

Knowledge and Barriers of Critical Care Nurses Regarding Evidence-Based Practices in Ventilator-Associated Pneumonia Prevention

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BACKGROUND/AIMS

To investigate the knowledge among nurses who work in critical care units on the prevention of ventilator-associated pneumonia (VAP) and their barriers of adherence to preventive measures.

MATERIAL and METHODS

The study was performed using descriptive cross-sectional design in two hospitals in Jordan, which included 185 critical care nurses. The data were collected between June-July 2017. The questionnaire was covered 30 questions related to knowledge of VAP prevention as well as eight statements about barriers of adherence to VAP prevention guidelines. Data were evaluated using descriptive statistics, Kruskal-Wallis test, and Mann-Whitney U tests.

RESULTS

The findings of the present study revealed that nurses' overall mean of knowledge on VAP prevention were adequate level (19.6 ± 3.43 out of 30) with low-level knowledge regarding prevention strategies of VAP. Lack of equipment's (65.9%), forgetting to practice the sterile techniques (54.1%), and lack of time to deliver proper infection control (53.0%) were the main barriers mentioned by Jordanian critical care nurses of VAP prevention. Nurse's with high experience and master degree showed significantly better knowledge of VAP prevention than their other groups.

CONCLUSION

Achieving an adequate knowledge of VAP prevention is an important feature for reinforcing patient care outcomes. The results of this study highlighted to necessity of creating new strategies for improving knowledge of critical care nurses and removing their barriers regarding VAP prevention.

Keywords: Critical care nurses, intensive care unit, ventilator associated pneumonia, ventilator bundle

INTRODUCTION

Ventilator-associated pneumonia (VAP) is the most serious acquired infections in intensive care units (ICUs) for patients undergoing mechanical ventilation.¹ The infection can progress after intubation between 48 or 72 hours. In some cases, it may be related to healthcare providers.² VAP is considered the most significant cause of death in ICU.^{3,4} Lately, it is estimated that between 9-13% deaths were as a result of ventilator assistance devices.⁵ VAP accounts for 25% of all types of ICUs acquired infections.⁶ Consequently it leads to prolonged hospitalization and ICUs stay.⁷ Moreover, it contributes to increased length of mechanical ventilation, which increases the cost of treatment to approximately \$40,000 per patient.⁸

In developing countries, multiple studies indicated a significant increase in VAP incidence. In northern India, the incidence of 40.1 VAP infections/1,000 ventilator days.⁹ In Costa Rica, the incidence of 44.3 VAP infections/1,000 ventilator days.¹⁰ In another study, In Iran, is 21.6% or 9.96 per 1,000 days of ventilation.¹¹ Multiple factors contribute to the increasing rate of VAP such as tracheostomy, reintubation, impaired consciousness, and presence of an endotracheal tube.¹² There is a few accurate information on VAP prevalence in Jordan hospitals, nevertheless a study found a prevalence rate of

29 cases per 1,000 ventilator-days and a mortality rate of 53% related to VAP.¹³ A few studies have been performed among Jordanian critical care nurses to assess their compliance and knowledge of VAP, yet, still not effectively and questionable. For instance, in a two-group post-test design study among critical care nurses, they demonstrated moderate compliance.¹⁴ In pre- and post-intervention study majority of nurses revealed low knowledge level regarding VAP preventative measures, risk factors and pathophysiology.¹⁵ An observational study, after 5 months of observations, revealed more than half of nurses had "insufficient compliance."¹⁶ In another study, Aloush et al., survey was performed for three countries: Jordan, Saudi Arabia, Egypt, the study showed insufficient compliance for both nurses and hospitals.¹⁷ That leads to adverse outcomes, and impact the quality of care.

There were many barriers in Jordan that impede nurses with respect to VAP prevention practices, the most common ones are; lack of equipment, low level of compliance with infection-control standards,¹⁸ lack of time and work load,¹⁵ lack of education, resources, and experience.¹⁷ Hence, it is susceptible to increasing VAP incidence.

