

# Critical Care Nurses' Knowledge on Prevention of Ventilator-associated Pneumonia: A Cross-sectional Study

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## ABSTRACT

**Background:** This study aims to assess the knowledge of Palestinian critical care nurses regarding the prevention of ventilator-associated pneumonia (VAP), an acquired infection that affects critically ill patients on ventilators in hospitals. Nurses caring for these patients may not always be aware of the most effective methods to prevent VAP.

**Materials and methods:** A descriptive cross-sectional study was conducted in five government hospitals in Gaza Strip, Palestine over 3 months. A convenience sample technique (72) of critical care nurses was selected. Data were collected through a self-administered questionnaire divided into; demographic characteristics and knowledge about critical care nurses of preventive interventions for VAP. Statistical analysis was performed using SPSS version 25.

**Results:** More than half of the critical care nurses (67%) were male and the majority of critical care nurses (63%) were aged between 20 and 29 years. Furthermore, 32% of critical care nurses were from Alshifa Medical Complex. The overall mean knowledge among critical care nurses to prevent VAP was 72%, indicating correct answers to knowledge-related queries.

**Conclusion:** Our study indicated that the knowledge of critical care nurses about VAP prevention was inadequate. Age, marital status, and years of experience were significantly associated with a good level of knowledge about the prevention of VAP ( $p < 0.05$ ). However, there was no significant association between knowledge about VAP prevention of VAP and gender, qualification level, and type of intensive care unit (ICU).

**Keywords:** Critical care, Nurses' knowledge, Ventilator-associated pneumonia.

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## HIGHLIGHTS

This study thoroughly evaluates the awareness, and knowledge on prevention of ventilator-associated pneumonia (VAP) among CCNs in the Gaza Strip, Palestine. Therefore, future research related to VAP prevention should focus on adherence training among CCNs to promote their professional development.

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## INTRODUCTION

Ventilator-associated pneumonia is a specific lung parenchymal infection that occurs 2–3 days after admission to intensive care units (ICUs) of critically ill patients requiring artificial intubation.<sup>1,2</sup> Determination to prevent VAP, as hospital-acquired infection (HAI), is a significant therapeutic competition where critical care nurses (CCNs) want to understand the threats and impact of emerging VAP.<sup>3</sup> Critically ill patients in the ICU on artificial mechanical ventilators have weak immunity and diminished gag reflexes.<sup>2</sup> They have a higher risk of many complications of VAP that include 1–2 month mortality, prolonged duration with an endotracheal tube (ETT), extended stay hospital days, and high care costs.<sup>4</sup> Focusing on clinical nursing care depending on the present evidence standard guidelines, the Centers for Disease Control and Prevention (CDC) guidelines are designed to prevent VAP in patients on mechanical ventilation (MV). These guidelines are useful as they establish patient safety measures and improve the overall quality of care.<sup>5</sup> The VAP rates vary across the world from 6 to 52%; in some developing

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countries, the rates can go as high as 76% VAP per all intubated patients. It contributes to 15–45% of deaths in critical care settings.<sup>2</sup> Martin-Loeches et al.,<sup>6</sup> conducted a large, prospective cohort study of more than 2,000 patients from 114 ICUs across Europe and South America between 2013 and 2014. They found that the incidence density of VAP in this study was 8.8 per hundred ventilation days, a rate that is statistically equivalent to the rate of incidence rate VAP.<sup>7</sup> However, the researchers also found that data that were obtained from developing countries indicated that the incidence of VAP is between 16 and 31%.<sup>8,9</sup> Contemporary research has also indicated that the incidence of VAP in ICUs varies between 8 and 28%, which establishes it as one of the leading causes of morbidity and mortality.<sup>10,11</sup> A study was conducted in hospitals in Lebanon that actually showed that VAP was the most common type of HAI in the ICU and was recorded at 25%.<sup>12</sup> This means that almost 31% of Egyptian patients developed VAP with a rate of 21.3 per 1000 ventilators,<sup>13</sup> compared with 21.6% of ventilated patients in hospitals in Palestine.<sup>14</sup> This is imperative for the implementation of effective measures to prevent and manage HAI in ICU.<sup>11</sup>

