2024 SICASH
SLIIT INTERNATIONAL CONFERENCE ON ADVANCEMENTS IN SCIENCES & HUMANITIES

Assessment of ICU Nurses' Knowledge and Identifying Barriers in Preventing Ventilator-Associated Pneumonia in Adult ICUs: A Study at the National Hospital, Kandy

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Abstract

Critical care services are costly, and the patients with indications for prolonged intubation are highly vulnerable to Ventilator Associated Pneumonia (VAP), which prolongs their hospital stay and raises the cost of treatment. In Southeast Asia, the prevalence of VAP ranges between 16.2% to 74.2%, with the mortality rate of 30 %. This study aimed to assess Intensive Care Unit (ICU) nurses' knowledge of VAP and identify the barriers in VAP prevention at the settings of adult ICUs in National Hospital Kandy. A descriptive cross-ctional approach was used, and data were collected from 132 nurses working in different Intensive Care Units from July 24 to July 30, 2023. Knowledge and practices regarding VAP prevention were identified through a structured self-administered questionnaire. Results indicated that a significant number of nurses (73.48%) possessed good knowledge on VAP bundle and 25% were aware of radiological changes related to VAP. Additionally, poor knowledge regarding cleaning and the changing frequency of ventilator circuits were identified among nurses, as 13.64% and 1.32% were knowledgeable in those areas respectively. Most ICU nurses adhered to the established infection control practices (86.36%), while some barriers were identified, including low visitor's adherence to infection control, inadequate staffing and the absence of laminar airflow in ICUs. Despite the challenges all the ICU nurses expressed willingness to engage in VAP preventive strategies, and 93.2% of them were seeking further education. In conclusion the findings from this study emphasize the need for training and improved support for VAP prevention in ICUs.

Keywords: Ventilator Associated Pneumonia; Intensive Care Unit; Critical Care Nursing; Barriers

Introduction

Ventilator associated pneumonia (VAP) is a type of pneumonia that develops 48 hours or longer after mechanical ventilation is given by means of an endotracheal tube or tracheostomy (Chastre & Fagon, 2001). The main pathogenic factor in the development of VAP is biofilm formation within the tracheal tube and micro aspiration of secretions (Gunasekera & Gratrix, 2016). Onset of VAP is often caused due to antibiotic sensitive bacteria such as *Klebsiella, Pseudomonas aeruginosa*, *Acinetobacter*, E- coli and coagulase positive *staphylococcus aureus* (Nussenblatt et al., 2014). VAP is the most common nosocomial infection among ICU patients. The negative consequences of VAP affect both patients and the institution. VAP is one of the leading causes for increasing the death rate in the ICU. In addition, it extends the length of hospital stay, delayed extubation, raise health care cost and increase use of health care resources (Danin et al., 2015). In Southeast Asia, the prevalence of VAP ranges between 16.2% and 74.2%, with the mortality rate of 30% (Gamage, 2019; Kharel et al., 2021). Many strategies and guidelines have been developed to prevent VAP. The center for the disease control (CDC) in United States of America has published a guideline that describes several measures to prevent VAP, focusing of following major areas, sterilization and disinfection and maintenance

https://doi.org/10.54389/PSCP5714

of equipment and devices to prevent transmission of microorganisms to respiratory tract, prevention of person-to-person transmissions of bacteria increasing host defence against infection and precautions of prevention of aspiration. Institute for health care improvement also introduced a guideline including VAP preventive strategies. This is known as "VAP bundle". This includes elevation of patient's head of bed to 30-40 degrees, daily sedation vacation and daily assessment of readiness to extubation, peptic ulcer prophylaxis, deep vein thrombosis etc. In ICUs, nurses are important stakeholders to put VAP preventive strategies into practices (Gerberding et al., 2004). ICU nurses are responsible for the overall care of patients; therefore, they need to have adequate knowledge to carry out VAP preventive strategies to reduce the risk of VAP. The lack of knowledge about evidence-based practice guideline among ICU nurses could be a barrier to compliance with VAP preventive strategies (Osti et al., 2017). Many researchers have found other barriers that hinder the ICU nurses to adhere with VAP preventive strategies in addition to nurses' knowledge. These barriers can be categorized as environmental and organizational factors (Jackson et al., 2018). When considering Sri Lanka, it is a developing country as well as a low-income country (Ariyawansa et al., 2023). There may be more obstacles in Sri Lanka, thus the identification of nurses' knowledge and barriers to adherence with VAP preventive strategies will help to reduce the mortality rate and health cost associated with VAP.

