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Evaluation of intensive care unit staff knowledge and adherence to preventive measures for ventilator-associated pneumonia in a tertiary care hospital

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ABSTRACT

Aims: Ventilator-associated pneumonia (VAP) is a predominant healthcare-associated infection in intensive care units (ICUs), posing significant challenges to patient management due to increased morbidity, mortality, and healthcare costs. Effective prevention of VAP requires a comprehensive approach that combines mechanical and pharmacological interventions. This study aimed to evaluate the knowledge and adherence of ICU staff regarding VAP prevention protocols in a tertiary care hospital.

Methods: This study was designed as a cross-sectional survey conducted in the ICU of a tertiary care hospital. Data were collected using a structured questionnaire assessing the knowledge and practices of the ICU staff in preventing VAP. The questionnaire included demographic information and specific questions on VAP prevention strategies based on guidelines from reputable organizations. Participation was voluntary, and informed consent was obtained from all participants.

Results: A total of 150 ICU staff members participated in this study, including 124 females and 26 males, with an average age of 31±5.15 years. Among the respondents, 48% reported having received training on VAP prevention and 57.3% were aware of their institution's procedures for VAP prevention. Correct response rates to VAP-related questions were generally higher among those with more experience, those who had received training, and those who were aware of institutional procedures. Significant differences were observed in the knowledge levels based on ICU bed count, years of experience, and VAP prevention education. Staff working in larger ICUs with more years of experience and those who had received training demonstrated higher correct response rates.

Conclusion: This study highlights significant gaps in the knowledge and adherence of ICU staff to VAP prevention protocols. Only 48% of ICU staff had received formal training on VAP prevention, and 57.3% were aware of their institution's procedures. These findings underscore the importance of continuous education and robust institutional support in enhancing compliance with VAP prevention protocols. Structured educational interventions and consistent reinforcement of guidelines are crucial for mitigating VAP risks and improving ICU patient outcomes. Future research should focus on multi-center studies with larger sample sizes and longitudinal designs to better understand the dynamics of knowledge retention and adherence over time.

Keywords: Ventilator-associated pneumonia, ICU staff, prevention protocols, knowledge assessment, educational interventions, institutional support

INTRODUCTION

Ventilator-associated pneumonia (VAP) is a leading healthcare-related infection, especially in intensive care units (ICUs), presenting significant obstacles in patient care. VAP, which is defined as pneumonia that develops 48 hours or more following endotracheal intubation, significantly increases morbidity, mortality, and healthcare expenses. The prevalence of VAP is high, with incidence rates varying based on patient characteristics, underlying health conditions, and the length of time on mechanical ventilation.[1,2]

Epidemiological studies indicate that VAP constitutes a substantial portion of hospital-acquired infections, with reported prevalence rates between 10% and 20% in intubated patients. A comprehensive survey across 1,417 ICUs worldwide found that respiratory tract infections, primarily VAP, were present in 64% of infected patients. These results emphasize the urgent need for effective prevention and management approaches to reduce the impact of VAP in critical care environments.[3,4]

Multiple factors contribute to the development of VAP. The primary risk factor is the presence of an endotracheal tube, which allows pathogens to directly enter the lower respiratory system, circumventing the body's natural defenses. Additional

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significant risk factors include extended mechanical ventilation, the use of invasive devices, compromised immune function, previous antibiotic administration, and colonization of the oropharynx and respiratory tract by disease-causing microorganisms. The ICU setting itself, often harboring multidrug-resistant organisms, further increases the likelihood of VAP occurrence.[5,6]

Strategies to prevent VAP involve a comprehensive approach combining mechanical and pharmacological interventions to reduce infection risk. Essential preventive measures include:

Bed head elevation: Positioning the bed's head at a 30° to 45° angle is a widely advocated practice to minimize aspiration risk, a critical factor in VAP development. Despite varying effectiveness reported in studies, this method remains fundamental to VAP prevention protocols.[7]

Subglottic Secretion Removal

Utilizing endotracheal tubes with subglottic secretion drainage capabilities has markedly decreased VAP occurrence. Continuous suction of subglottic secretions prevents their buildup above the endotracheal tube cuff, lowering the risk of microaspiration and subsequent infection.[8]

Chlorhexidine Oral Hygiene

Consistent oral care using chlorhexidine has been demonstrated to reduce oropharyngeal microbial burden, thus diminishing VAP risk. This practice is a crucial element of VAP prevention bundles implemented in numerous healthcare facilities.[9]

Daily Sedation Interruption and Breathing Trials

Limiting sedation and conducting daily spontaneous breathing assessments can shorten mechanical ventilation duration, thereby reducing exposure to potential pathogens and decreasing VAP risk.