Since CCNs are involved directly in delivering most of the preventive measures for VAP, it remains a multidisciplinary task where CCNs are considered vital in implementing most measures to prevent VAP.<sup>2</sup> This is because they are in direct contact with patients from the admission period to the ICU, providing nursing care and closely monitoring critically ill patients.<sup>2</sup> After reviewing the libraries of different universities in the Gaza Strip (GS), Palestine, and searching different websites for VAP intervention, there is an inadequate study evaluating the knowledge and practice of CCNs regarding VAP guidelines in GS, Palestine.<sup>15</sup> This is because critically ill patients on artificial mechanical ventilators are susceptible to many complications related to VAP, such as an increased risk of mortality, prolonged duration with an intratracheal tube, extended hospitalization, and higher care costs.<sup>4</sup> Assessing CCNs' knowledge of VAP prevention could be beneficial in enhancing their awareness, therefore, leading to improving their skills in preventing this serious problem in GS, Palestine. Therefore, this study aimed to assess VAP knowledge related to the prevention among CCNs working in adult ICUs at government hospitals in GS, Palestine.

## MATERIALS AND METHODS

### Study Design, Population, and Setting

A multicenter institutional-based cross-sectional descriptive study was conducted among CCNs working in adult ICUs at five governmental hospitals which include the Indonesian Hospital, the Alshifa Medical Hospital, the Aqsa Martyrs Hospital, the Nasser Medical Hospital, and the European Gaza Hospital in GS, Palestine, from March to June 2023.

### Study Participants and Sampling Method

A total of 72 CCNs both men and women aged between 20 and 49 years completed the questionnaire. Nurses were recruited using a convenience sampling technique. At the beginning of the questionnaire on the first page where the objectives and importance of the study should be spelled out. The sample was chosen using a convenient sampling technique, and an online sample size was calculated using a Raosoft sample size calculator (Raosoft, Inc. 2004, [http://www.raosoft.com/sample\\_size.html](http://www.raosoft.com/sample_size.html)),<sup>16</sup> which determined a confidence level of 95%, accepted margin of error of 5%, and a response distribution of 50%. Consequently, the response rate to the questionnaire was 100% among CCNs because

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Conflict of interest: None

the sample was collected through convenient techniques, which allowed excluding any nurse who refused to participate in the study at the beginning of the data collection.

### Inclusion and Exclusion Criteria

These included all qualified nurses who for the previous 6 months in five governmental hospitals had been employed only in adult ICU and who were either on probation or with regular monthly wages during the period beginning end of March to June 2023 who consented to participate in the study. Newly recruited nurses in the ICU, unpaid voluntary nurses, the head nurses were also excluded from the current study to eliminate any possibility of bias. The studies were carried out among pediatric nurses, excluding those who had worked in PICUs as well as those who did not take the survey due to critically severe health conditions.

### Data Collection

Subsequently, approval was sought from the general administration of hospitals in the Palestinian Ministry of Health, after permission, a face-to-face interview was conducted with nurses to collect research data in adult ICUs. It was administered by five researchers who delivered the questionnaires to the respondents and the data were collected from the filled questionnaire respondents when they were willing to answer it. The estimated time taken to fill out the questionnaire ranged from 20 to 30 minutes.

### An Interview-based Questionnaire

The survey was a self-completed questionnaire in English. It was used to collect data from CCNs: job attributes, comprising gender, age, marital status, qualification, years of experience, special training courses in ICU, and VAP guidelines. It consisted of 11 items.

### Critical Care Nurses' Knowledge of Preventive Interventions for Ventilator-associated Pneumonia

Is a well-developed questionnaire to assess the level of knowledge among CCNs regarding the prevention of VAP for critically ill patients, The questionnaire was adapted from a reliable source, developed by Labeau et al.,<sup>17</sup> which was published in an article entitled "Critical care nurses' knowledge of evidence-based guidelines for preventing associated pneumonia: An evaluation questionnaire."<sup>17</sup> Some questions were also obtained from another study done in southern Taiwan,<sup>18</sup> but the questions were extended to correspond to the context of GS in Palestine. The response data was securely kept by the principal investigator.<sup>17</sup> and Selamat et al.,<sup>3</sup> also found an acceptable level of internal consistency (reliability) using the Cronbach alpha coefficient for the knowledge with values (0.79). It was composed of 14 items in the multiple-choice section (details in the Supplementary Material). The assessment of each knowledge item consists of four possible answers. A mark will be given for every correct response and a zero if the response is incorrect. The total scores ranged from 0 to 14, these scores were then transformed into percentages. The level of total average CCN knowledge score is derived by summing the total item scores and ranging from 70%.

