

Nursing Interventions to Prevent Ventilator-Associated Pneumonia in ICUs
ABSTRACT**Sevgisun Kapucu¹**
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Department of Medical Nurses, Ankara²Gazi University, Department of Director
of Nursing, Ankara**Objective:** This study was conducted to determine the interventions of nurses working in intensive care units to prevent ventilator-associated pneumonia (VAP) in intensive care units (ICUs).**Methods:** This study was a descriptive study. Nurses working in the adult ICUs of six state and four university hospitals within the boundaries of the municipality of Ankara were participated in this study. The research sample included 290 ICU nurses. In the study, data were collected by questionnaire developed by researchers. For the statistical evaluation of the data, Student's t-test was used to compare two groups, whereas analysis of variance was used to compare more than two groups.**Results:** Although the number of the nurses who sterilized their hands with alcohol-containing liquids or measured the cuff pressure to prevent VAP was found to be below average, the number of nurses who preferred alternative methods appeared to be above average. Nurses with a university degree who worked in university hospitals and surgical ICUs implemented methods to prevent VAP more successfully, and the difference between the groups was statistically significant ($p < 0.05$).**Conclusion:** None of the hospitals had a protocol regarding the prevention of VAP, and only 7.9% of the nurses said that they read and followed the scientific literature on the issue. This study suggested that institutions should develop their own protocols regarding the prevention of VAP, nurses should be referred to training programs to enhance their knowledge on the issue, and VAP prevention methods should be regularly monitored.**Key words:** Intensive Care Unit, Ventilator-Associated Pneumonia, Nurse, Prevention**Corresponding Author:**

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Yoğunbakımda Ventilator İlişkili Pnömoninin Önlenmesine Yönelik Hemşirelik Girişimleri
ÖZET**Amaç:** Bu çalışma, yoğun bakımda çalışan hemşirelerin ventilator ilişkili pnömoni (VİP)'nin önlenmesine yönelik uyguladıkları girişimlerin belirlenmesi amacıyla yapılmıştır.**Metod:** Çalışma tanımlayıcı tipdedir. Çalışmaya Ankara sınırları içinde yer alan dört üniversite ve altı devlet hastanesinde çalışan yoğun bakım hemşireleri alınmıştır. Çalışmanın örneklemini 209 yoğun bakım hemşiresi oluşturmuştur. Çalışmada veriler araştırmacılar tarafından geliştirilen soru formu ile toplanmıştır. İstatistiksel değerlendirmede, iki grubun karşılaştırılmasında t testi, ikiden fazla grubun karşılaştırılmasında ise varyans analizi kullanılmıştır.**Bulgular:** Alkol içeren sıvılarla ellerini sterilize eden ya da VİP'i önlemek için kuff basıncını ölçen hemşirelerin sayısı ortalamanın altında bulunmuş olsa da, alternatif yöntemleri tercih eden hemşirelerin sayısı ortalamanın üstünde bulunmuştur. Üniversite hastanelerinde ve cerrahi YBÜ'de çalışan üniversite mezunu hemşirelerin VİP'i daha başarılı bir şekilde önlemeye yönelik yöntemler uyguladığı saptanmıştır, ayrıca gruplar arasındaki fark istatistiksel olarak anlamlı bulunmuştur ($p < 0.05$).**Sonuç:** Çalışma sonuçlarına bakıldığında, hiçbir hastanede VİP'in önlenmesiyle ilgili bir protokol bulunmamaktadır ve hemşirelerin sadece %7.9'u konuyla ilgili bilimsel literatürü okuduklarını ve takip ettiklerini belirtmiştir. Bu çalışmada, kurumların VİP'in önlenmesine yönelik kendi protokollerini geliştirmesini, hemşirelerin bu konuda bilgi sahibi olmaları için eğitim programlarına yönlendirilmesini ve VİP önlemine yönelik alınan önlemlerin düzenli olarak izlenmesini önermekteyiz.**Anahtar Kelimeler:** Yoğun Bakım, Ventilator İlişkili Pnömoni, Hemşire, Önlem