In critical care units, VAP prevention is prioritized for intubated patients.¹⁹ Many organizations such as the European Respiratory Society,¹ The Society for Healthcare Epidemiology of America³ has launched a concept "ventilator bundle" to decrease VAP mortality and enhance prevention, it comprises several clinical practice guidelines. These guidelines combinations such as oropharyngeal hygiene, suction endotracheal secretions,³ the elevation of the head at 30-45° and facilitating early mobilization.²⁰ Even though considered as low-costs and nonpharmacological practices as well as efficient for preventing VAP, yet still Jordanian critical care nurses showed insufficient capacity.²¹ Substantial evidence shows that the implementation of a VAP prevention bundle is a proven way in respect to providing an efficacious reduction in VAP rates,²² improving patient safety, and enhancing the quality of care.²³

Determination the knowledge among critical care nurses related to VAP prevention, and the barriers to the obligation to implement evidence preventives may be useful in improving their awareness, thus leading to better practices and preventing this important problem in Jordan. Thus, this study aims to investigate the knowledge of VAP prevention guidelines and determine the barriers which impede to the obligation of preventive strategies among critical care nurses. In this context, the research questions were:

- What is the knowledge level of critical care nurses on the prevention of VAP?
- What are the barriers which may prevent critical care nurses to adhere to preventive measures of VAP?
- Is there any difference between descriptive characteristics and knowledge of the nurses working in critical care units on the prevention of VAP?

MATERIAL and METHODS

Study Design

The study was designed in a descriptive cross-sectional. It was conducted at two randomly hospitals in the middle and northern region in Jordan. The King Abdullah University Hospital is

an affiliated hospital to the largest and leading university of Jordan which is located in the northern part of Jordan. The hospital consists of 15 floors and 683 beds, 12 operating theaters, 78-intensive care beds for adult and child patients. It has care bundles for VAP prevention. The Islamic hospital located in the middle part of Jordan, it has a capacity of 300 beds, eight operating theaters and 25 intensive care beds and hospital protocol for prevention of VAP.

Study Population

The study population was composed of 193 registered nurses who were working at day or night shift in ICU departments of the hospitals. A total of 132 nurses were working in the ICU units in the first hospital and 61 nurses in ICU in second hospital. Nurses work in the ICUs with at least one year experience, willing to participate and hold a bachelor's degree were involved in the study. Nurses who have a diploma degree in nursing and trainees were out of the study.

Study Instrument

A questionnaire which was used as a data collection tool in this study by the researchers was based on recent evidence-based guidelines of VAP prevention.¹³ The questionnaire composed of three sections. The first section with eight questions included the demographic characteristics of the nurses. The second section had questions regarding the knowledge needed in the prevention of VAP, which had 30 questions with two options; true option was marked 1, false option was 0, questionnaire contains eight items negative statements (items 4, 7, 9, 11, 17, 19, 20, and 23) were recorded to compute a percent correct statements response rate. The last section consisted of eight questions with three response options of "Always/Sometimes/Never" designed to determine the barriers to adherence to VAP prevention measures.

In the current study, Cronbach's α was showed an acceptable range of 0.77. Questionnaire content was assessed for clarity and acceptability by three ICU nurse specialists and necessary revisions were made based on their recommendations. Then, a pilot study was implemented in 10 nurses, since there was not reported any difficulty and obscurity in questionnaire content, these nurses were included in the main sample. Researchers were using the English language for survey content because it is the official language for teaching at all of the nursing faculties in Jordan.

