal tube with an extra lumen for the drainage of secretions. This significant result indicates that hospitals in Turkey do not use guidelines for evidence-based practices regarding the prevention of VAP.

Conclusion

Results of the study found the nurses' knowledge of EBPs regarding the prevention of VAP was low. In addition, there were no significant differences in mean knowledge by socio-demographic variables except for age and gender. Knowledge levels were not affected by years in ICU, years in the profession, and ICU certification. Because this study is a descriptive study, it would be better to implement ventilator bundle in conjunction with evidence-based practices. Therefore, it is recommended to revise and update the content of the certifications in terms of evidence-based. In addition, in-service training programs conducted for intensive care nurses should also be taken into consideration. However, the clinical guidelines and care protocols for prevention of VAP have been updated and implemented as a standard care for patients on ventilators in the ICU.

Learning Points

The nurses' knowledge of evidence-based practices was examined. Their knowledge level on the prevention of ventilator-associated pneumonia was quite low. The importance of evidence-based nursing education was emphasized.

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