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Saudi Critical Care Nurses' Knowledge Of and Barriers toward Adherence to Prevention of Ventilator Associated Pneumonia Guidelines

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Abstract
Objectives: *To estimate Saudi critical care nurses' knowledge regarding ventilator associated pneumonia (VAP) prevention guidelines and to explore the barriers that may restrict adherence to these guidelines*
Design: *Descriptive, cross sectional survey.*
Method: *A survey to evaluate nurses' knowledge of VAP prevention using a multiple choice questionnaire was distributed to intensive care nurses (n=93) in two large hospitals in Makkah, Saudi Arabia. Demographic data was summarized and the association between the total knowledge score and age, gender, marital status, level of education, ICU experience and number of ICU beds was analyzed.*
Results: *The mean of the total knowledge score was 7.13 (±1.36). More experienced nurses performed significantly better than their less experienced colleagues ($p<0.05$), and mean of total knowledge score for diploma nurses was significantly lower than for Bachelor and Graduate degree nurses. The main barriers to adherence to VAP guidelines were lack of VAP courses and nursing shortages.*
Conclusion: *There is a need for ongoing improvements in the Nursing schools' curriculum and hospital education. Although knowledge is an important component of behavior changes, strict protocols must be considered to increase nurses' compliance toward VAP guidelines.*
Keywords: *critical care nurses, Saudi Arabia, VAP, knowledge , barriers.*

I. Introduction

Ventilator associated pneumonia(VAP) is pneumonia occurring 48 hours after the initiation of a mechanical ventilator (Augustyn, 2008). It is the most common nosocomial infection accounting for 25 % of all types of intensive care unit acquired infection (Balkhy et al., 2014). The U.S. National Healthcare Safety Network claims that the incidence of VAP ranged from 0-4.4/1000 ventilation day (Dudeck et al., 2012). In Saudi Arabia, VAP was reported as a common device-associated infection with an overall rate of 4.52/1000 device days, with a higher incidence in medical and surgical ICU (Al-Tawfiq, Amalraj & Memish , 2013).

Previous prevalence studies have shown that VAP is responsible for impacting mortality and morbidity rates, increased length of stay and additional patient costs (Augustyn, 2008;Keyt, Faverio & Restrepo, 2014;Jansson, Ala-Kokko , Ylipalosaari , Syrjala & Kyngas, 2013;Jordan et al., 2014 & Blot, Labeau , Vandijek , Aken & Claes, 2007). Prevention of VAP is considered a priority among ICU nurses and an indicator of quality care (Labeau et al., 2008). Prevention and control of VAP are dependent on education, attitudes and knowledge of nurses about VAP issues (Jordan et al., 2014).

Educational intervention programs are a significant key to a positive outcome on nosocomial infection rates (Gupta et al, 2014).A previous study has shown that critical care nurses' knowledge about VAP guidelines is limited (Jansson et al, 2013. Further research is needed to evaluate critical care nurses' knowledge and barriers that prevent their adherence to guidelines (Jansson et al, 2013).

II. Research Questions And Objectives

The aim of the study is to estimate critical care nurses' knowledge regarding VAP prevention guidelines and to explore the barriers toward adherence to these guidelines

Methods

Design: This descriptive cross-sectional study of 93 nurses was conducted in two major hospitals in Makkah, Saudi Arabia. Inclusion criteria was limited to nurses working in ICUs.

Ethical Consideration: Approval for the survey was obtained from the Makkah Department of Practice and Design and the two hospitals. Completion of a questionnaire was considered as a consent form for participation in the study. Participants were assured of the voluntary nature of their participation. The anonymity of participants was assured by coding of the data.

Measurement: Two questionnaires were presented to participants. One was designed to evaluate knowledge of VAP and its prevention; the second elicited information about possible barriers to adherence by nurses to VAP guidelines.