Score of the composite percent of the knowledge questionnaire:

- Fair knowledge: refers to CCNs who score items <70%.
- Good knowledge: refers to CCNs who score items ≥70%.

Fair knowledge includes low and moderate levels of knowledge that indicate inadequate knowledge or reflect unsatisfactory knowledge.

Good knowledge includes high levels of knowledge that indicate adequate knowledge or reflect satisfactory knowledge.

In the current study, the questionnaire was in English and the self-administered language. The language of the questionnaire, its content, the clarity, and refinement of the question were in turn reviewed and approved by five professionals in related fields before it was administered to the CCNs. The internal consistency of the questionnaire was determined using the Cronbach alpha coefficient to establish its reliability, consistency, and stability ( $\alpha = 0.80$ ).

### Pilot Study

A pilot study was carried out on 10% of the total study sample (7 CCNs) at Alshifa Medical Hospital (the largest hospital in the GS), before the data collection process, to ensure the survey's acceptance and consistency. After that, small adjustments were made considering the findings of the pilot study.

### Statistical Analysis

After data collection, the data were coded for the questions, and the authors entered and cleaned the data before subjecting it to statistical tests. Data analysis was done using Statistical Package for Social Sciences, version 25 for computer software. Frequency descriptive and inferential analyses were used to summarize the demographic characterization of the CCNs and their knowledge scores. The Chi-square ( $\chi^2$ ) test was used for analysis, which averages that a score less than the mean is considered (fair) a low and moderate level of knowledge, and a score higher than or equal to the mean is considered (good) a high level of knowledge. Statistical significance was also set at  $p$ -value  $< 0.05$ .

## RESULTS

A total of 72 nurses working in the ICUs of GS government hospitals GS in Palestine were included in the study. More than half of the study respondents that is, 66.7% were male, 45 (62.2%) were in the age-group of 20–29 years, and more than half of the study respondents, that is, 66.1% were married. Approximately, two-thirds of the respondents had a bachelor's degree as their academic qualification, with 32% of the respondents working at Alshifa Medical Hospital. Most of them, 68.1%, had less than 5 years of work experience in the ICU. Approximately, half of the study respondents, 55.6%, had mixed shifts. Of the four critical units, 66.7% of the study respondents were in the medical ICU. Regarding the response of CCNs to course training, more than half of the respondents 68.1% received on-the-job training about VAP, while 51.4% of them had no training program on the prevention of VAP. However, only 12.5% of the participants had a diploma in respiratory therapy (Table 1).

As presented in Table 2, the overall mean knowledge score among CCNs regarding the prevention of VAP out of 14 questions was 72%, indicating correct answers on knowledge "inadequate"-related queries. The highest scores showed that 69 (95.8%) of nurses knew that a nurse caring for a ventilated patient is required to wash hands before and after oral/ETT suctioning, followed by 65 (90.3%) who knew that early weaning from MV reduces the risk of VAP, while the lowest scores indicated that 36 (50%) knew that it is recommended to change humidifiers every week or when clinically indicated, followed by 38 (52.8%) who knew that it is

