Journal of Research in Clinical Medicine

J Res Clin Med. 2025;13:34714
doi: 10.34172/jrcm.025.34714
https://jrcm.tbzmed.ac.ir

TUOMS PRESS

Original Article

Knowledge, attitudes and practices of intensive care unit nurses about ventilator-associated pneumonia bundle: A descriptive cross-sectional study

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Article info

Article History:
Received: December 31, 2023
Revised: August 14, 2024
Accepted: August 14, 2024
ePublished: December 27, 2025

Keywords:
Attitude, Intensive care units, Knowledge, Pneumonia, Ventilator-associated, Patient care bundles

Abstract

Introduction: Ventilator-associated pneumonia (VAP), a common nosocomial infection, increases the length of hospitalization and the patient mortality rate. A ventilator care process "bundle", composed of peptic ulcer disease prophylaxis, deep vein thrombosis (DVT) prophylaxis, elevation of the head of the bed, and a sedation vacation, may decrease VAP rates. This cross-sectional descriptive study aimed to assess the knowledge, attitudes, and practical levels of intensive care unit (ICU) nurses toward VAP bundle.

Methods: A four-part questionnaire was designed and distributed to the all-general ICU nurses ($n=100$) at Sina, Shohada and Imam Reza hospitals of Tabriz University of Medical Science in Iran, from November 2021 to November 2022, who intended to take part in this project and completed the questionnaire form completely. Analysis of variance (ANOVA) tests were used to compare ICU nurses' knowledge, attitude, and practice levels.

Results: 54% of nurses presented high knowledge, 64% had moderate practices, and 90% had a positive attitude toward VAP bundles. Nursing experience in ICU wards, level of education, and participation in infection control courses had a significant relation with the knowledge and practice levels ($P<0.05$), while only the education level showed significant association with positive attitude ($P=0.007$).

Conclusion: ICU nurses demonstrated a high level of knowledge, a positive attitude, and a moderate level of practice regarding the VAP bundle.

Introduction

VAP is a well-known hospital-acquired infection which can prolong the length of hospital and intensive care unit (ICU) stays, and also rise treatment costs by 40,000 dollars annually.[1] This infection appears more than 48 hours after endotracheal intubation, with an incidence rate between 8 and 28% and a mortality rate of 30 to 70%.[2] A bundle is a collection of distinct components that work together to create a set of quality indicators for a certain system, process, or therapy.[3,4] Oral care, subglottic drainage and closed suctioning, the prophylaxis of deep vein thrombosis (DVT), daily assessment of extubation readiness, daily sedative interruption, and adjusting the head of bed elevation to 30° and 45° are components of care that provided by the Institute for Healthcare Improvement's (IHI's) ventilator bundle.[5,6]

The use of ventilator-associated pneumonia (VAP) care bundles has been recommended by the IHI and the Centers for Disease Control and Prevention (CDC) to decline mortality and morbidity in patients with VAP. In addition, VAP bundle tried to decrease or remove VAP and promote attitude and adherence toward evidence-based guidelines (EBGs) for the patient outcomes improvement.[7]

Hospitals that use a VAP prevention bundle more than 95% of the time have even maintained zero VAP rates for extended periods.[8] Despite the fact and data that showed VAP is preventable, there is still a substantial gap between

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knowledge, attitude, and actual practices of ICU staff about VAP bundle.[7]

The attitudes and knowledge of all ICU staff, as well as the suitable organizational support including infrastructure, reinforcements, reminders, and effective monitoring, all play a role in how well VAP prevention guidelines are followed.[9-11] Efforts to improve knowledge and attitudes improvement toward VAP prevention, should include information about the level of knowledge regarding risk factors and incidence of VAP, the severity of consequences to create the essential ground for motivation to change the behavior.[12] The purpose of this study is to investigate the current knowledge, attitude and practices of ICU nurses related to VAP prevention bundle among patients on mechanical ventilation.

Methods

Study Design

This project is a cross-sectional descriptive study which was conducted in Sina, Shohada and Imam Reza hospitals of Tabriz University of Medical Science from November 2021 to November 2022 in accordance with the ethical standards. Also, each subject in the project signed a detailed informed consent form. Data collection and analysis were determined by Tabriz University of Medical Sciences to be a part of the continual public health investigation. One hundred of ICU nursing staff participated in this study. Using census sampling, 139 nurses who worked in general ICU wards of Sina, Shohada and Imam Reza hospitals were enrolled in this study. The inclusion criteria were as follows: The nurses who signed the informed consent and had at least 6 months working experience in the ICU wards with education level of B.Sc and more were included in this study. The exclusion criteria were as follow: (1) The ICU nurses were not signed informed consent; (2) The questionnaires were completed by staff members other than ICU nurses; and (3) The questioners filled incompletely with the participants. The total number of the nurses who participated in this project was 100 persons based on the inclusion and exclusion criteria. The sample size was calculated based on similar studies according to the following formula: $n = Nz^2pq / Nd^2 + z^2pq$. n represents the sample size, N = Population size, Z is confidence level at %95 = 1.96, pq = variance of population = 0.501, d = estimated error.

