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Analysis of Determinant Factors Affecting the Behavior of Intensive Care Nurses about Ventilator-Associated Pneumonia (VAP) Bundle Care

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ABSTRACT

Ventilator-associated pneumonia (VAP) commonly arises due to the use of invasive endotracheal tubes, which facilitate the entry of bacteria into the respiratory system. VAP typically develops after a patient has been on mechanical ventilation for more than 48 hours. This study aims to analyze the determinant factors influencing the behavior of intensive care unit (ICU) nurses regarding VAP management at a General Hospital in Medan, Indonesia. The study employed a quantitative research approach with a survey design, involving 56 ICU nurses. The results of the multivariate analysis indicated significant p-values for the variables of education (p = 0.014), length of work experience (p = 0.004), and training (p = 0.013), demonstrating their collective influence on ICU nurses' behaviors toward implementing VAP bundle care. Among these factors, the availability of facilities emerged as the most significant determinant, with the highest odds ratio (OR = 3.486). Nurses who had received training were 3.486 times more likely to exhibit appropriate behavior when providing VAP bundle care interventions compared to those who had not undergone such training. Based on these findings, it is recommended that every ICU nurse enhance their skills and knowledge through comprehensive training programs on VAP bundle care.

Keyword: Ventilator Associated Pneumonia (VAP) Bundle Care, ICU Nurses

1. Introduction

Ventilator-associated pneumonia (VAP) is a lower respiratory tract infection affecting the lung parenchyma in patients who have been exposed to mechanical ventilation for more than 48 hours. Its symptoms are characterized by the presence of a new or progressive infiltrate, fever, alterations in white blood cell count, and purulent tracheobronchial secretions (Chen et al., 2022). Patients undergoing mechanical ventilation are at a heightened risk of developing VAP due to the invasive nature of the endotracheal tube, which provides a direct pathway for bacterial entry into the lower respiratory tract. The absence of a functional cough reflex, coupled with excessive mucus secretion, further facilitates bacterial invasion within the respiratory tract (Getahun et al., 2022).

Healthcare-associated infections (HAIs), also known as hospital-acquired infections, are infections that occur in patients who receive medical treatment, as well as in healthcare workers and hospital visitors. (Yuniandita & Hudiyawati, 2020). Among HAIs, VAP ranks as the second most common nosocomial infection and is associated with a significantly elevated mortality rate, being twice as fatal as non-VAP-related

conditions. Patients with VAP typically require an additional 4 to 9 days of admission in the Intensive Care Unit (ICU). In the United States alone, VAP accounts for approximately 36,000 deaths annually. In Europe, about 18,900 cases of VAP are confirmed each year, with mortality rates for severe cases ranging between 50% and 76% (Álvarez-Lerma & García, 2018).

The incidence of pneumonia, including VAP, is particularly high in developing countries, affecting approximately 450 million people annually. In Indonesia, data from the Ministry of Health indicates a prevalence rate of 4.5% for pneumonia based on health worker diagnoses, with a pneumonia mortality rate of 1.19%. (the Ministry of Health of the Republic of Indonesia, 2018). Patients on mechanical ventilation in ICUs are especially vulnerable to VAP, leading to prolonged hospital stays, increased medical costs, and a significantly higher risk of mortality. This condition imposes a considerable burden on patients, their families, and society as a whole. (Solikin et al., 2021).

VAP is condition through the application of a bundle approach, which involves a series of evidence-based preventive interventions. The VAP care bundle was developed by the Institute for Healthcare Improvement (IHI) and comprises four key elements: maintaining the head of the bed elevation between 30° and 45°, implementing Deep Vein Thrombosis (DVT) prophylaxis, providing peptic ulcer prophylaxis, and discontinuation of daily sedation and assessment of readiness for extubation (Burja et al., 2018). In 2021, the Korea Disease Control and Prevention Agency (KDCA) introduced a VAP care bundle tailored to the standards of domestic medical institutions, drawing from the guidelines of the Centers for Disease Control and Prevention (CDC). This care bundle includes five essential components: head-of-bed elevation between 30° and 45°, daily sedation interruption and readiness-for-extubation assessment, DVT prophylaxis, peptic ulcer prophylaxis, and daily oral care using chlorhexidine 0.02% antiseptic (CDC, 2020).

Research conducted by Abou Zed and Mohammed (2019) shows that nurses' knowledge of preventing VAP will increase according to their education level. This knowledge is reflected in the behavior of nurses in implementing optimal VAP bundle care. The higher a person's Education, the easier it is to receive information, and the more knowledge is obtained. Education can change attitudes and behavior and increase one's knowledge, a basic human life process. Similarly, Apriyani et al. (2021) found a significant correlation between educational levels and nurses' knowledge regarding VAP prevention.