**Table 1:** Demographic characteristics of CCNs in ICUs

Variables	Frequency (n)	Percentage (%)
Gender		
Male	48.0	66.7
Female	24.0	33.3
Age (years) Mean $\pm$ SD: 14.0 $\pm$ 5.7		
20–29	45.0	62.2
$\geq 30$ –39	24.0	33.3
$\geq 40$ –49	3.0	4.2
Marital status		
Single	28.0	38.9
Married	44.0	66.1
Qualification		
Diploma	6.0	8.3
Bachelor	54.0	75.0
Postgraduate	12.0	16.7
Workplace		
Indonesian Hospital	19.0	26.4
Alshifa Medical Hospital	23.0	31.9
Al-Aqsa Martyrs hospital	12.0	16.7
Nasser Medical Hospital	10.0	13.9
European Gaza Hospital	8.0	11.1
Years of experience in ICU		
<5 years	49.0	68.1
$\geq 5$ years	23.0	31.9
Working shift		
Straight morning	32.0	44.4
Mixed shifts	40.0	55.6
Type of ICU		
Medical ICU	48.0	66.7
Cardiac Care Unit	2.0	2.8
Surgical ICU	8.0	11.1
Other ICU (Neuro ...)	14.0	19.4
Received on-job training about VAP		
Yes	49.0	68.1
No	23.0	31.9
Attended a program about the prevention of VAP		
Yes	35.0	48.6
No	37.0	51.4
Having a diploma in respiratory therapy		
Yes	9.0	12.5
No	63.0	87.5

Data are expressed as means  $\pm$  SD for continuous variables and as percentages for different categorical variables. CCNs, critical care nurses; ICU, intensive care unit; SD, standard deviation; VAP, ventilator-associated pneumonia

recommended to change suction systems for every new patient, or when clinically indicated.

In Table 3, it is shown that  $\sim 30.6\%$  of the study, respondents had good/"adequate" knowledge of VAP, while 69.4% of them had fair/"inadequate" knowledge.

The authors used the Chi-square test to reveal a statistically significant difference, as presented in Table 4, which shows that there

**Table 2:** Critical care nurses' answers to questions about knowledge of prevention of VAP

No.	Item	Correct answer		Incorrect answer		Rank
		n	%	n	%	
1.	Oral intubation is recommended	46	63.9	26	36.1	10
2.	It is recommended to change the ventilator circuit when clinically indicated	45	62.5	27	37.5	9
3.	Using ETT with an extra lumen for drainage of subglottic secretions increases the risk of VAP	59	81.9	13	18.1	5
4.	The best airway humidifier to prevent VAP is a heated humidifier	40	55.6	32	44.4	11
5.	It is recommended to change humidifiers every week or when clinically indicated	36	50.0	36	50.0	14
6.	Using a closed suction system is recommended as a preventive measure of VAP	46	63.9	26	36.1	12
7.	The insertion of the suction catheter into the ETT is a sterile procedure	51	70.8	21	29.2	8
8.	It is recommended to change suction systems for each new patient, or when clinically indicated	38	52.8	34	47.2	13
9.	It is recommended to perform oral care by using a swab moistened with mouthwash and water every 4–6 hours	54	75.0	18	25.0	6
10.	It is recommended to perform chest physiotherapy for ICU patients to reduce the risk of VAP	61	84.7	11	15.3	4
11.	Early weaning from MV reduces the risk of VAP	65	90.3	7	9.7	2
12.	Overfeeding ventilated patients can increase the risk of aspiration, leading to an increase in the risk of VAP	67	93.1	5	6.9	3
13.	Semi-recumbent positioning is recommended for ventilated patients	50	69.4	22	30.6	7
14.	A nurse caring for a ventilated patient is required to wash hands before and after oral /ETT suctioning	69	95.8	3	4.2	1
Overall		72.12		27.88		

Data are expressed as average scores for continuous variables and as (%) percentages for different categorical variables. n, Number; EET, endotracheal tube; ICU, intensive care unit; MV, mechanical ventilation; VAP, ventilator-associated pneumonia

**Table 3:** Total level of knowledge about the prevention of VAP among CCNs

Total level of knowledge	Range of scores	Frequency (n)	Percentage (%)
Fair knowledge	<70%	50	69.4
Good knowledge	≥70%	22	30.6