The questionnaire was designed by Department of Anesthesiology and Critical Care Medicine professors and distributed to all ICU- nursing staff (Tables 1-4). The following sections of a four-part questionnaire were used: demographic data and closed/open questions about knowledge, closed/open questions about attitudes, and closed/open questions about practices.

To evaluate the validity of the data, the designed questionnaire was given to the 10 individuals who were expert in the fields of nutrition, critical care medicine. The reliability of the questionnaire was assessed using Cronbach's alpha test.

Table 1. Questionnaire (part I): Demographic data

Questions	Numbers
Gender	1
Age	2
Level of education	3
School/university of obtaining the last degree?	4
Are VAP bundle criteria observed in your ICU wards?	5
Average nursing experience in hospital (year)	6
Average nursing experience in the ICU wards (year)	7
Participation in infection control courses?	8

Abbreviations: VAP, ventilation associated pneumonia; ICU, intensive care unit.

A score 1 was assigned to correct responses, while incorrect ones were assigned by a score of 0. About questions which included yes or no options, "yes" answers were given a score of 2 and "no" answers were given a score of zero and questions without answer were given 1 score. The highest possible score was 44, while the lowest was 0.

The descriptive statistics were used to determine the frequency and percentage of quantitative variables for demographic data and participant's responses. Also, mean ± SD was evaluated for the continuous variables.

Statistical Analysis

Data were analyzed using SPSS software (version 26.0, Chicago, Il, USA). Descriptive statistics were used to depict demographic information and participants' responses. Percentages and frequencies were used to analyze categorical variables, while for continuous variables, mean ± SD deviation was calculated. The normality of data distribution was evaluated by One-Sample Kolmogorov-Smirnov test. The association and differences between categorical variables were evaluated using the Kruskal-Wallis and the chi-square tests, and the knowledge, attitudes, and practices of ICU nurses were compared with each of the questionnaire variables using analysis of variance (ANOVA) tests. Pearson correlation was used to assess the relationship between knowledge and practice. *P* value less than 0.05 was considered statistically significant.

Results

Of the 100 ICU nursing staff who participated in this project, 75% were female and 25% were male. The frequency of correct responses to the knowledge, attitude, and practice questions were summarized in Tables 2, 3, and 4, respectively. The demographic information was depicted in Table 5. The majority of participants (54%) were the nurses with a high-level of education while, medium level of practice (64%) was shown by most of ICU nursing staff. Regarding nurses' attitude, 90% of participants had positive attitude toward the VAP-bundle guideline. Levels of knowledge, attitudes, and practices

Table 2. Questionnaire (part II): Knowledge questions

Correct response N = 100 (%)	Questions	Numbers
58 (58)	About the ventilator-induced pneumonia definition, what is the minimum time required for a patient to be under mechanical ventilation and suffer from VAP? 24hours 48 hours 72 hours 1 week	1
56 (56)	What is the first common infection in ICU wards? Urinary tract infection VAP Catheter related infections Gastrointestinal infections	2
97 (97)	Which of the following is true regarding complications from ventilator-associated infection? It increases the duration of hospitalization in ICU ward. Increases the days connected to the ventilator in the patients. Increases the patient's mortality rate. All of the above.	3
84 (84)	Which option plays a role in creating VAP? The head of bed angle for patients Gastrointestinal prophylaxis (PVD) and DVT Maintaining oral hygiene with mouthwash solution All points mentioned above.	4
62(62)	Which option does not play a role in creating VAP? Suction of subglottic secretions Selective intestinal decontamination Turning to the sides continuously All cases.	5
71.40 ± 18.16	**Total score, Mean ± SD**	

Abbreviations: VAP, ventilation associated pneumonia; ICU, intensive care unit.

Table 3. Questionnaire (part III): Attitude questions

Positive response N = 100 (%)	Questions	Numbers
57 (57)	Are the VAP Bundle items routinely observed in your department? 1) Yes 2) No 3) Somehow	1
52 (52)	Are infection control classes regularly and routinely held in your department and the hospital? 1) Yes 2) No 3) Irregularly and occasionally	2
46 (46)	Are the typed VAP Bundle items exposed in your department as a protocol? 1) Yes 2) No	3
87 (87)	Do you personally follow the VAP Bundle for your patients? 1) Yes 2) No 3) I don't have any information about VAP Bundle	4
60.50 ± 18.23	**Total score, Mean ± SD**	

Abbreviations: VAP, ventilation associated pneumonia.