Redho et al. (2020) emphasized that VAP bundle care represents both a collaborative and an independent nursing intervention. The success of VAP bundle care in the ICU room depends on adherence to standard operating procedures, the depth of knowledge about VAP prevention, and nurses' ability to implement these interventions effectively. As caregivers for critically ill patients, ICU nurses must possess specialized knowledge and skills, which are often obtained through targeted ICU training programs.

Shanen Cunanan et al. (2021) research stated that the incidence of VAP was reduced to zero when nurses applied VAP bundle care appropriately. The VAP bundle care strategy focuses on preventing VAP by minimizing bacterial colonization in the oropharynx and tracheobronchial tract and reducing aspiration rates. Given these findings, the current study aims to analyze the determinants of factors influencing the knowledge of intensive care nurses regarding VAP, particularly those employed at Haji Adam Malik General Hospital Medan.

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2. Methods

The research design employed in this study was quantitative, utilizing a survey method. This approach was selected as it is well-suited for analyzing the determinants and factors influencing the behavior of intensive care unit (ICU) nurses regarding Ventilator-Associated Pneumonia (VAP) at Haji Adam Malik Hospital Medan. The study population comprised 128 ICU nurses at Haji Adam Malik General Hospital in 2022. The sample size was determined using the Slovin formula, resulting in a sample of 56 respondents.

The sampling technique applied was probability non-random sampling, specifically the convenience sampling method. The inclusion criteria encompassed all actively working ICU nurses, while the exclusion criteria excluded nurses who were undergoing training or on leave. Participation in the study was voluntary, and every nurse retained the right to decline participation. Nurses who agreed to participate were required to fill out and sign a willingness and consent form. Prior to signing, participants were provided with a detailed explanation of the study's purpose and benefits.

Ethics approval for the study was obtained from the Ethics Committee NO: 28/KEPK/USU/2023 before initiating data collection.

Data collection was conducted via the distribution of questionnaires. The gathered data underwent a series of processing stages, beginning with data entry and cleaning, followed by data analysis. The data analysis process commenced with univariate analysis to examine the demographic and professional characteristics of the respondents. Subsequently, bivariate analysis was performed, and finally, multivariate analysis was

undertaken to identify the determinants influencing ICU nurses' behavior in relation to VAP prevention. The findings are presented in the research results section.

3. Results

3.1 Univariate Analysis

The following is a presentation of the research results. Table 1 explains the characteristics of respondents.

Table 1 Characteristics of the Respondents

Characteristic	f	%
Sex		
Male	4	7,1
Female	52	92,9
Age		
20-30	6	10,7
31-40	36	64,3
41-50	13	23,2
>50	1	1,8
Education		
Associate degree	19	33,9
Professional Degree	36	64,3
Master's degree	1	1,8
Length of Service (in years)		
1-5	10	17,9
6-10	6	10,7
11-15	24	42,9
>15	16	28,6
Information source		
Formal Education	9	16,1
Workshop	9	16,1
Seminar	34	60,7
Health promotion	4	7,1
Training		
Yes	35	62,5
Acute Training	21	37,5
Additional Training		
Yes	38	67,9
Acute Training	18	32,1
Behavior towards VAP		
Bundle Care		
Very good	27	48,2
Good	29	51,8
Poor	0	0

Based on Table 1, the demographic characteristics of the respondents indicate that the majority were female, with a total of 52 individuals (92.2%). The average age of the respondents was between 31–40 years, comprising 36 individuals (64.3%). Most respondents had an educational background in the nursing profession, accounting for 36 individuals (64.3%). The average work experience was 11–15 years, with 24 respondents (42.9%) falling into this category. To enhance their knowledge, respondents utilized various sources, such as attending seminars, reported by 34 individuals (60.7%), and critical care training, attended by 36 individuals (64.3%). Moreover, the majority of the nurses exhibited excellent behavior in implementing VAP bundle care, as demonstrated by 31 respondents (55.4%).

3.2 Normality Test

Table 2 Results of Normality Test

Group	Kolmogorov-Smirnov		
	Statistic	Df	Sig.
Age	.351	56	.000
Sex	.537	56	.000
Education	.397	56	.000
Length of Service	.282	56	.000
Information source	.364	56	.000
Training	.404	56	.000
VAP	.367	56	.000

Before proceeding to the multivariate analysis, a data normality test was conducted. The test results are considered acceptable if all data have a significance value of >0.05. As shown in Table 2, the normality test results indicate that all variables have a significance value of <0.05, suggesting that the data distribution is not expected in all variables.