Data are expressed as average scores for continuous variables and as (%) percentages for different levels of knowledge and range of scores. n, Number; CCNs, critical care nurses. Fair knowledge = mild + moderate level of knowledge (if the total range of score is <70%), Good knowledge (if the total score is 70% or more)

were no significant differences in knowledge about the prevention of VAP between male and female nurses ( $p = 0.856$ ). This finding indicates a significant association between knowledge about VAP prevention and the age of nurses, as younger ages have significantly lower knowledge about VAP prevention ( $p = 0.000$ ). Furthermore, there is a statistically significant positive association between VAP knowledge and the marital status of CCN, which means that married nurses have significantly higher knowledge of VAP prevention compared with single nurses ( $p = 0.004$ ). Regarding qualifications and workplace, it was indicated that there was no significant association between knowledge about VAP prevention and qualifications or

**Table 4:** Association between the total level of knowledge about VAP prevention with demographic characteristics of CCNs

Demographic data	Total level of knowledge		Chi-square value	p-value
	Fair n (%)	Good n (%)		
Gender				
Male	33 (68.8)	15 (31.3)	0.033	0.856
Female	17 (70.8)	7 (29.2)		
Age				
20–29 years	41 (91.1)	4 (8.9)	28.316	0.000* (<0.05)
30–39 years	7 (29.2)	17 (70.8)		
40–49 years	2 (66.7)	1 (33.3)		
Marital status				
Single	25 (89.3)	3 (10.7)	8.501	0.004* (<0.05)
Married	25 (56.8)	19 (43.2)		
Qualification				
Diploma	5 (83.3)	1 (16.7)	2.880	0.237
Bachelor	39 (72.2)	15 (27.8)		
Postgraduate	6 (50.0)	6 (50.0)		

(Contd...)

Table 4: (Contd...)

Demographic data	Total level of knowledge		Chi-square value	p-value
	Fair n (%)	Good n (%)		
Workplace				
Indonesian Hospital	15 (78.9)	4 (21.1)	3.731	0.444
Alshifa Medical Hospital	14 (60.9)	9 (39.1)		
Al-Aqsa Martyrs hospital	9 (75.0)	3 (25.0)		
Nasser Medical Hospital	8 (80.0)	2 (20.0)		
European Gaza Hospital	4 (50.0)	4 (50.0)		
Years of experience in ICU				
<5 years	44 (89.8)	5 (10.2)	29.941	0.000* (<0.05)
≥5 years	6 (26.1)	17 (73.9)		
Working shifts				
Straight morning	16 (50.0)	16 (50.0)	10.263	0.001* (<0.05)
Mixed shifts	34 (85.0)	6 (15.0)		
Received on-the-job training about VAP				
Yes	29 (59.2)	20 (40.8)	7.611	0.006 (<0.05)
No	21 (91.3)	2 (8.7)		
Attended a program about the prevention of VAP				
Yes	21 (56.8)	16 (43.2)	5.774	0.016* (<0.05)
No	29 (82.9)	6 (17.1)		
Having a diploma in respiratory therapy				
Yes	6 (66.7)	3 (33.3)	0.037	0.847
No	44 (69.8)	19 (30.2)		

Data are expressed as N.: Number and (%) percentages for different categorical variables. The Chi-square ( $\chi^2$ ) test was used to examine differences in the prevalence of different categorical variables. A p-value < 0.05 was considered statistically significant. n, Number. ICU, intensive care unit; VAP, ventilator-associated pneumonia

workplace. Additional findings on the association between the level of knowledge on prevention and years of experience in the ICU and work shifts showed that there was a statistically significant positive association between knowledge to prevent VAP and years of experience with CCNs ( $p = 0.000$ ) and a statistically significant association between knowledge to prevent VAP and work shifts ( $p = 0.001$ ). This finding indicates a significant association between knowledge to prevent VAP and on-job training, which means that nurses who received training have significantly better knowledge compared with nurses who did not receive training ( $p = 0.006$ ), and a significant association between knowledge and attending training programs about the prevention of VAP ( $p = 0.016$ ). The last finding indicates that there was no statistically significant association between knowledge of the prevention of VAP among nurses who have a diploma in respiratory therapy and those who do not have a diploma in respiratory therapy ( $p = 0.847$ ).