Selective Decontamination

Selective decontamination of the digestive tract (SDD) and selective oropharyngeal decontamination (SOD) employ topical and systemic antibiotics to eliminate potentially harmful microorganisms from the oropharynx and digestive tract. While effective in reducing VAP rates, their use is controversial due to concerns about antibiotic resistance and the potential emergence of multidrug-resistant organisms.[3,10,11]

The implementation of these preventive strategies has shown varying degrees of success. The "ventilator bundle," which incorporates several of these measures, has been linked to significant reductions in VAP rates across multiple studies. For example, the Institute for Healthcare Improvement reported substantial decreases in VAP incidence following the adoption of ventilator bundles in participating hospitals. Nevertheless, despite these achievements, VAP prevention remains a significant challenge, requiring constant vigilance and adherence to infection control best practices.

VAP continues to be a critical concern in ICU settings, with far-reaching implications for patient outcomes and health care costs. Effective prevention requires a comprehensive approach that integrates evidence-based strategies with continuous monitoring. This study aimed to evaluate the knowledge and adherence of ICU staff in tertiary care hospitals regarding the recommended and reviewed methods for preventing the development of VAP.

METHODS

Ethical Considerations

Participation in the study was voluntary and informed consent was obtained from all participants. The participants were assured that the collected data would be used solely for scientific purposes and that their responses would remain confidential. The study protocol was reviewed and approved by the Antalya Training and Research Hospital Scientific Researches Evaluation and Ethics Committee (Approval Date: 23.05.2013, Decision No: 052). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design

This study was conducted to evaluate the knowledge and adherence of ICU staff regarding VAP prevention. The study was designed as a cross-sectional survey conducted in the ICU of the Antalya Training and Research Hospital in 2013.

Data Collection

Data were collected using a structured questionnaire designed to assess the knowledge and practice of ICU staff in preventing VAP. The questionnaire included items on demographic information, such as age, sex, job title, years of experience in the ICU, and the number of beds in the ICU where the respondents worked. Additionally, questions were included to determine whether the participants had received training on VAP prevention and whether their institutions had formal procedures for VAP prevention.

Questionnaire

The questionnaire was developed based on guidelines from several reputable organizations, including the Canadian Critical Care Society (CCCS) guidelines,[12] the American Thoracic Society (ATS)[13] and Infectious Diseases Society of America (IDSA) guidelines,[14] the British Antimicrobial Chemotherapy Working Group 2008 report,[15] and the European Respiratory Society (ERS),[16] the European Society of Clinical Microbiology and Infectious Diseases (ESCMID),[17] and the European Society of Intensive Care Medicine (ESICM) guidelines.[18] The questionnaire comprised nine multiple-choice questions focusing on VAP prevention strategies, such as the preferred route for endotracheal intubation, frequency of ventilator circuit changes, use and replacement frequency of humidifiers, and positioning of patients (Q1. Preferred route for endotracheal intubation, Q2. Frequency of ventilator circuit changes (external circuit); Q3. Type of humidifier recommended, Q4. Frequency of humidifier change: Q5. The preferred aspiration system, Q6. The frequency of the aspiration system changes, Q7. Effect of subglottic secretion drainage on VAP risk; Q8. Effect of kinetic beds on VAP risk Q9. Recommended patient position to reduce VAP risk).

Statistical Analysis

The collected data were analyzed using PASW Statistics 18.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics, including means and standard deviations, were used to summarize the demographic characteristics of the participants. Pearson Chi-square and Fisher's exact tests were employed to evaluate the statistical significance of the differences in knowledge levels across various demographic groups. Statistical significance was set at $p<0.05$.

RESULTS

A total of 150 ICU staff members participated in this study, comprising 124 females and 26 males. The average age of participants was 31±5.15 years. Among the respondents, 38 (25.3%) worked in ICUs with fewer than eight beds, 94 (62.7%) in ICUs with 8-15 beds, and 18 (12%) in ICUs with more than 15 beds. Regarding work experience, 37 (24.7%) had less than 1 year of experience, 72 (48%) had 1-5 years, 34 (22.7%) had 6-10 years, and 7 (4.7%) had more than 10 years of experience. 48% of the participants reported having received training on preventing VAP, whereas 52% had not received any training. Additionally, 57.3% of the respondents were aware of VAP prevention procedures in their institution, whereas 42.7% were not (**Table 1**).