3.3 Bivariate Analysis

Table 3 Determinants of Intensive Care Unit Nurses' Behavior on VAP Bundle Care

Variable	*P-value*
Sex	0,205
Age	0,030
Education	0,001
Length of Service	0,000
Information Source	1,155
Training	0,020

Bivariate analysis, using a logistic regression test, revealed that only four variables had a *p-value* <0.05: age, education, length of service, and training. Based on these findings, only these candidate variables were included for further testing in the multivariate analysis. The results suggest that age, Education, length of service, and Training significantly influence the behavior of ICU nurses in implementing VAP bundle care.

3.4 Multivariate Analysis

Table 4 Results of Multivariate Analysis of Intensive Care Nurses' Behavior on VAP Bundle Care

Variable	B	*Wall*	*P-value*	OR
Age	0,619	0,502	0,478	1,858
Education	-2,137	5,960	0,015	0,118
Length of Service	-1,737	8,194	0,004	0,176
Training	1,286	6,649	0,010	3,618
Constant	4,001	2,970	0,085	

The multivariate analysis results indicated that a p-value of <0.05 was obtained for Education, length of service, and training variables. However, the age variable showed a p-value >0.05 and was therefore excluded from the model as a determinant factor. After re-analysis, the following results were obtained.

Table 5 Results of Multivariate Analysis of Intensive Care Nurses' Behavior on VAP Bundle Care

Variable	B	*Wall*	*P-value*	OR	CI 95%
Education	-2,135	6,030	0,014	0,118	0,022-0,650
Length Of Service	-1,548	8,517	0,004	0,213	0,075-0,601
Training	1,249	6,118	0,013	3,486	1,296-9,378
Constant	4,912	5,991	0,014		

As shown in Table 4, the multivariate analysis yielded *p-values* for Education (0.014), length of service (0.004), and training (0.013), all of which had a significant impact on the behavior of ICU nurses toward the implementation of VAP bundle care. These three variables will undergo interaction testing at the next stage.

Based on the model presented in Table 4, the dominant factor influencing the behavior of ICU nurses in implementing VAP bundle care was the availability of facilities, which had the highest Odds Ratio (OR = 3.486). According to the model, nurses who received training were 3.486 times more likely to demonstrate excellent behavior in implementing VAP bundle care compared to those who did not receive training.

4. Discussion

This study aims to analyze the determinant factors influencing the behavior of intensive care unit (ICU) nurses on VAP. Based on the results of a bivariate analysis using logistic regression, the age variable demonstrated statistical significance with a *p-value* of <0.005 (0.030). Thus, age is shown to affect ICU nurses' behavior in the application of VAP bundle care. As individuals grow older, they typically develop greater maturity in cognitive abilities and intellectual capacity, which influences their work environment. This aligns with the societal tendency to rely on individuals with higher levels of maturity and intellectual competence (Notoatmodjo, 2014).

Early adulthood is characterized by a focus on occupational and social pursuits, during which individuals strive to enhance their socioeconomic status through improved work ethics (Anggoro et al., 2019). According to Chen et al. (2022), aging tends to modify behavior, and this observation is applicable to nurses as well.

However, it is important to note that aging does not inherently guarantee positive behavioral traits, as these are contingent upon individual characteristics. The researchers posit that the predominant age range of respondents, 31–40 years, represents a peak period for intellectual development conducive to optimal learning. As intellectual growth advances, individuals are better equipped to make informed decisions, engage in rational thinking, regulate emotions effectively, and adopt an open-minded approach—qualities that collectively enhance behavior in delivering ideal nursing care.

The bivariate analysis using logistic regression also examined the sex variable, which yielded a p-value of >0.005 (0.205). Consequently, it can be concluded that there is no significant correlation between sex and the behavior of ICU nurses concerning the application of VAP bundle care. Historically, the field of nursing, influenced by prominent figures such as Florence Nightingale, has been associated with a stigma identifying it predominantly as a female profession. While the proportion of male nurses has increased over time, female nurses continue to dominate the nursing workforce (Anggoro et al., 2019).

Research by Kusnanto et al. (2020) indicates no significant correlation between male and female nurses in terms of work performance. Both genders demonstrate equal capacity for learning, memorization, reasoning, and creativity. However, some Muslim nurses may experience ethical dilemmas arising from their religious beliefs, particularly in situations that require interaction with patients of the opposite sex. Nonetheless, professional nurses are expected to provide comprehensive and indiscriminate care that encompasses biological, psychological, socio-cultural, and spiritual dimensions. This highlights the need for enhanced competencies among nurses to meet these service requirements.