## DISCUSSION

Globally, the purpose of this study was to assess the knowledge levels of CCNs toward the prevention of VAP at five adult ICU governmental hospitals in GS, Palestine. The prevention of VAP is primarily the responsibility of the CCN, whose knowledge influences the health outcomes of critically ill patients. This facility-based cross-sectional study was conducted to assess the CCNs' knowledge of the prevention of VAP for critically ill patients in adult ICUs in GS, Palestine.

The participants involved 72 nurses employed in five different adult government ICUs in GS, Palestine. More than half of the participants 66.7% were male nurses and 66.1% were married. This

finding is supported by Getahun et al.,<sup>19</sup> and Ahmed.<sup>20</sup> Our findings disagree with the results reported by Ghimire and Neupane,<sup>21</sup> who found that around 71% were female CCNs, and disagree with Al-jaradi,<sup>22</sup> who showed that 52% of CCNs are unmarried. This is due to the fact that most of the nurses are male in GS, Palestine. More than three-quarters of the participants were within 20–29 years of age and the mean years of professional experience of the CCN were ( $14.0 \pm 5.7$  years). These findings were similar to Al-Sayaghi,<sup>23</sup> in which the majority of the respondents were young, agreeing with Aloush and Al-Rawajfa.<sup>24</sup> But the findings were contrary to the recent study reported by Yeganeh et al.,<sup>25</sup> which mentioned that the largest group of 29.8% of CCNs were in the age-group of 50–59 years. Regarding the level of CCNs, it was found that 75% of the CCNs had achieved a bachelor's degree, followed by 16.7% who had postgraduate degrees. These findings were not consistent with the study carried out by Al-jaradi,<sup>22</sup> Al-Sayaghi.<sup>23</sup> Regarding years of working experience and training on the job on VAP, systematically, over half, 68% of them did not have more than 5 years of work experience in the ICU and gave on-job training on the job on VAP. These findings were inconsistent with the study by Aloush and Al-Rawajfa,<sup>24</sup> who found that the participants in their study had a working experience of less than 2 years in the ICU.

Approximately 87.5% of the total number of nurses have no diploma in respiratory therapy. This result is in agreement with studies conducted by Getahun et al.,<sup>19</sup> in North West Ethiopia and by Madhuvu et al.,<sup>26</sup> in Australia. This disparity may exist because most CCNs residing in GS face challenges when trying to travel due to the blockade imposed by the Israeli occupation, making them unable to attend advanced training programs. The main findings of this study indicate that ~ one-third of 31% of the CCNs have good

knowledge about the prevention of VAP, while two-thirds of them have fair knowledge. These findings were consistent with recent studies reported by Al-jaradi,<sup>22</sup> Abo Elseoud et al.,<sup>27</sup> Ciampoli et al.,<sup>28</sup> and Busi and Ramanjamma,<sup>29</sup> all of whom found that most CCNs had inadequate knowledge of the prevention of VAP. Furthermore, these findings were consistent with those of refs.<sup>17–26</sup> who conducted a study on knowledge among CCNs on evidence-based guidelines for the prevention of VAP, and the results revealed that the overall knowledge results were inadequate. However, this finding is related to the study by Ghimire and Neupane,<sup>21</sup> who found that more than half of the participants had adequate knowledge about VAP prevention. However, the present study revealed a significantly lower mean knowledge score compared with previous studies reported by El-Khatib et al.<sup>30</sup> and Tafere et al.,<sup>31</sup> Variations in practice settings, healthcare organizations, and amendments to specific guidelines or policies that have developed training for the use of effective evidence-based measures to comprise VAP in ICUs may explain difference in the knowledge score acquired in the present study,<sup>30</sup> and differences in specific guidelines and policies that govern training and implementation of evidence-based practices to prevent VAP in critical care units. Adequate nursing knowledge for ventilation patients does lead to better outcomes and the approach taken when developing this guide is as follows.<sup>32</sup> Teaching strategy and guidelines for the prevention of VAP must also take into consideration some of the difficulties that arise in the context of the resource-limited settings, adequate development of a certain guideline approach to improve VAP prevention while also helping to reduce specific issues stop gaps in knowledge in resource-limited settings.