INTRODUCTION

Ventilator-associated pneumonia (VAP) is one of the important hospital infections usually observed in intensive care units (ICUs) (1). VAP is a nosocomial infection that emerges within 48–72 h following the initiation of mechanical ventilation in a patient through incubation with an endotracheal tube (2). VAP might lead to an increase in the mortality/morbidity ratios at these patients, extend hospitalization periods, and increase health care costs (3). In 2012, the VAP ratios varied from 0.0 to 4.4 per 1000 ventilation days in USA (4). The International Nosocomial Infection Control Consortium found that VAP incidence in 55 ICUs of 46 hospitals in eight countries (Argentina, Brasil, Colombia, India, Mexico, Morocco, Peru, and Turkey) was 24.1 cases per 1000 ventilation days (10.0–52.7) between 2002 and 2005. Accordingly, it was concluded that VAP is the fastest hospital infection related to a hospital device (5). The European Prevalence of Infection in Intensive Care (EPIC) study reported VAP as the most important hospital infection in the ICUs of European hospitals with a 45% ratio (6). In the EPIC II study in 2007, it was emphasized that 64% of ICU infections were related to respiration (7). In Turkey, studies have reported that VAP incidence ranges from 26.8% to 45% per 1000 ventilation days (8–13).

There are both preventable and non-preventable risk factors related to the emergence of VAP. The non-preventable risk factors related to VAP are age, gender, underlying previous health conditions of the patient, and risk factors that emerge as a consequence of the patient's treatment. Preventable risk factors related to VAP are lying back, enteral feeding, insufficient subglottic aspiration, stress ulcer prophylaxis, a cuff pressure under 20 cm H₂O, nasal intubation, inadequate hand hygiene, and tracheostomy (11,14,15). ICU nurses can prevent the emergence of VAP in patients who are being mechanically ventilated and thus help decrease the frequency of VAP using precautions to control infections (14–19).

MATERIALS AND METHODS

Study Objective

This study was conducted to determine the nursing interventions that can prevent the incidence of VAP that is usually observed in ICUs.

Design and Methods

Design: Stratified random sampling and complementary study

Setting and sample: The participants included 535 nurses who were working in the ICUs of the state hospitals within the boundaries of the municipality of Ankara. Among these nurses, 64.9% worked in the adult ICUs of the state hospitals, and 35.1% worked in the adult ICUs of the university hospitals. Assuming that the nurses would be 75% successful, the sample was calculated as 290 nurses with type 1 error being 5% and type 2 error being 20%; 64.9% ($347/535 \times 290 = 188$) and 35.1% ($188/535 \times 290 = 102$) nurses from state and university hospitals, respectively, were selected using stratified random sampling.

Data collection tools and methods: To collect data, a questionnaire prepared by the researcher based on relevant literature was used (15,17,18,20). The

questionnaire contained two sections. The first section composed of 13 questions targeting the hospital and the ICU, and the second section composed of 62 questions wherein the first 10 questions aimed at specifying the defining characteristics of the nurses and the remaining questions tried identifying the interventions used to prevent VAP. The survey was completed during the period from 09/23/2009 to 12/31/2009. Only those nurses who worked in the ICU for over a year were surveyed. Each survey lasted for 20–25 min.

Data analysis: SPSS 15.0 (Statistical Package for Social Sciences) was used to evaluate the data. For descriptive statistics, numbers and percentages were used. In the analysis of the scored data, Student's t-test was used to compare two groups, whereas analysis of variance was used to compare more than two groups. The significance level was 0.05 in all analyses.

ETHICAL AND RESEARCH APPROVALS

This study was approved by the 3rd Ethics Board for Clinical Researches, Ankara on 12/17/2009 in line with decision number 36. In addition, we obtained written consent from the hospitals and nurses participating in this study.

RESULTS

In this study, 40.3% of the nurses who participated were 25–29 years old, 86.6% were female, 53.4% were single, 45.9% were university graduates, and 71.7% had been working in an ICU for 1–5 years (Table 1). More than half of the nurses (59.6%) worked night shifts while caring for three or more patients per nurse. The study found that although 58.3% of nurses had received training on the prevention of hospital infections, only 7.9% followed and read the scientific literature on preventing VAP. Only 16.6% of nurses said that they obtained an influenza shot every year, and 81% consider hospital personnel as one of the factors for the outbreak of VAP.

All of the hospitals that participated in this study were scrutinized. There was a ventilation bundle in 74.5% of the ICUs, no scale was used to measure sedation levels in patients in 83% of the ICUs, and the Glasgow Coma Scale was used to evaluate the level of consciousness of the patients with no protocols regarding VAP in 80.9% of the units. Hand sanitizers were available next to each patient in 95.6% of the ICUs.

Table 2 displays a list of general interventions that the nurses utilized to prevent VAP. Looking at the mean values of the interventions, we determined that hand sanitation using alcohol-containing liquids ($\bar{x} = 1.44$) and cuff pressure measurement ($\bar{x} = 0.42$) remained below mean values, whereas interventions like hand washing ($\bar{x} = 2.62$), wearing gloves ($\bar{x} = 2.80$), the frequency of hand hygiene implementation ($\bar{x} = 0.64$), the frequency of equipment changes ($\bar{x} = 5.65$), and the interventions to take care of the patient ($\bar{x} = 3.85$) were above mean values (Table 3). Although it has not shown in the table, nurses with a university degree who were working in university hospitals or surgical ICUs and who had training in preventing infections were more successful in implementing interventions to prevent VAP. The difference between the two groups were statistically significant ($p < 0.05$).