The researchers noted that the majority of respondents in the study were female (52 individuals, accounting for 92.5%), which aligns with historical perspectives on nursing influenced by Florence Nightingale's contributions. These historical developments have often associated the nursing profession with women. Despite this gender association, male nurses have also been found to perform well in delivering quality nursing care to patients.

The results of a multivariate analysis revealed a significant influence of education on ICU nurses' behavior in implementing Ventilator-Associated Pneumonia (VAP) bundle care, as evidenced by a *p-value* of 0.014. Education involves the systematic transmission of knowledge, skills, and habits across generations through teaching, training, or research (Notoatmodjo, 2014). It serves as a fundamental requirement for jobs demanding expertise and knowledge. Furthermore, education and training are essential for enhancing mastery of specialized skills and knowledge, enabling individuals to effectively perform and complete assigned tasks (Rachmawati, 2019).

Research by Abou Zed & Mohammed (2019) corroborates these findings, demonstrating that nurses' knowledge of VAP prevention improves with higher levels of Education, which in turn positively influences their behavior in implementing optimal VAP bundle care. This aligns with research conducted by Apriyani et al. (2021). The research reported a significant relationship between Education and nurses' knowledge regarding VAP prevention.

Another multivariate analysis found that the length of work experience significantly affects ICU nurses' behavior in applying VAP bundle care, as indicated by a *p-value* of 0.004. Experience facilitates the development of knowledge through repeated application and problem-solving. It serves as a valuable asset in acquiring practical wisdom and understanding. Experienced nurses tend to exhibit heightened sensitivity to problems and possess a deeper reservoir of knowledge derived from their professional practice (Widaningsih et al.,2022).

The length of service is synonymous with experience; the longer an individual's working period, the greater their accumulated experience. Experience significantly contributes to the enhancement of knowledge, as knowledge is often derived from practical experience (Apriyani et al., 2021). Most nurses working in the ICU play a pivotal role in VAP prevention, as they are positioned at the patient's bedside 24 hours a day, practicing evidence-based knowledge related to VAP prevention (Getahun et al., 2021; Getahun et al., 2022).

Bivariate analysis using logistic regression revealed that the information source variable, with a *p-value* > 0.005 (1.155), is not significantly correlated with ICU nurses' behavior regarding the implementation of VAP bundle care. Information acquired from formal and informal Education provides short-term knowledge, yielding immediate impacts that can lead to changes and increases in knowledge levels.

Technological advancements offer diverse sources of information that significantly influence people's acquisition of new knowledge. Communication media such as television, radio, newspapers, magazines, and counseling play substantial roles in shaping public opinions and beliefs (Rachmawati, 2019). According to the researcher's assumption, most respondents have attended seminars and pursued further education to enhance their knowledge, experience, and skills to provide optimal nursing care.

Multivariate analysis results indicated that the *p-value* for the training variable (0.013) showed a significant influence on ICU nurses' behavior regarding the implementation of VAP bundle care. Training serves as an activity designed to develop and enhance specific skills and competencies that are highly beneficial (Dipanjali et al., 2020).

Research by Kusnanto et al. (2020) demonstrates that training is an active implementation strategy that equips nurses with increased knowledge about VAP bundle care, thereby enabling appropriate implementation. Implementing VAP bundle care, as a set of evidence-based interventions, constitutes an effective strategy for preventing VAP and improving patient health outcomes. It facilitates and encourages transformative changes in care delivery within the ICU. Nurses are expected to continually enhance their knowledge concerning the application of hospital-established VAP bundle care guidelines (Bankanie et al., 2021).

5. Conclusion

The results of the multiple logistic regression analysis revealed that three independent variables exhibited positive regression coefficients with respect to the dependent variable: Education (0.014), Length of Service (0.004), and Training (0.013). Collectively, these variables had a statistically significant impact on the behavior of ICU nurses in implementing VAP bundle care.

Among these factors, Training emerged as the most dominant determinant influencing ICU nurses' behavior, as indicated by the highest Odds Ratio (OR = 3.486). This implies that nurses who received training were 3.486 times more likely to demonstrate favorable behavior in applying VAP bundle care compared to those who did not undergo training.

Based on the findings of this study, the following recommendations are more holistic and comprehensive nursing service is needed. This can begin by ensuring the consistent application of VAP bundle care in accordance with established SOP for patients in the ICU who are receiving mechanical ventilation. Regular dissemination of information on the prevention of VAP should be provided to ICU nurses through seminars and training programs. This initiative aims to ensure a uniform understanding and capability among ICU nurses concerning the principles and practices of VAP bundle care.

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