Knowledge Measures: A questionnaire designed by Labeau et al.(2007) and supplemented by Lin, Lai & Yang (2014) was used to measure intensive care nurses' knowledge regarding VAP prevention. The questionnaire consists of 11 multiple choice questions with four choices and only one correct answer. One point was given for each correct answer and the total knowledge score ranged from 0-11, with a higher score reflecting greater knowledge of participants. The questionnaire was evaluated for content validity by a panel of experts (infection control consultant, infection control physician, expert nurse in infection control and respiratory therapist). In addition, the questionnaire was pretested for internal validity by a group of critical care nurses (n=5) who did not participate in the primary study.

Barriers to Adherence to VAP Prevention Guidelines: To determine the barriers to adherence to VAP prevention guidelines, the participants were asked nine yes / no questions derived from previous studies to determine the causes of barriers. The yes answer was coded as 1 and no answer was coded as 0.

Statistical Analysis: Data were analyzed using SPSS software, version 16.0. Descriptive statistics, including frequency distribution and percentages were used to describe the participants' characteristics, correct answers in the questionnaire and perceived barriers of participants toward adherence to VAP prevention guidelines.
To estimate the mean of the total knowledge score, one sample t-test was used on the 11 multiple choice questions. One-way ANOVA test was used to compare the knowledge of intensive care nurses with gender, marital and different levels of education (Diploma vs. Bachelor, Master's and Doctorate).Pearson correlation was also used to determine whether the mean of the total knowledge score will be associated with age, ICU experience or number of ICU beds. A p value less than 0.05 was considered statistically significant.

Table I The main demographic data of the study population (n=93).

Nurse variables	n (%)
Gender	
Females	65(69.9)
Males	28(30.1)
Marital Status	
Single	39(41.9)
Married	42(45.2)
Divorced	12(12.9)
ICU experience *	
1-5 years	47(53.4)
6-15 years	41(46.6)
Level of Education	
Diploma	35(37.6)
BSN	45(48.4)
Graduate Degrees	13(14.0)
ICU Beds	
20-30 beds	36(39)
31-40 beds	57(61)
VAP Guidelines*	
Yes	77(83)
NO	4(4.3)
*Some participants did not respond to this items	

III. Results

The questionnaire was distributed to 93 ICU nurses with a response rate of 100%. Of the93 nurses, 65 (69.9%)were females, and 48.4% of all participants had a Bachelor of Nursing (BSN) degree while 35 (37.6%) had Diploma degrees. More than half of nurses (53.4%) had 1- 5 years of experience in ICU and 46.6% of the nurses had more than 6 years of clinical experience; the majority (57%) were working in hospitals with more than 30 ICU beds. VAP courses had been attended by 56% of nurses and 83 % believed that their hospitals had VAP policies and guidelines. In this study, 86.5% of respondents recognized the importance of recumbent position for prevention of VAP. Of respondents, 85.6% knew the importance of closed system suctioning for

prevention of VAP and almost 78 % reported preferring the use of kinetic beds to reduce the risk of VAP although not all beds are kinetic.

The questionnaire and nurses' answers are shown in Table 2. The mean of the total knowledge score was 7.13 (±1.36) for the 11 questions.

