



Knowledge and Its Associated Factors Related Ventilator Associated Pneumonia Among Intensive Care Nurses: Cross-sectional Study in Southern Province of Sri Lanka

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Abstract

This study aimed to assess knowledge and its associated factors on ventilator-associated pneumonia (VAP) among intensive care nurses. This descriptive cross-sectional study included 164 nurses who worked in intensive care units. Data were collected through a content-validated, pretested self-administered questionnaire. It included participants' socio-demographic information and knowledge-assessing questions. Descriptive statistics, the Mann–Whitney U-test, and the Kruskal–Wallis test were performed. Significance was accepted at $\alpha < 0.05$. The sample was female predominant and included more undergraduate and graduate nurses than diploma nurses. The overall knowledge of VAP among nurses ranged from 82.92 to 14.86, with 75% of them achieving a score above 80%. Nurses' knowledge of VAP was associated with their age, professional qualifications, and experiences in nursing service and intensive care units ($p < 0.05$). Nurses had satisfactory knowledge of VAP. However, gaps exist. Nurses' knowledge is associated with their on-the-job training and professional qualifications.

Keywords: ventilator associated pneumonia; intensive care nurses; knowledge; factors

Introduction

Ventilator-associated pneumonia (VAP) is defined as pneumonia occurring in patients who have been on mechanical ventilation for at least 48 hours (The American Thoracic Society and Infectious Diseases

Society of America, 2005). It is an infection in the lung parenchyma acquired after 48-72 hours of invasive mechanical ventilation (Kharel et al., 2021) and represents the most common nosocomial infection among critically ill patients in Intensive Care Units (ICU).

VAP significantly contributes to patient morbidity, mortality, and healthcare costs. A recent study reported that the mortality rate associated with VAP is twice as high as in patients without VAP (McEnery & Martin-Loeches, 2020). Both developed and developing countries report VAP cases, with a systematic review highlighting mortality rates in the Southeast Asian region that ranged from 16.2% to 74.1% across 13 studies (Kharel et al., 2021). VAP is commonly caused by Gram-negative bacteria such as *Acinetobacter* spp., *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*, as well as Gram-positive bacteria like *Staphylococcus aureus* and *Enterococcus* species (Kharel et al., 2021).

In Sri Lanka, a study at the Teaching Hospital, Karapitiya, found that 29.4% of ICU patients on mechanical ventilation developed lower respiratory tract infections, with VAP accounting for 21.9% of cases (Gunaratne & Vidanagama, 2011). VAP prolongs ventilation duration, delays extubation, increases hospital stay, and escalates both mortality and healthcare costs. Preventing VAP is thus essential in the management of mechanically ventilated patients, though it remains a significant clinical challenge for

ICU nurses.

The knowledge level of intensive care unit (ICU) nurses is crucial for effective patient management and the prevention and control of VAP. However, previous studies indicate that ICU nurses' knowledge of VAP is often suboptimal. For instance, a study in Malaysia among general ICU nurses reported that 59.5% had poor knowledge of VAP (Norazlin & Norzalila, 2019). This study also found that factors such as age, nursing experience, and participation in infection control programs influenced nurses' knowledge. Similarly, a multi-center cross-sectional study in Ethiopia found that 51% of ICU nurses had poor knowledge of VAP, which was associated with their academic qualifications and training on VAP (Getahun et al., 2022). This Ethiopian study emphasized the need to revise the nursing curriculum to incorporate infection prevention strategies specific to intensive care. Consistent with these findings, a systematic review by Al-Mugheed et al. (2022) among critical care nurses in the Eastern Mediterranean region revealed low levels of VAP knowledge, highlighting the importance of implementing comprehensive interventions to improve ICU nurses' knowledge.

Although numerous studies exist on this topic globally, research on VAP knowledge among ICU nurses in the local context is limited. A cross-sectional study conducted in two leading hospitals in the Colombo district of Sri Lanka reported an average level of knowledge about VAP among ICU nurses, emphasizing the need to update their knowledge on VAP and its preventive measures to improve patient outcomes. Evidence on ICU nurses' knowledge of VAP in Sri Lanka is inconsistent and limited. Understanding current VAP knowledge levels among ICU nurses in a major hospital in the Southern province of Sri Lanka is essential to identify any knowledge gaps and develop strategies to address them. Therefore, the present study aimed to assess the knowledge of VAP among intensive care nurses at the Teaching Hospital Karapitiya (THK), Sri Lanka.

Materials and Methods

Study design and setting

This was a descriptive cross-sectional study conducted among intensive care nurses. The study was conducted in five ICUs at THK including Emergency ICU, Neuro Trauma ICU, Neonatal ICU, Pediatric ICU and Main ICU.

Study participants

A total of 164 nurses were working across five ICUs. To ensure feasibility and achieve precise, valid findings, all the nurses in these ICUs were invited to participate in the study. Both male and female nurses, as well as those with more than one year of ICU experience, volunteered for the study. Convenience sampling technique was used for recruitment.