Table 1. Descriptive Characteristics of Nurses (n = 290)

Descriptive Characteristics	Number	%
Age (years)		
20–24	57	19.7
25–29	117	40.3
30–34	92	31.7
35 and above	24	8.3
Gender		
Female	251	86.6
Male	39	13.4
Marital status		
Single	155	53.4
Married	135	46.6
Education		
High School of Vocational Training on Health Care	90	31.0
Nursing School, Associate Degree	49	16.9
Nursing School, University Degree	133	45.9
Graduate degree	6	2.1
Other*	12	4.1
Time worked in intensive care units (years)		
1–5	208	71.7
6–10	51	17.6
11 and above	31	10.7

*High School of Vocational Training on Health Care + laboratory assistant and veterinarian with associate degree, midwife with university degree, medical officer with university degree, High School of Vocational Training on Health Care + associate degree in audiometry

Table 2. The Distribution of the Interventions Nurses Use to Prevent VAP

Interventions of nurses (n = 290)*	Applied by		Not applied by	
	n	%	n	%
Use of hand sanitizer with alcohol				
Amount: 3–5 ml	148	51.0	142	49.0
Time applied: 20 s	123	42.4	167	57.6
Scrubbing hands until they are dry	177	61.0	113	39.0
Hand washing				
Use of liquid-antiseptic soap	289	99.7	1	0.3
Time taken to wash hands: 40–60 s	188	64.8	102	35.2
Drying hands with a paper towel	283	97.6	7	2.4
Frequency hand hygiene is applied				
Always	188	64.8	102	35.2
Use of gloves				
Wearing a pair of gloves during procedures	123	42.4	167	57.6
Wearing unsterilized gloves during closed aspiration (n = 284)**	203	71.5	81	28.5
Wearing gloves while checking for vital symptoms	215	74.1	75	25.9
Wearing unsterilized gloves during mouth oral care	273	94.1	17	5.9
Wearing gloves while registering vital symptoms	150	51.7	140	48.3
Measuring the cuff pressure				
Measuring the cuff pressure (with cuff meter or manually)	98	33.8	192	66.2
Measuring the cuff pressure with cuff meter (n = 98)*	25	25.5	73	74.5
Devices and tools that are used and the frequency with which they are changed				
No routine change of ventilatory circuits unless they are visibly unclean or there is a mechanical dysfunction	127	43.8	163	56.2
Use of humidifier	278	95.9	12	4.1
Use of sterilized distillate water in humidifier cups (n = 130)*	105	80.8	25	19.2

Interventions of nurses (n = 290)*	Applied by		Not applied by	
	n	%	n	%
Use of hand sanitizer with alcohol				
No routine change of filters to maintain heat and humidity unless they are visibly unclean or there is a mechanical dysfunction (n = 232)*	60	25.9	172	74.1
Functional disorder of closed system carotis, changing the catheter in case of embolization or when there is a hole in the sleeve (n = 102)*	36	35.3	66	64.7
Use of sterilized gloves in case of open system aspiration	200	69.0	90	31.0
Duration of aspiration: 15 s	202	69.7	88	30.3
Throwing away the aspiration carotis after it was used once	270	93.1	20	6.9
Injecting fluid through endotracheal tube during aspiration	193	66.6	97	33.4
Using fluid in throw away plastic bags during aspiration (n = 193)*	54	28.0	139	72.0
Interventions regarding patient care				
Aspiration performed by the nurse	280	96.6	10	3.4
Aspirating the patient whenever necessary	114	39.3	176	60.7
Registration after aspiration	104	35.9	186	64.1
Placing the patient in a semi-fowler position	268	92.4	22	7.6
Checking the stomach residuals following enteral feeding (n = 241)*	150	62.2	91	37.8
Stomach residual check: every hours (n = 141)**	22	15.6	119	84.4
Oral care: every 2–4 h	85	29.3	205	70.7
Deep inhaling and coughing exercise following the operation	208	71.7	82	28.3

*Percentages were taken from the given n.