of ICU nursing staff towards VAP-bundle guideline in ICU-wards and their relations to their demographic characteristics are shown in Tables 6 and 7. Our findings showed that there is a significant association between nursing experiences in ICU wards and nurses' knowledge ($P = 0.02$) and practice ($P = 0.04$). Moreover, the nurses' education level had a significant relation with knowledge ($P < 0.001$), attitudes ($P = 0.007$), and practice ($P = 0.02$). Also, nurses who took part in the infection control courses had better knowledge ($P = 0.03$) and practice ($P = 0.005$) in VAP-bundle guideline observation. Table 8 illustrated the positive correlation between ICU-nurses' knowledge and practice ($r = 0.17$; $P = 0.041$).

Discussion

VAP is the most common nosocomial infection that increases the length of hospitalization, costs of medical care and mortality rates.[13] Previous studies showed that VAP incidence rate decreased following high quality ICU cares.[14-16] In our study the nurses' mean ± SD total score of correct responses to the VAP questionnaire (knowledge section questions) was 71.40 ± 18.16. El-Khatib et al study indicated that the nurses' mean total score of correct responses to the VAP bundle knowledge questions was

Table 4. Questionnaire (part IV): Practice questions

Correct Response N = 100 (%)	Questions	Numbers
72 (72)	Regarding nasal intubation compared to oral intubation, which option do you suggest? Oral intubation Nasal intubation Both methods can be useful. I don't know.	1
38 (38)	Regarding the number of replacement in the tubes connected to the ventilator, which option do you recommend? Changing it every 48 hours or when clinically indicated. Changing it every week or when clinically indicated. It should be changed for each newly hospitalized patient or when clinically indicated. I don't know	2
61 (61)	Which type of humidifier is recommended for the ventilator? Heated humidifiers Heat and moisture exchangers (HMEs) Both models is suitable. I don't know.	3
36 (36)	When is it recommended to replace the recommended humidifiers? Changing it every 48 hours or when clinically indicated. Changing it every 72 hours or when clinically indicated. Changing it every week or when clinically indicated. I don't know.	4
15 (15)	Between the open and closed suction system, which one do you recommend? Open suction system. Closed suction system. Both systems can be recommended. I don't know.	5
49 (49)	How often is it recommended to change the tubes of the suction system? Changing daily or when clinically indicated. Weekly replacement or when clinically indicated. For each newly hepatized patient or when clinically indicated. I don't know.	6
62 (62)	Tracheal tubes with special lumens for suctioning subglottic secretions:	7
65 (65)	Do mobile beds increase the occurrence of VAP*? Increases the risk of VAP. Reduces the risk of VAP. It has no effect on the incidence of VAP. I don't know.	8
83 (83)	Which position is recommended to reduce the risk of VAP? Supine The position of the patient has no effect on the incidence of VAP. Semi-recumbent I don't know	9
85 (85)	Which mouthwash is recommended to reduce the risk of VAP? Normal saline Chlorhexidine Nystatin I don't know.	10
40 (40)	What is the effect of daily interruption of sedation and daily examination of the patient in terms of the extubation ability on the occurrence of VAP? Increases the risk of VAP. Reduces the risk of VAP. It has no effect on the incidence of VAP. I don't know.	11
91 (91)	What is the recommended position for the head of the patient to reduce the incidence of VAP? 15-20 degree angle 20-25 degree angle 30-45 degree angle 6-90 degree angle	12
58.08 ± 23.06	**Total score, Mean ± SD**	

Abbreviation: VAP: Ventilation associated pneumonia.

78.1% which was confirms our results. In El-Khatib et al study ICU staff members participated which was different with our study that just ICU nurses participated.[12] Jansson et al revealed that the mean score of nurses knowledge was more than 59.9%.[9] Akafzadeh et al study showed that the mean knowledge score of ICU-nurses was less than 50% (15.02 ± 4.29) which was inconsistent with our results.[17] The variability of the results might have related to differences between the specific healthcare delivery models. Our findings showed that adequate ICU-nurses knowledge level about VAP-bundle guideline is helpful for the prevention of VAP because the patients hospitalized in ICU-wards were not able to manage their personal affairs this issue demands a high level of knowledge from nurses.