Study instrument

Data were collected using a self-administered questionnaire consisting of two sections. The first section gathered participants' socio-demographic characteristics, including age, sex, and years of experience in nursing and ICU settings. The second section contained 30 questions assessing ICU nurses' knowledge of VAP. For scoring, correct answers were awarded 1 point. The total number of correct answers was converted to a percentage score and categorized according to McDonald's standard learning outcome criteria (McDonald, 2002) to evaluate the nurses' knowledge level.

The questionnaire was initially developed in English, then translated into Sinhala and Tamil, and administered in the participants' preferred language. Its content validity was assessed by an expert team with experience in managing and caring for ICU patients, and the questionnaire was modified based on their feedback. The instrument was pre-tested with ten ICU nurses of similar characteristics in another setting, who were not involved in the study. This pre-test helped to identify any confusing, difficult, or offensive wording and gathered suggestions for

improvement. A few terms were modified based on the feedback.

The reliability of the knowledge questions was assessed using data from the first 50 subjects (Kumarasinghe et al., 2018). With a high Cronbach's alpha value of .894 (Danielsen et al., 2015), it was decided to continue data collection until the required sample size was achieved

Data analysis

Data were analyzed using SPSS version 21. Descriptive statistics, including mean, standard deviation, frequencies, and percentages, were used to describe participants' characteristics and knowledge scores. The non-parametric Mann–Whitney U test and Kruskal–Wallis test were performed to examine the association between knowledge and participants' characteristics. Significance was accepted at an alpha level of <.05.

Ethical considerations

This study was approved by the Ethics Review Committee of THK. Volunteer participation was encouraged and the right to withdraw from the study was allowed. The consent forms were signed by all the participants. The anonymity and confidentiality of participants were ensured.

Results and Discussion

Participants' characteristics are shown in Table 1. Most participants were female (96.3%) and under 40 years old (69.5%). The female predominance observed in this study aligns with findings in other settings (Abad et al., 2021; Bankanie et al., 2021; Muralitharan & Seneviratne, 2022). A significant portion of the sample comprised undergraduate or graduate nurses (62.3%), reflecting the recent trend of nurses pursuing higher education in Sri Lanka. Over 65% of nurses had 11-20 years of nursing experience, with fewer than 10 years of ICU experience. Only a small percentage had received intensive care training as part of in-service education (12.2%).

Table 1. Demographic characteristics of the participants (N=164)

Variable	Category	n	%
Age (in years)	<30	17	10.4
	30-39	97	59.1
	> 40	50	30.5
Gender	Male	06	3.7
	Female	158	96.3
Professional qualification	Diploma in nursing	61	37.2
	Undergraduate	53	32.3
	BSc. in nursing	49	29.9
	MSc.in nursing	01	0.6
Nursing experience (in years)	≤10	57	34.8
	11-20	99	60.4
	> 20	08	4.9
ICU experience (in years)	1-10	96	58.5
	11-20	50	30.5
	>21-30	18	10.9
ICU training	Yes	20	12.2
	No	144	87.8

Table 2. Categorization of nurses' knowledge according to Mc Donald Learning outcome criteria (N=164)

Category	n	%
Very low knowledge (<60%)	24	14.6
Low knowledge (60 -69.99%)	13	7.9
Moderate Knowledge (70-79.99%)	3	1.8
High Knowledge (80-89.99%)	43	26.2
Very high Knowledge (90-100%)	81	49.4

Intensive Care Nurses' Knowledge Regarding VAP

The nurses' knowledge of individual questions on VAP is presented in Table 3. Of the 30 items tested, 17 questions were answered correctly by more than 80% of participants. All nurses knew the correct method for inserting a suction catheter into the

endotracheal tube, the importance of using sterilized gloves, and the factors that increase the risk of VAP. However, a significant portion of nurses (66.5%) were unaware of the causative agents of VAP.

When comparing these findings to the study by Kalyan et al. (2020) a higher percentage of nurses in the Indian study could expand the term “VAP” (98.14% vs. 90.9%) and were aware of the causative organisms (66.67% vs. 33.5%). However, only one-third of nurses in the Kalyan study knew that prolonged use of stress ulcer prophylaxis increased the risk of VAP (36.11%), whereas 74.4% of nurses in the present study were aware of this. Additionally, compared to the Kalyan study, a higher percentage of nurses in the present study knew about the frequency of disposable ventilator circuit changes (77.8% vs. 41.66%), the impact of increased sedation on VAP risk (78% vs. 50%), and the correct cuff pressure (89% vs. 42.59%).

Notably, nearly all nurses in the present study (99%) knew that a closed suction system helps to prevent VAP, whereas only 39.2% of ICU nurses in Nepal were aware of this (Ghimire & Neupane, 2018). This discrepancy may be due to differences in the sample attributes, such as the smaller sample size in the Nepalese study (n=51), which included fewer graduate nurses (n=5) and more nurses with ≤ 2 years of experience (n=37).