Data Collection

Data were collected in a period from 20 June to July 20, 2017 by using self-completion method filled out the study questionnaire. Before collecting data, researchers sent an official letter from the principal investigator, along with hospital director permission to nurse manager of ICUs in both hospitals to encourage critical care nurses to participate in this study, as well as informing them the results will not affect your annual evaluation. After encouragement and explanation the purpose of the study we distributed the questionnaires depending on the hospital size, each participant received a copy of the informed consent and questionnaire. During data collection, researchers avoided the period's nurses were providing treatment and care to patients, to avoid stressing participants that could affect the proficiency of the data collection process. Duration of questionnaire between 10 to 15 minutes, after completion, researchers collected it immediately to obviate data miss, also we informed

them you can keep it with you and give back to researchers, inside the sealed envelope without using any employee information's to ensure privacy. Ethical approval was secured from the Near East University Institutional Reviews Board (IRB) and permission was obtained from the director of the hospitals. Written informed consent was sought from all participants.

Statistical Analysis

All survey papers were kept in a closed locker in investigator office, as well as data were inserted to the Statistical Package for the Social Sciences, version 22.0 (IBM SPSS Corp.; Armonk, NY, USA) using numeric codes and saved on password computer. Descriptive statistic included frequency and percentages were performed to describe characteristics of the nurses, knowledge prevention and barriers of VAP. The highest score of knowledge prevention was 30 and the lowest 0. Mean knowledge prevention (≥ 15) were reflected as inadequate knowledge; while score more than (> 15) were indicated adequate knowledge. A nonparametric tests Kruskal-Wallis test and Mann-Whitney U test was used to compare knowledge in prevention concerning demographic characteristics. $P < .05$ sets a significance.

RESULTS

Once completed, 185 out of 193 completed the questionnaire with a response rate of 95.9%, eight of them did not fill the questionnaire. The mean age of the participants was the 26-30 age group (55.1%). Females composed the majority of the participants (58.4%). Most of the participants had bachelor's degrees (89.2%). The majority of the nurses had an experience of fewer than 5 years as registered nurses (60.1%).

The majority of the nurses had already received VAP education (71.4%). The participants mentioned educational resources where they had received the related education, with external courses making up 24.9%, the highest rate in this respect. As far as the quality of VAP education was concerned, most of the nurses (86.9%) held the opinion that the education was "Satisfactory." The majority of the nurses mentioned that they wanted to be educated on VAP (79.5%) (Table 1).

Concerning the knowledge of evidence-based guidelines of VAP prevention, they had an adequate overall mean knowledge, with (19.6 ± 3.43). The results of the study showed that the highest correct response rates were delivered in terms of; elevating the head of the bed to 30-45° (89.2%), regular oral care with chlorhexidine (88.7%), followed by adequate hand hygiene (88.6%), continual education for ICU nurses (88.1%), proper sterilization and disinfection of respiratory care equipment (87.6%), VAP is the cause of highest mortality among nosocomial infections (86.5%), and assess readiness of the patient to extubate daily (84.9%) (Table 2).

Table 3 shows the barriers the nurses have to face in respect of adherence to VAP prevention guidelines. Findings revealed that most of the nurses responded in the option of "sometimes" with respect to the barriers nurses face regarding adherence to VAP prevention guideline. The option of "Shortage of staff in the ICU" got most of the answers. In "always" option (51.4%) and "Lack of VAP Prevention Knowledge" (49.7%). As far as the answers in the option of "sometimes" are concerned, it was the items of "Lack of equipment such as gloves and face masks" (65.9%), "Hospital system insufficiencies" (54.1%), and "Lack of time to deliver proper infection control" (53.0%).

TABLE I. Demographic Characteristics of the Nurses (N = 185)

Demographic characteristics	N	%
<i>Age (mean :28.1)</i>		
≤25 years	44	23.8
26-30 years	102	55.1
≥31	39	21.1
<i>Gender</i>		
Male	77	41.6
Female	108	58.4
<i>Education degree</i>		
Bachelor's	165	89.2
Master degree	20	10.8
<i>Working experience in the ICU</i>		
≤5 years	114	61.6
6-10 years	62	33.5
≥11 years	9	4.9
<i>Previous VAP education</i>		
Yes	132	71.4
No	53	28.6
<i>Education resource (N = 132)*</i>		
Nursing school	20	10.8
External courses	46	24.9
Web resources	17	9.2
In-service education	32	17.3
Other	13	7.0
<i>Quality of the VAP education (N = 132)*</i>		
Satisfied	114	86.9
Dissatisfied	18	13.1
<i>Need for education on VAP</i>		
Yes	147	79.5
No	38	20.5

*Percentages were calculated based on the number of nurses who had received education previously (N = 132).