Table II Nurses' Answers on multiple choice questions regarding VAP prevention

Questions	n %of answers *
1. The definition of Ventilator Associated Pneumonia (VAP) is:	
a. Pneumonia that occurs > or equal 48 hours after endotracheal intubation	73(70.2)*
b. Pneumonia that occurs within 48 hours after endotracheal intubation	26(25)
c. Pneumonia that occurs > 24 hours after endotracheal intubation	2(1.9)
d. I don't know	1(1)
2. What is the pathogenesis of VAP?	
a. Via ventilator circuit	73(70.2)
b. Via other patients	16(15.4)
c. Via oral flora a translocation	6(5.8)*
d. I don't know	6(5.8)
3. Which pathogen does not cause VAP?	
a. Taphylococcusaureas	31(29.8)
b. Clostridium difficle	47(45.2)*
c. Enterobacteriaceae	5(4.8)
d. I don't know	17(16.3)
4. Oral versus nasal route for endotracheal intubation	
a. Nasal route is recommended	6(5.8)
b. Oral route is recommended	81(77.9)*
c. Both routes are recommended	12(11.5)
d. I don't know	0
5. Which suction system is recommended to be used open suction or close suction system	
a. Open suction system is recommended	6(5.8)
b. Closed suction system is recommended	89(85.6)*
c. Both systems can be recommended	6(5.8)
d. I don't know	1(1)
6. Frequency of change in suction system	
a. Daily changes are recommended	70(67.3)
b. Weekly changes are recommended	11(10.6)
c. It is recommended to change systems for every new patient	15(14.4)*
d. I don't know	2(1.9)
7. Do you prefer to use kinetic beds or standard beds for ventilated patients?	
a. Kinetic beds increase the risk of VAP	3(2.9)
b. Kinetic beds reduce the risk of VAP	82(78.8)*
c. The use of kinetic beds does not influence the risk of VAP	7(6.7)
d. I don't know	6(5.8)
8. What is the recommended position for ventilated patients?	
a. Supine positioning is recommended	6(5.8)
b. Semi recumbent positioning is recommended	90(86.5)*
c. The position of the patient does not influence the risk of VAP	5(4.8)
d. I don't know	0
9. Which intervention can prevent VAP	
a. Use of endotracheal tube with sbglottic suction	64(61.5)*
b. Keep the cuff pressure of endotracheal tube < 20 mm Hg	14(13.5)
c. Change ventilator circuit weekly	15(14.4)
d. I don't know	7(6.7)
10. Which solution is recommended for oral care?	
a. Chlorhexidine	89(85.6)*
b. Povidone-iodine	2(1.9)
c. Normal saline	11(10.6)
d. I don't know	0
11. Frequency of oral care	
a. Once per day	29(27.9)
b. At least once per shift	55(52.9)*
c. Following suction	11(10.6)
d. I don't know	0
NB: * = correct answer	

An independent samples t test was run to determine if there were differences in the means of the total knowledge score between males and females. Although the mean of the total knowledge score was higher for female nurses (7.22, ±1.4) than for their male colleagues (6.9, ±1.2), the difference was not statistically significant (t=0.89, p=0.37). BSN and Master degree nurses scored a higher mean of the total knowledge score

(7.5 ± 1.2, 8.0 ± 1.0, respectively) than diploma nurses (6.6, ±1.4) and the difference was statistically significant (F=3.1, P=0.02, df=3,81). In contrast, no significant differences were found between single, married and divorced nurses (p=0.95) See Table 3. There was a significant correlation between the total knowledge score and ICU experience (r=0.236, p=0.03). Neither age (r=0.154, p= 0.15) nor ICU bed numbers (r=-0.085, p=0.44) were significantly correlated with the total knowledge score (Table 4).

Table III: Knowledge total scores according to participants gender, level of education and marital status

	Mean	SD	P value
Gender			
Female	7.2	1.4	0.37[a]
Male	6.9	1.2	
Level of Education			
Diploma			
BSN	6.6	1.45	
Masters	7.5	1.20	0.02[b]
Doctorate	8.0	1.00	
	7.1	1.45	
Marital Status			
Single			
Married	7.1	1.3	
Divorced	7.2	1.4	0.95[b]
	7.0	1.1	

NB: [a]=Independent t-test [b]=ANOVA test

The questionnaire did not question current adherence rates of participants to VAP guidelines, but the participants were asked yes-no questions regarding barriers toward the use of VAP guidelines. The main barriers were lack of VAP courses (74.2%) nursing shortages (74.2%), lack of knowledge during studying (50.5%), failure to change gloves between patients (55.9%) and improper hand washing (57%). Other barriers included lack of time (48.4%) and not wearing personal protective equipment (36.6%) Table 5.

Table IV Pearson Correlation between total Knowledge Score with age, ICU experience, & ICU beds.