Factors Associated with Nurses’ Knowledge

The nurses’ knowledge showed significant associations with their professional qualifications, nursing experience, and ICU experience ($p < .05$). However, no association was observed between knowledge and whether they had received ICU-specific training (Table 4). Previous research supports the link between nurses’ knowledge of VAP and educational qualifications. For example, a study in China found that nurses with a degree or higher education level had greater knowledge than those with a diploma or lower qualifications (Bankanie et al., 2021). Similarly, a study in Hebei Province, China,

confirmed a significant association between VAP incidence and nurses’ bachelor’s or higher education levels as well as their work experience ($p < .0001$).

Additionally, Aiken et al. (27) reported that a 10% increase in the proportion of nurses with a bachelor’s degree or higher was associated with a 7% decrease in hospital mortality rates. In essence, these findings highlight the importance of higher educational qualifications in nursing, suggesting that advanced education equips nurses with the knowledge and competencies to manage complex ICU conditions effectively. This trend underscores the need for well-educated nurses in reducing the incidence of VAP, as demonstrated by data linking better nursing education with improved patient outcomes (Yin et al., 2022).

Additionally, the findings of the present study demonstrate an association between nurses’ knowledge and their years of experience in both nursing and ICU practice. Notably, nurses with 5-10 years of experience had a significantly higher level of knowledge compared to those with more than 10 years of experience—a trend also observed in a recent study in China (Yin et al., 2022). This may suggest that nurses with 5-10 years of experience are more recently trained and up-to-date on current ICU protocols compared to those with over 10 years, who may rely more on established practices.

Table 3. Frequency and percentage distribution of intensive care nurses' knowledge regarding VAP

Item	Correct responses	
	n	(%)
Full form of VAP	149	90.9
The causative agent of VAP	55	33.5
Clinical features of VAP	111	67.7
The best route recommended for intubation	114	69.5
Reduce Risk of VAP	146	89.0
Recommended System for suction	163	99.4
Suction catheter insertion procedure	164	100
Disposing suction catheter	164	100
Endotracheal tube suction	108	65.9
Suction should be done first	163	99.4
Preference type of humidifiers	148	90.2
Temperature of humidifier	102	62.2
Recommended duration to change humidifiers	128	78.0
Cleaning of equipment	128	78.0
Head end elevation	122	74.4
Type of bed reduce risk of VAP	138	84.1
Wearing sterile gloves	164	100
Hand washing	148	90.2
Oral care mouth wash	149	90.9
Prolonged use of stress ulcer prophylaxis	122	74.4
Risk of VAP decreased by postural drainage and chest physiotherapy	132	80.5
Risk of VAP decreased by early weaning	164	100
Overfeeding causes	143	87.2
Position for feeding	117	71.3
Adequate cuff pressure decreases VAP	145	88.4
Cuff pressure	146	89.0
Unplanned extubation increased risk of VAP	149	90.9
Frequency of disposable ventilator circuit change	127	77.4
The level of placing ventilator tube	143	87.2
Role of sedation in ventilated patients	128	78.0

Table 4. Factors associated with nurses' knowledge

Variable	Category	Mean±SD	Median	IQR	p-value
Age (in years)	<40	83.09±12.85	86.66	6.67	.037*
	> 40	82.53±18.81	91.66	40.00	
Professional qualification	Diploma in nursing	79.61±15.22	86.66	25.00	<.001*
	Undergraduate	78.78±17.47	86.66	36.67	
	Degree	91.46±4.42	90.00	3.33	
Professional experience (in years)	<10	89.64±6.89	90.00	6.67	.002*
	> 10	79.34±16.65	86.66	30.00	
ICU experience (in years)	<10	83.88±15.26	90.00	22.25	.033*
	> 10	78.11±14.27	86.66	6.67	
ICU training	Yes	86.83±12.06	90.00	6.67	.267
	No	82.38±15.16	86.66	15.83	

IQR, interquartile range; ICU, Intensive Care Unit

*Significant at $p < .05$

Limitations

Limitations are unavoidable in research studies. This study's limitations include being conducted in a single setting, which restricts the generalizability of the findings. Additionally, the small sample size limits the robustness of the results. Future research should consider national-level studies with larger samples to enhance the generalizability and applicability of the findings.

Conclusions

Intensive care nurses in the study demonstrated satisfactory knowledge regarding ventilator-associated pneumonia, likely due to their exposure to patient care. However, important knowledge gaps remain, particularly in areas such as understanding the causative agents and clinical features of VAP, managing humidifier temperature, maintaining proper head elevation, ensuring correct feeding positions, knowing the frequency for changing ventilator circuits, and understanding the role of sedation in ventilated patients. Addressing these areas through in-service education could enhance prevention efforts. The associations between nurses' knowledge and their experience in nursing and ICU

settings highlight the need to keep experienced nurses' knowledge current, while the link with professional qualifications underscores the value of engaging nurses in higher education. As this study was conducted in a single setting with a relatively small sample, further research is warranted.

Acknowledgment

We gratefully acknowledge all participants for their contribution to this study.

Conflict of Interest

The authors declare that there are no conflicts of interest associated with this study.

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