Regarding the correlation between nurses' age, years of ICU experience and previous VAP education with knowledge of evidence-based guidelines of VAP prevention revealed no statically significant differences. The study revealed that nurses with ≤ 25 years old had higher VAP prevention knowledge mean rates (19.7 ± 3.2) than other age groups. The nurses who had ≥ 11 years of experience showed higher mean rates (20.6 ± 3.6) on VAP prevention knowledge than the groups with 6-10 and ≤ 5 years. The nurses who had previous VAP education had high mean prevention knowledge (19.8 ± 3.3) than nurses without VAP education (Table 4).

DISCUSSION

The main focus of the present study was to determine knowledge of critical care nurses toward VAP prevention guidelines and the barriers which they face in respect of adherence to preventive measures in critical care units. In the current study, the mean overall knowledge of VAP prevention was adequate, contrary to previous studies which reported mean scores knowledge were relatively low.²⁴⁻²⁶ The explanations of higher mean scores might be related to the participant's effective memory since most of them were fresh graduates, which could easily remember what they had learned. Another explanation may be attributed to the revising and correcting which was made to create a new questionnaire on knowledge regarding VAP prevention. In the current study, our participants had highest correct answers about elevating the head of the bed to 30-45°, regular oral care with chlorhexidine, adequate hand

TABLE 2. Nurses' General Knowledge of VAP Prevention (N = 185)

Statements on VAP	T\F	Correct answer	
		N	%
The ventilator associated pneumonia (VAP) is pneumonia that occurs > or equal 48 hours after endotracheal intubation	T	151	81.6
VAP is cause of highest mortality rate among nosocomial infections	T	160	86.5
VAP is the most prevalent infection in intensive care units	T	140	75.7
Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP	T	102	55.1
Over feeding a ventilated patient is associated with increased the risk for VAP	T	144	77.8
Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP	T	165	88.1
If possible, intubation should be avoided to prevent VAP	T	135	73.0
Whenever feasible, noninvasive positive pressure ventilation should be used to prevent VAP	T	98	53.0
It is necessary to manage patients without sedation whenever possible to prevent VAP	T	113	61.1
Benzodiazepines should always be preferred to manage agitation	F	107	57.8
Sedation should be interrupted daily to prevent VAP	T	119	64.3
It is necessary to assess readiness to extubate of the patient daily to prevent VAP	T	157	84.9
Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary	F	123	66.5
Minimizing pooling of secretions above the endotracheal tube cuff is necessary to prevent VAP	T	128	69.2
Changing the ventilator circuit regularly is necessary to prevent VAP	F	47	25.4
Elevating the head of the bed to 30-45 is important in prevention of VAP	T	165	89.2
Early exercise and mobilization may increase the possibility of VAP	F	88	47.6
Regular oral care with chlorhexidine is necessary to prevent VAP	T	165	88.7
Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP	T	162	87.6
Oral route is recommended for endotracheal intubation to prevent VAP	T	118	63.8
Prophylactic probiotics may be useful to prevent VAP	T	134	72.4
Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates	T	68	36.8
Saline instillation before tracheal suctioning may cause to VAP	F	70	37.8
Mechanical tooth brushing may be useful in prevention of VAP	T	109	58.9
Closed/in-line endotracheal suctioning reduce the risk of VAP	F	48	25.9
Kinetic beds reduce the risk of VAP and recommended	F	63	34.1
Adequate hand hygiene between patients and change gloves is important to prevent the VAP	T	164	88.6
Prone positioning intermittently may prevent VAP and recommended	F	105	56.8
Using selective oral or digestive decontamination to reduce risk VAP	T	129	69.7
Care bundles may be useful in reducing VAP	T	149	80.5

T, true; F, false.