Variable	r	P
Age	0.154	0.15
ICU Experience	0.236	0.03
ICU Beds	-0.085	0.44

IV. Discussion

Present results indicate that ICU nurses' mean of knowledge score was similar compared with the Lin et al study (2014) study. However, other authors have reported lower mean of knowledge scores for nurses (Jansson et al., 2013; Blot et al., 2007 and Labeau et al., 2008). The variability in knowledge scores are possibly related to the modifications made to the original questionnaire used compared with other studies. Other causes might be due to differences between specific health care delivery models (El-Khatib , Zeineldine , Ayoub , Husari & Bou-Khalil , 2010) and due to differences in local and international guidelines (Labeau et al.,2008).

In this study, nurses responded more positively with respect to their nursing role in prevention of VAP (e.g. positioning, suctioning, using of beds) than was found in other studies (Blot et al., 2007 and Jansson et al., 2013). Years of experience was a significant indicator for increased knowledge among ICU nurses, as evidenced also in other studies (Jansson et al., 2013, Blot et al., 2007 and Labeau et al., 2008). Contrary to these findings, El Khatib et al., 2010 did not find any significant differences between health professionals with more than five years ICU experience and the reason behind that might be not having enough participants with less than 1 year of ICU experience. Level of education was considered a strong indicator for an increased knowledge score between nurses, as reported by others (Jansson et al., 2013 and Blot et al., 2007).

Nevertheless, females scored higher in the mean of knowledge score than males, but the difference was not significant; this result is consistent with the Blot et al.(2007) study. In the present study, this may be caused by the smaller sample size of male nurses relative to the female sample.

Contrary to our study, Llauado et al.(2011) found that nurses working with smaller ICU bed numbers have better knowledge scores than nurses in large ICUs. In this study no relation was found between knowledge score and number of ICU beds. According to Liauado et al. (2011), the literature couldn't define a clear reason for that and Liauado et al.(2011) assumed that teams with fewer people might improve their implementation to guidelines. According to the literature, the main barriers to using VAP guidelines are lack of VAP courses and nursing shortages (Jordan et al., 2014). Lack of knowledge as described in other studies (Jansson et al., 2013) may be the result of poor information provided to nurses regarding current guidelines and the lack of instruction in VAP prevention methods in nursing schools. Lack of time was identified as another barrier (Jordan et al.,

2014 and Wandel, Maes , Labeau , Vereecken & Blot, 2010) which may be related to nursing shortages and small number of nurses in ICUs.

Table V Nurses' Answers on Yes-No Questions Regarding Barriers for Adherence to VAP Guidelines

Item	Yes n(%)	NOn(%)
Lack of VAP courses	69(74.2)	23(24.7)*
Lack of time	45(48.4)	48(51.6)
Shortage of staff	69(74.2)	21(22.6)*
Lack of written protocol	47(50.5)	44(47.3)*
Decrease incidents of VAP	46(49.5)	46(49.5)*
Lack of VAP knowledge during studying	47(50.5)	44(47.3)*
Improper hand washing	53(57.0)	38(40.9)*
Failure to change gloves between patients	52(55.9)	40(43)*
Not wearing personal protective equipment	34(36.6)	58(62.4)*
*= Some participants did not respond to this item		

This study shows that educational level and the length of ICU experience impact the use of VAP guidelines. These results can be used to guide local practice and education and contribute to the debate regarding critical care nurses' knowledge about VAP prevention. Limitations of the study are as follow: Firstly, the sample was drawn using a convenience method, whereby the questionnaire was administered to all nurses in ICUs who were working during the data collection period; hence, the results can't be generalized over a larger population of nurses. Secondly, the adherence rates by participants to VAP guidelines were not taken into consideration.

V. Conclusion

The findings have clinical and research implications. The level of knowledge regarding VAP prevention is considered similar to other studies. Yet, to improve intensive care nurses' knowledge, attention must be paid by schools of nursing and hospitals to the need for improvement of educational programs and training. Future studies should be repeated on a larger sample size, especially for male nurses.

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