** The question was not answered by 9 nurses (6.0%)

Table 3. Mean Values of Interventions by Nurses that Aim to Prevent VAP

Interventions	Number of interventions	Number of interventions		
		Min	Max	X ± SD
Use of hand antiseptic with alcohol	3	0	3	1.44 ± 1.02
Washing the hands	3	1	3	2.62 ± 0.51
Frequency of hand hygiene	1	0	1	0.64 ± 0.47
Use of gloves	5	0	5	2.80 ± 1.20
Measuring cuff pressure	2	0	2	0.42 ± 0.64
Tools and devices used and the frequency with which they are changed	10	1	10	5.65 ± 1.63
Interventions regarding patient care	8	1	7	3.85 ± 1.22

DISCUSSION

Approximately half of the nurses who took part in the study stated that they had received training on hospital infections. In addition, the group that had received training on infections was found to have a higher mean level of implementing care-taking interventions intended to prevent VAP ($p < 0.05$). The literature emphasizes that training on the issue has positive effects on the prevention of VAP in ICUs (21-23).

According to our study on interventions to prevent VAP, interventions like hand washing, frequency of hand washing, use of hand antiseptics containing alcohol, and wearing gloves were approximately or above mean values. Hand washing has been one of the primary interventions to prevent infections in hospitals (23). In our study, nurses

listed the following reasons for not washing their hands: (1) too busy at work, (2) considered hand washing as redundant because they use gloves, (3) insufficient time to

wash hands, (4) allergic or sensitive to the soap or liquid used to wash hands, and (5) inadequate number of wash basins. According to another study conducted in Turkey, 68.9% of nurses listed hand irritation as a reason for not washing their hands, 23.2% noted that they were too busy

at work, and 7.7% said that they did not wash their hands because they wear gloves (24). Pittet suggested that precautions, such as training programs to assure compliance with hand hygiene rules, feedback about compliance with hand hygiene rules, maintenance of an

adequate number of personnel, placement of reminders around the work place, easily-accessible wash basins, use of role models, and use of administrative sanctions and rewards, might enhance compliance with the hand hygiene rules (25). When not used correctly, gloves might lead to cross-contamination among patients. The hand hygiene handbook has recommended hand hygiene both before and after using gloves (20). Our study showed that wearing gloves decreased compliance with hand hygiene rules among nurses. Self-protection appeared to be the primary concern of the nurses when wearing gloves. Majority of the nurses preferred to use more than one pair of gloves when treating patients.

In this study we found that interventions, such as measuring cuff pressure, the frequency of equipment changes, and interventions to take care of the patients, were approximately or below mean values.

Measuring Cuff Pressure: If the endotracheal cuff pressure is below 20 cm H₂O, secretions proceed into the lower respiratory tract and the risk of VAP increases. If it is above 30 cm H₂O, the circulation in the trachea might be disrupted, which might lead to necrosis. Therefore, it is extremely important that the cuff pressure remains between 20 and 30 cm H₂O (26,27). Our study discovered that most nurses failed to use a cuff meter, and they lacked knowledge on the normal values of cuff pressure. Most of the nurses who measured cuff pressure stated that they believed that the normal cuff pressure values ranged between 10 and 15 cm H₂O. This controversy might be because nurses inject air with a 10-cc injector after checking the inflated part of the endotracheal tube. Thus, they might be referring to the volume of the air that they injected without taking the units into account. Our study established that there was a considerable lack of knowledge on cuff pressure measurements as well as a significant amount of misguided information.

Replacement frequency the tools and devices: In our study, approximately half of the nurses admitted that they

changed the ventilatory circuits only when the circuits were visibly unclean or when they noticed that there was some mechanical dysfunction. A regular change of

ventilatory circuits is not recommended unless they are visibly unclean (15,26). In a study by Blot et al, 48.6% of the nurses stated that they had been instructed to change these circuits only with each new patient (28).

Our study found that the interventions of nurses regarding the aspiration of the patients were above mean values. Managing the aspiration of the patients in line with the asepsis rules can be considered to be one of the factors that can play a role in decreasing the risk of VAP (18,29).

Interventions regarding the care taking of the patient: In our study, we found that care-taking interventions, such as the frequency with which nurses register to the observation form after aspiration, aspirating the patient when necessary, and managing stomach residuals following enteral feeding, were below mean values. Stomach residuals must be controlled to determine a patient's tolerance to the feeding solution. The suggested time for residual controls is at 4-h intervals (30).

STUDY LIMITATIONS

Our study was limited to the data derived from the hospitals where our research was conducted.

CONCLUSION

The findings of our study showed that the interventions by the nurses to prevent VAP were inadequate and that the nurses lacked the necessary training on the issue. We suggest that nurses should receive on-the-job training to learn more about protection from hospital infections and VAP and that hospitals should establish protocols or bundles on how to prevent VAP.

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