TABLE 3. Barriers of Nurses to Adherence to VAP Prevention Guidelines (N = 185)

Statements about barriers	Always		Sometimes		Never	
	N	%	N	%	N	%
Lack of VAP prevention knowledge	92	49.7	76	41.1	17	9.2
Lack of educational programs on VAP such as in-service education or courses	89	48.1	82	44.3	14	7.6
Shortage of staff in the ICU	95	51.4	70	37.8	20	10.8
Lack of equipment such as gloves and face masks	40	21.6	122	65.9	23	12.4
Lack of written VAP protocol at the hospital	72	38.9	89	48.1	24	13.0
Hospital system insufficiencies	76	41.1	90	48.6	19	10.3
Lack of time to deliver proper infection control	66	35.7	98	53.0	21	11.4
Forgetting to practice the sterile technique	68	36.8	100	54.1	17	9.2

hygiene, continual education for ICU nurses proper sterilization and disinfection of equipment, assessing the readiness of the patient for intubation and importance of care bundles. There is evidence in the relevant literature about these preventive measures. A study found that head-of-bed elevation to 30-45° significantly decreases the prevalence of VAP.²⁷ A recent study shows that Jordanian nurses were using, more than Saudi Arabia and Egypt nurses, chlorhexidine solution.¹⁷ Another study held among Jordanian nurses that showed around two-third of them wash their hands before and after performing patient care.¹⁸ It also revealed significant improvement among nurses after VAP training.²³ A review study concluded the asepsis is the main mode of mechanical ventilation pneumonia

prevention.²⁸ A study found a substantial decreasing of incidence and risk of VAP after implementation of the ventilator care bundle.²⁹

Although the high level of correct answers in respect of several strategies, results revealed the participants had a low level of correct knowledge regarding interventions which are considered as high and moderate interventions like; noninvasive positive pressure ventilation, minimizing pooling of secretions above the endotracheal tube cuff, oral route, noninvasive positive pressure, selective oral or digestive decontamination, and patients without sedation with studies.^{15,30,31} These findings are attributed to several reasons; shortage of staff and resources,¹⁵

TABLE 4. Relationship between Knowledge of VAP Prevention and Demographic Characteristics of the Nurses

Demographic characteristics	VAP knowledge prevention mean	SD
<i>Age</i>		
≤25 years	19.3	3.4
26-30 years	19.7	3.2
≥31 years	19.4	4.0
<i>P</i>	.744	
<i>ICU experience</i>		
≤5 years	19.5	3.4
6-10 years	20.4	3.2
≥11 years	20.6	3.6
<i>P</i>	.249	
<i>Education degree</i>		
Bachelor's	19.4	3.3
Master degree	20.6	3.8
<i>P</i>	.161	
<i>Previous VAP education</i>		
Yes	19.8	3.3
No	19.0	3.5
<i>P</i>	.160	

lack of administration of antibiotics¹³ lack of unit policies,³² and nurse-patient ratio.¹⁶