Additionally, our result showed that 54% of general ICU nurses answered to more than 80% of the knowledge questions. Abad et al reported that 73.33% of ICU nurses and ICPs answered correctly to the 50% of the questions which is inconsistent with our results that may related that in our study the questionnaires were filled with ICU nurses, not all ICU staff members, also the education level of the various participants could affect the results.[7]

The results of this study disclosed that 90% of the ICU-nurses had positive attitude compliance with the VAP bundle guideline which is toward the results of Stein et al and Angelillo et al studies about compliance infection control guideline.[18,19]

Our outcome showed that the mean practice score of ICU nurses was above 50% and Akafzadeh et al reported that the mean score of nurses' practice about VAP prevention was above average which is consistent with our finding.[17] The nurses with the mean of 3.47 ± 2.02 years of experience in the ICU wards significantly associated with the nursing knowledge and practice. Reisskarimian and Rostaminezhad study demonstrated that there was a positive correlation between high knowledge and better nurses' practice.[20]

Eskander et al reported that the significant positive correlation between knowledge and practice of ICU-nurses about infection control standard precautions in the current study. This finding proved that nurses' practice toward infection based on their knowledge which is in line with our results.[21] Also, Gijare, Hamid et al, and Ndikom & Onibokun studies result were in agreement with our research outcome which indicated statistically significant association between nurses' knowledge and practice.[22-24]

Consequently, the nurses with an experience in the ICU wards were more probably to participate in VAP bundle training courses. However, in Abad et al study, the knowledge of long-experienced nurses were similar to less experienced nurses which is different with our result.[14] Labeau et al reported that there was a significant association between nurses' experience and their knowledge which is in line with our findings.[25]

The experienced nurses had high knowledge level about VAP-bundle guideline. The results of this study showed that the knowledge level in ICU nurses was significantly associated with nursing experience in the ICU wards,

Table 5. Nurse's demographic information

Variables	Frequency
Age	32.21 ± 6.79 (min = 24; max = 50)
Gender	
Female	75 (75%)
Male	25 (25%)
Education level	
B.Sc.	73 (73%)
M.Sc.	20 (20%)
Ph.D.	7 (7%)
Average nursing experience in hospital (year)	8.29 ± 6.33
Average nursing experience in the ICU wards (year)	3.47 ± 2.02
Participation in infection control courses	
Yes	87 (87%)
No	13 (13%)

Abbreviation: ICU, intensive care unit.

Table 6. Level of Knowledge, attitudes and practices of intensive care unit nurses towards VAP bundle

		Total Number	Total Percentage
Knowledge	High (4-5)	54	54%
	Medium (2-3)	42	42%
	Low (0-1)	4	4%
Attitude	Positive answer (3-4)	90	90%
	Positive answer (0-2)	10	10%
Practice	High (9-12)	22	22%
	Medium (5-8)	64	64%
	Low (0-4)	14	14%

Table 8. Correlation between knowledge and practice scores of the studied sample (N = 100)

Variable	Practice	
	rho	*P* value
Knowledge	0. 17	0.041

Table 7. Association between demographic data and Knowledge, attitudes and practices of ICU nursing staff

Variables	Age	Gender	Nursing experience in hospital (year)	Nursing experience in the ICU wards (year)	Education level	Participation in infection control courses
Knowledge	0.34	0.23	0.52	0.002	<0.001	0.03
Attitude	0.25	0.36	0.21	0.39	0.007	0.51
Practice	0.13	0.32	0.32	0.04	0.02	0.005

education level and participation in infection control courses which was in line with Akafzadeh et al and Reisskarimian & Rostaminezhad studies that showed a significant association between nurses' knowledge level and work experience.[17,20]

This project has some limitations. Self-reporting could affect the reliability of the results because participants answer the knowledge questions based on their memories. The general ICU nurses who participated in the survey may have had a specific interest in VAP prevention The sample was small, meaning that some of the nurses excluded based on exclusion criteria. But the sample showed various age groups, experience level, education and education level which reflects the ICU nurses' interest in the issue of VAP prevention. Therefore, these findings can be regarded as a description of East Azerbaijan ICU nurses. This study can help to expand our understanding of nurses' knowledge, attitude and adherence to VAP bundle in ICU wards of East Azarbaijan.

Conclusion

Our study showed that the ICU-nurses presented high knowledge, moderate practice, and a positive attitude about VAP-bundle guideline in ICU wards. Regarding the essential role of ICU-nurses in ventilator associated pneumonia prevention and its consequences, it is recommended to improve the practical ability of nurses through holding educational workshops and courses and increase the surveillance of head-nurses' on nurses' practice regarding patients under mechanical ventilation.

Acknowledgments

The authors wish to thank all the nurses who participated in the study and also acknowledge the Clinical Research Development Unit of Sina Educational, Research and Treatment Center, Tabriz University of Medical Sciences, Tabriz, Iran.

Authors' Contribution

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Competing Interests

None declared.

Study Highlights

- ICU nurses demonstrated a high level of knowledge, a positive attitude, and a moderate level of practice regarding the VAP bundle.

Ethical Approval

This study was ethically approved by Ethical Committee of Tabriz University of Medical Sciences (Ethical Code: IR.TBZMED.REC.1398.612).

Funding

This research was fully supported by Tabriz university off medical sciences, Tabriz, Iran (grant No. 5605).

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