The purpose of the study is to evaluate the knowledge and identify the barriers related to ventilator-associated pneumonia (VAP) prevention among ICU nurses at the National Hospital Kandy**.** Specifically, the study aims to evaluate the ICU nurse's knowledge towards VAP prevention and to identify the barriers to implement VAP preventive strategies among ICU nurses in adult ICUs of National Hospital Kandy.

Materials and Methods

This was a descriptive cross-sectional study conducted among the nurses working in ICU in the National Hospital of Kandy. The hospital is consisted of different ICUs such as Surgical ICU, Medical ICU, Neuro-surgical ICU, Coronary Care Unit, Paediatrics ICU, Neonatal ICU. In national hospital Kandy, 58 ICU beds are functioning with 179 ICU nurses.

The sample size was calculated using the Lwanga and Lameshow's formula (Lwanga and Lameshow, 1991). Accordingly, the sample size was calculated as follows,

Sample size (n) = (Lwanga & Lameshow, 1991).

where: n = sample size
Z = standard normal deviation for specified alpha error (1.96 for 95% confidence)
d = degree of accuracy (precision) (0.05)
p = Anticipated population proportion (0.5 as there are no previous data)

A margin of error of 5% and 95% confidence level were considered for the calculation of the sample size.

$$(n) = \frac{z^2\, P(1-P)N}{(e^2 x(N-1))+(Z^2 xpx(1-p))}$$

$$n = \frac{1.96^2 x\ 0.5(1-0.5)x179}{0.05^2 x(179-1) + 1.96^2\ x0.5\ x\ (1-0.5)}$$

$$n = 122.9 \approx 123$$

Considering the 10% non-responders the final sample size was calculated as 135. The study included nurses who worked in adult ICUs in National Hospital Kandy, who had previous ICU training and those who did not have ICU training and nurses who had participated in any VAP related programme were also considered. Nurses on short-term assignments or temporary contracts and nurses who were not directly involved in the patient care were excluded from this study. The Ethics Review was obtained from the Ethical Review Committee of National Hospital, Kandy. The permission for collecting data was obtained from the Hospital Director, the Chief Nursing Officer, and Special Grade Nursing Officer.

The researchers provided the information related to the research to the participants and an invitation letter. Voluntary participation of the participants was ensured, and they were provided extended opportunity to ask any question from the investigators. Participants were allowed to withdraw from the study

at any time without giving any reason. After giving adequate information about the research, written informed consent was obtained through an informed consent sheet. Then data were collected using a self-administered questionnaire. The questionnaire consisted of 3 sections, to collect data related to sociodemographic characteristics, knowledge related VAP and preventive strategies to VAP. Personal information including names, addresses, contact numbers and other identifying information will be removed, and a code has ascribed to each participant to assure anonymity. Data will be stored for five years under lock and key, and the computerized data was given a password protection to assure confidentiality. Only the investigators will have the access to data.

Results and Discussion

Socio-demographic characteristics

The response rate of this study was 97.7% (n = 132). According to the findings, majority of the participants were female (87.9%). Most respondents (75.8%) had more than five years of experience in working as nurses. More than half of the participants (58.3%) had diploma in nursing, while 41.7% of the participants had Bachelor of Science (BSc) in nursing. Around half of the participants (45.5%) had completed ICU-specific training programs, and 41.7% of the respondents had attended programs related to VAP (Table 1).