In the findings of the present study, a significant association was found between VAP knowledge about the prevention of VAP and the age of nurses, as younger nurses had significantly lower knowledge about VAP prevention of VAP ( $p = 0.000$ ). These findings were consistent with recent studies reported by Aloush and Qadire.<sup>33</sup> Furthermore, a statistically significant positive association was observed between the knowledge of preventing VAP and the marital status of the CCN, indicating that married participants had significantly higher knowledge of preventing VAP compared with single nurses ( $p = 0.004$ ). These findings were consistent with recent studies reported by Getahun et al.,<sup>19</sup> and Ciampoli et al.,<sup>28</sup> which suggest that married nurses may have increased awareness of health problems due to personal or family experiences. This increased awareness can translate into a greater emphasis on preventive measures such as VAP awareness and prevention. The researcher posits that married individuals often benefit from a supportive partner, which may enhance their capacity to engage in continued education and professional development. Based on the results of the current study, it was found that qualification was not a significant predictor of the level of knowledge of CCNs on the prevention of VAP ( $p = 0.237$ ). This finding is inconsistent with research conducted in other countries, including Egypt by Ahmed,<sup>20</sup> and Yemen by Al-Sayaghi.<sup>23</sup> The current study showed that there were statistically significant positive associations between knowledge of the prevention of VAP and years of experience in CCN ( $p = 0.000$ ) ( $p < 0.05$ ). This finding is supported by previous studies in Egypt by Ahmed,<sup>20</sup> and also in Manipal by Mannava et al.,<sup>34</sup> This study finding is contrary to Wilson JL and Sahin ZA et al.<sup>35,36</sup> who concluded that more experience increases the cognitive resources available for interpretation of data, resulting in increased knowledge. However, this result disagrees with previous studies conducted in different countries such as Sana'a City-Yemen by Al-jaradi,<sup>22</sup> in Johannesburg by Yeganeh et al.,<sup>25</sup> and Australia

by Madhuvu et al.,<sup>26</sup> Furthermore, this indicated that knowledge of prevention of VAP had a statically significant relationship with work shifts, meaning that nurses working in the morning shift had better knowledge of VAP than. This result is relevant to the study conducted by Akin Korhan et al.,<sup>32</sup> in Turkey. It is known to cause sleep disorder, general fatigue, stress, diminished social relationships, decreased job satisfaction, reduced performance, loss of motivation, burnout, and compromised patient care.<sup>35,36</sup>

Furthermore, the results demonstrated a statistically significant difference in the level of knowledge about VAP between CCNs who had on-the-job training on VAP and those CCNs who had attended VAP prevention ( $p = 0.006$ ,  $p = 0.016$ ), respectively. This finding is supported by various studies by Al-jaradi,<sup>22</sup> Botros et al.,<sup>37</sup> and Ahmed.<sup>20</sup> However, in their study, Karaca and Arslan<sup>38</sup> reported that 75% of nurses had received training in programs on VAP prevention, and the trainees indicated that they found the training adequate. Possible validation could be obtained through on-the-job training and attending training programs on VAP prevention for nurses to effectively prevent VAP and detect early signs and symptoms of respiratory complications.

### Limitations

This study has several limitations, including its cross-sectional design conducted in the Gaza Strip, Palestine. Furthermore, the research was carried out in a small geographic area with only three hospitals, and the convenience sampling technique involved a small number of CCNs, which may not provide representative results. The challenging living conditions and political instability in the region further restrict the generalizability of our findings to other populations.

### CONCLUSION

Our study indicates that critical care nurses' knowledge of VAP prevention is inadequate. Age, marital status, and years of experience are significantly associated with a good level of knowledge about the prevention of VAP ( $p < 0.05$ ). However, there is no significant association between knowledge about the prevention of VAP and gender, qualification level, and type of ICU. Therefore, future research related to VAP prevention should focus on adherence training among CCNs to promote their professional development.

### Ethical Approval

The researcher obtained ethical approval from the Palestinian Health Research Council (Departmental Health Research Unit of the Palestinian Ministry of Health, GS). (Code No.: MOH 1258293/2023). Furthermore, written informed consent was obtained from each CCN upon enrolment.

### SUPPLEMENTARY MATERIALS

All the supplementary materials are available online on the website of [www.ijccm.org](http://www.ijccm.org).

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