Regarding the items which were coded as negative statements, although it is considered as high and moderate interventions; except that participants reported a low level of knowledge, which indicated that comprehensive training is needed under supervision in-service education units. In the current study, around half of the nurses thought benzodiazepines should be always preferred to manage agitation, although the recommended is other agents.³³ In this study, findings were consistent with study³⁴ nurse's beliefs that changing of ventilator circuit should be regular, while the change is only recommended if there is clear soiling or malfunctioning. In early exercise and mobilization, nearly half of nurses reported it to contribute to increasing the possibility of VAP, whilst the early exercise reduces prolonged hospitalization.³⁴ In this study, findings are comparable with other studies in which nurses contrary believed the closed/in-line endotracheal suctioning is recommended, whilst the recommended is closed-suction system.^{30,31,34} Majority of nurses reveals that kinetic beds and prone positioning may reduce the risk of VAP, while both of them generally are not recommended.³ This reveals that closed-suction system and ventilator circuit were changed continually during daily practice, which is congruous with another study.²⁴ That may be attributed to nonupdate VAP guidelines and absence or few qualified ICU nurses with a specific degree of VAP prevention, another reason it may be associated with VAP education resource, more than one third of our participants said that they had received an external course and less frequently in in-service training and nursing school, that corroborate with studies conducted among Jordanian ICU nurses that found a majority of nurses gained their knowledge not directly from nursing schools and in in-service training.^{15,16}

Concerning the barriers of the nurses on adherence to VAP prevention guidelines, most of them selected the option of "sometimes" in this respect. The items that attracted the answers in the option of "sometimes" were regarding lack of

equipment such as gloves and face masks, forgetting to practice the sterile technique and lack of time, which was congruous with regional study among Jordanian critical care nurses, also indicate the limited of infection control equipment's is unsafe practice in Jordan hospitals and forms a significant challenge.¹⁸ On the other hand, the items of "Shortage of staff in the ICU," "lack of VAP knowledge," and "lack of educational programs" attracted the majority of the answers in the option of "always." These results were in agreement with several studies; in one study, the author indicates the small number of staff in the ICU, and it constitutes the main barrier.³⁵ Another Jordanian critical care nurse who works with equal nurses: patient ratio reflects better VAP compliance than others.¹⁶ However, the adequate number of nurses in ICUs may reduce the VAP rate and ICU length stay. Lack of VAP knowledge, and educational programs presented main barriers among Jordanian critical care nurses.^{15,17} Sufficient nurses' knowledge contribute to provide perfect patient care, create a trust to apply optimal decisions and enhance ventilated patients outcomes.²⁴

In the current study, we observed the expert's nurses and the master degree revealed an adequate knowledge, when nurses' degree level and experience increased, their level and experience of knowledge as well increased, which is congruence with studies.^{26,31} Availability of an expert ICU qualification contributes a significantly better for VAP prevention.

On the other hand, nurses who received previous VAP education showed adequate knowledge than their colleagues who did not receive, these findings were supported by studies that revealed that continuous education and training enhanced both knowledge and compliance related to VAP preventive measures and significant practical improvement were seen after education sessions.²⁴ Continuing education programs are necessary to improve nurses' knowledge of VAP prevention, and nursing administrators and hospitals should be utilizing a systemic strategic and educational plan of VAP prevention.

There were some limitations. First, no sample selection method was used. Second, we have been unable to find out the impact of work climate of VAP knowledge prevention among critical care nurses; third, the study was conducted only at two hospitals and it can be difficult to generalize and apply it to other nursing populations.

In conclusion, the basic knowledge of VAP among nurses was adequate level. The study findings reflect that nurses gained this knowledge from daily routine and their schools, which is considered fundamental nursing skills. However, participants needed education on VAP to improve nursing skills and enhance patient's outcomes.

Policymakers and hospitals administrators should pay attention to implement and update VAP prevention guidelines, which would be useful for improving the quality of nursing care and increasing awareness of the nurses to make the right decisions. In additional, deans of nursing faculties should revise the undergraduate nursing curriculum in Jordan and incorporate acute care initiatives.

The results yielded showed main barriers nurses mentioned, these barriers may inhibit both the development and motivation of the personnel and increase the incidence of VAP

complications, both national and institutional regulations are necessary to prevent barriers of VAP prevention.

Ethics Committee Approval: Ethical committee approval was received from the Near East University Institutional Reviews Board (IRB) (Reference number: 2017\47-420).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer-review: Externally peer-reviewed. Written informed consent was sought from all participants.

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