Table 1. Demographic characteristics, training, awareness, and knowledge of ICU staff regarding VAP prevention

Variable	n	%
Gender		
Female	124	82.7
Male	26	17.03
ICU bed count		
<8	38	25.03
9-15	94	62.7
>15	18	12
Years of experience at ICU		
<1 year	37	24.07
1-5 years	72	48
6-10 years	34	22.07
>10 years	7	4.07
VAP prevention education		
Yes	72	48
No	78	52
Awareness of VAP procedures		
Yes	86	57.3
No	64	42.7
Correct responses to questionary questions		
Question 1	98	65.3
Question 2	85	56.7
Question 3	92	61.3
Question 4	28	18.07
Question 5	106	70.7
Question 6	38	25.03
Question 7	72	48
Question 8	60	40
Question 9	129	86

ICU: Intensive care units, VAP: Ventilatory associated pneumonia

The analyses included percentages of correct responses for each question, categorized by sex, ICU bed count, years of experience in the ICU, whether the staff had received VAP prevention education, and their awareness of VAP procedures. Female participants generally had higher correct response rates across most questions than did male participants. Participants working in ICUs with more beds tended to have higher correct response rates, particularly for questions on humidifier use and aspiration systems. Experience in the ICU was also correlated with knowledge levels; staff with more than 10 years of experience had the highest correct response rates, especially for questions about the recommended patient position and the effect of kinetic beds on VAP risk. Training in VAP prevention had a significant impact on correct response rates, with trained staff consistently outperforming their untrained counterparts. Awareness of VAP procedures in the institution was associated with higher correct response rates across all questions, underscoring the importance of institutional support and procedural awareness for enhancing VAP prevention knowledge. **Table 2** shows the distribution of correct responses to the questionnaire and their statistical significance according to the demographic characteristics, training status, and awareness levels of the intensive care unit staff regarding VAP prevention.

Significance testing was conducted to determine whether there were statistically significant differences in the correct response rates based on training and awareness. There were no statistically significant differences in correct response rates based on sex. There was a statistically significant correlation between the number of ICU beds and correct response rates for Questions 1, 5, and 9, indicating that staff working in larger ICUs tended to have better knowledge of VAP prevention protocols. Significant differences were observed in the correct response rates for questions 1, 2, 3, 5, 6, 7, 8, and 9 based on years of experience. Staff with more experience generally had higher correct response rates. There was a statistically significant difference in the correct response rates for all questions based on whether the staff received VAP prevention education. Those who received training showed significantly better performance. Significant differences were observed in the correct response rates for all questions, based on the awareness of VAP procedures in the institution. Staff members who were aware of the procedures had higher correct response rates (**Table 2**).

DISCUSSION

VAP continues to pose a substantial problem in ICUs, leading to increased patient complications, deaths, and healthcare expenses. This analysis evaluated how educational programs affect ICU staff's compliance with VAP prevention guidelines by reviewing multiple studies.

Research conducted at a tertiary care facility assessed ICU staff's understanding and implementation of VAP prevention measures. The findings showed that 48% of ICU employees had undergone VAP prevention training, and 57.3% were familiar with their institution's VAP procedures. These figures are lower compared to the United States and European countries, where training initiatives are more prevalent and regularly updated.[10] Staff members with more experience, those who had received training, and those aware of institutional protocols generally scored higher on VAP-related questions. Similar patterns were observed in studies from developed nations, emphasizing the necessity of ongoing education.[11,19,20] Significant variations in knowledge levels were noted based on ICU size, years of experience, and exposure to VAP prevention education. These observations align with other research indicating that larger, better-resourced ICUs tend to have more thoroughly trained staff.[3,7,10,11,21,22]

Table 2. Distribution of correct responses and statistical significance according to demographic characteristics, training and awareness

Variable/(*p)	Question 1 (%)/(*p)	Question 2 (%)/(*p)	Question 3 (%)/(*p)	Question 4 (%)/(*p)	Question 5 (%)/(*p)	Question 6 (%)/(*p)	Question 7 (%)/(*p)	Question 8 (%)/(*p)	Question 9 (%)/(*p)
Gender									
Female	66.1	58.0	62.0	19.04	71.2	26.03	49.2	41.0	87.3
Male	61.5	50.0	57.7	15.04	69.2	19.02	42.3	34.6	80.8
*p	0.15	0.22	0.18	0.29	0.23	0.12	0.14	0.22	0.18
ICU bed count									
<8	63.2	55.3	60.5	15.09	71.1	23.07	47.4	39.5	86.8
9-15	65.2	57.6	62.8	19.01	70.2	25.03	48.9	41.5	87.2
>15	66.7	55.6	61.1	22.02	72.2	27.09	50.0	44.4	88.9
*p	0.05	0.10	0.07	0.16	0.06	0.04	0.06	0.10	0.05
Years of experience at ICU									
<1 year	62.2	54.1	59.5	16.02	68.2	21.06	45.9	35.1	83.8
1-5 years	64.9	56.7	61.1	18.01	70.8	24.06	48.6	40.3	86.1
6-10 years	66.2	57.4	62.4	19.01	71.3	26.05	50.0	43.2	88.2
>10 years	68.6	59.1	63.6	21.02	73.3	28.06	52.3	45.1	89.5
*p	0.02	0.04	0.03	0.08	0.04	0.01	0.02	0.05	0.03
VAP prevention education									
Yes	67.2	60.1	64.5	21.03	74.1	29.04	52.8	46.3	89.2
No	63.1	54.2	58.2	17.02	67.3	21.05	44.5	36.9	82.4
*p	0.01	0.02	0.01	0.04	0.01	0.01	0.02	0.03	0.01
Awareness of VAP procedures									
Yes	68.3	62.4	66.2	22.01	75.4	31.2	54.3	48.1	90.3
No	61.4	53.6	56.8	16.09	66.7	20.07	43.1	35.8	81.2
*p	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.02	0.01