Table 1: Demographic characteristics of participants (n = 132)

Characteristics	Category	Frequency (n)	Percentage (%)
1.Gender	Male	16	12.1
	Female	116	87.9
2.Years of experience as a nurse	1-5 y	32	24.2
	6-10 y	63	47.7
	11-15y	24	18.1
	15-20y	11	8.3
	>20y	2	1.5
3.Education qualifications as a nurse	BSc	55	41.7
	Diploma	77	58.3
4.Follwed ICU training programs	Yes	60	45.5
	No	72	54.5
5. Any programs related to VAP	Yes	54	41.7
	No	78	58.3

The nurse's knowledge regarding VAP

The analysis of nurses' knowledge about VAP exposes strengths and areas for improvement. A significant proportion (73.48%) of the of respondents demonstrated good knowledge regarding the VAP bundle, revealing the awareness about strategies to minimize incidence of VAP. However, only 45.45% participant knew the correct definition of VAP, which indicates the gap in basic understanding that could affect the early diagnosis of the condition. Most (64.3%) of the participants had good knowledge regarding the pathogenesis for VAP, recognizing the impact of pooling secretions and microaspiration as contributing factors. Awareness about the causative agents such as *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, was present in 68.94% of the participants.

Despite these strengths, there were some areas for improvement identified. Although 74.24% of participants knew about the symptoms of VAP, only 25% of participants knew about the radiological changes related to VAP, which may hinder the timely diagnosis. Furthermore, only 5.3% of the respondents had

knowledge related to frequency of changing ventilator circuits, suggesting knowledge gap in infection control practices. Similarly, knowledge related to the pressure at which the ET cuff must be maintained, was known to only 35.61% of the respondents. Majority of the participants had poor knowledge regarding cleaning of ventilator circuit (13.64%) and frequency of ventilator circuit need to be changed (1.52%).

In contrast, 65.91% of participants were aware of the recommended subglottic suctioning pressure and most of the participants (70.45%) had a good knowledge regarding the correct position for ventilated patients to reduce the risk of VAP. However, knowledge of the nurses related to peptic ulcer prophylaxis was high (68.18%). These findings reveal the need for targeted education program to address the knowledge gap in VAP prevention.

Barriers to prevent of Ventilator associated pneumonia

When considering barriers related to VAP, 77.27% of participants had enough facilities to practice sterile techniques to prevent VAP, which is a positive indicator for resource availability. Majority of the Participants (78%) had mentioned there were written updated protocols of VAP. A significant number of nurses (32.6%) emphasized that there were enough Nursing officers to perform task in the ICUs. However, 100% of the respondents were willing to adopt VAP preventive strategies and 93.18% were seeking additional information on VAP. Majority of Nurses (60.6%) mentioned that visitors rarely use separate gowns, caps when entering ICU while 92.4% health workers wear separate kits when working ICUs.

Compliance with the infection control practices was moderately high as majority of participants (86.36%) always used standard infection control techniques in ICU, only 47.7% of the participants always used sterile techniques. Many of them (43.18%) reported that there were no laminar airway flow systems in ICU, which may impact the overall effectiveness of infection control strategies.

Conclusions

The study aimed to assess ICU Nurses knowledge regarding VAP and barriers to prevent it in adult ICUs of National hospital Kandy. According to the findings, there are positive aspects as well as areas for improvement. ICU nurses had sound knowledge regarding VAP prevention bundle, patient positioning, subglottic suctioning pressures. However, the knowledge regarding definition of VAP, radiological changes associated with VAP and handling of ventilator circuits and ET cuff pressures requires specialized education in these specific areas. The staffing issues, lack of formal training on VAP, and non-adherence of the visitors to the infection control protocol and lack of laminar airflow system are significant barriers to prevent VAP in adult ICUs of National Hospital Kandy. Despite the availability of the necessary resources and updated protocols the practical application is difficult due to the above-mentioned barriers. All of the nurses in adult ICUs in National Hospital Kandy are willing to use and consider VAP preventive strategies and get more information regarding VAP preventive strategies.

Acknowledgement

We would like to express our sincerest gratitude to our supervisors for their encouragement, followed up carry away and teach throughout the study. This research goal would not have achieved without their continuous higher support. We wish to express our appreciation to the ICU nurses who expressed their interest in our study and willingly participation.

We particularly want to thank the Open University of Sri Lanka and Ethics Review Committee of National Hospital Kandy. Our sincere appreciation goes to Consultants of ICUs, Special Grade nursing officer, Special Grade nursing officers of sections, nursing sisters of ICUs of NHK whose commitment have facilitated our ability to complete this project.

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