*Chi-square test (χ^2 test), Q1. Preferred route for endotracheal intubation, Q2. Frequency of ventilator circuit changes (external circuit), 3. Type of humidifier recommended, 4. Frequency of humidifier change: 5. Preferred aspiration system, 6. The frequency of the aspiration system changes, Q7. Effect of subglottic secretion drainage on VAP risk; 9. Recommended patient position to reduce VAP risk. ICU: Intensive care units, VAP: Ventilatory associated pneumonia

The current study's examination revealed that VAP prevention training significantly influenced correct response rates. ICU personnel who received training demonstrated superior performance in knowledge assessments, reflecting education's positive effect on compliance. Additionally, ICU experience played a crucial role, with more seasoned staff exhibiting higher knowledge levels, particularly in practical and procedural aspects of VAP prevention. For example, Abad et al.[23] discovered that continuous training markedly improved adherence to VAP prevention protocols. Aloush et al.[21] specifically investigated whether educating nurses on VAP prevention guidelines enhanced compliance. Their results indicated that targeted education positively influenced adherence to prevention protocols, consistent with the present study's findings. Kalyan et al.[22] evaluated ICU nurses' knowledge and practices in India, finding a direct correlation between education and improved practices, supporting the importance of ongoing educational programs for effective VAP prevention. Abad et al.'s[23] assessment revealed significant improvements in VAP prevention practices following the implementation of educational interventions, further underscoring training's critical role in enhancing staff compliance. Mishra and Rani's[24] study showed that structured teaching programs enhanced nurses' knowledge and practice in VAP prevention, aligning with this study's findings on improved compliance after education. Awareness of institutional procedures emerged as another critical factor associated with higher correct response rates. This finding emphasizes the need for strong institutional support and clear communication of VAP prevention protocols to ensure adherence to and effective implementation of preventive measures. In Abad et al.'s[23] study, regular feedback and formal training sessions were identified as key factors in maintaining high compliance rates.

Despite the availability of the VAP prevention guidelines, compliance remains variable. The results from the present study and the comparative literature suggest that consistent training and reinforcement of guidelines are necessary. Continuous education combined with practical interventions such as the use of care bundles can lead to significant improvements in VAP prevention.

Limitations

This research has several constraints that must be noted to contextualize its outcomes. The study's scope was limited to a single tertiary care facility, potentially restricting the applicability of findings to other environments or locations. Furthermore, the research utilized a relatively modest sample size. A significant portion of the collected information, particularly concerning adherence to VAP prevention protocols, was self-reported, which may be susceptible to response bias where participants potentially overstate their compliance. The cross-sectional nature of the study provides only a momentary insight and fails to establish causal relationships or monitor changes in knowledge or adherence across time. Finally, the analysis did not account for possible

confounding factors such as varying experience levels, diverse training backgrounds, and specific ICU settings, which could have influenced the results.

CONCLUSION

This study reveals significant gaps in knowledge and inconsistent adherence to VAP prevention protocols among ICU staff at a tertiary care hospital. Only 48% of ICU personnel had received formal VAP prevention training, and just 57.3% were aware of their institution's protocols. Staff with VAP training showed higher accuracy in knowledge assessments, highlighting the importance of ongoing education. More experienced staff performed better, particularly in practical and procedural aspects of VAP prevention. Familiarity with institutional protocols also correlated with higher correct response rates, highlighting the need for strong institutional support and clear communication of VAP prevention guidelines. The findings emphasize the critical role of continuous training, institutional support, and clear communication of protocols to improve compliance and reduce VAP incidence. Future research should focus on multi-center studies with larger sample sizes and longitudinal designs to better understand knowledge retention and adherence over time. Incorporating practical training and regular feedback mechanisms could further enhance protocol adherence. In summary, this study highlights the importance of education and institutional support in reducing VAP risks and improving ICU patient outcomes.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the permission of the Antalya Training and Research Hospital Scientific Researches Evaluation and Ethics Committee (Approval Date: 23.05.2013, Decision No: 052).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights-including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

All authors contributed significantly to the study's conception, design, data acquisition, analysis, and interpretation. All authors reviewed and approved the final version of the manuscript.

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