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Knowledge of Intensive Care Nurse on Evidence-Based Guidelines for Reducing Ventilator-Associated Pneumonia at the Benghazi Medical Centre, Libya

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Ventilator-associated pneumonia is an issue in intensive care units. it leads to an increased burden on the hospital, as a result of the increase in the length of stay of affected patients in hospital. Increases in cost, as well as increases in morbidity and mortality rate are all effects of VAP. ICU staffs' knowledge of evidence-based guidelines plays an important role in VAP prevention and control.
Aim: To evaluate the critical care staff knowledge of evidence-based guidelines with regard to reducing VAP.

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Methodology: This study incorporates a descriptive quantitative design. Data was collected from 45 nurses in the medical and surgical care units of the Benghazi Medical Centre using a validated questionnaire. The collected data was analyzed using SPSS software. The percentage of correct answers was determined and compared. In addition, Chi-square tests, Mann-Whitney tests and Kruskal-Wallis tests were used as appropriate.
Results: The study indicated that the knowledge level of nurses was poor at 45%, and no association between their knowledge and gender. Although no statistical correlation between nurses' knowledge and their qualification, there is a slight increase in the knowledge of nurses who hold Bachelor than others. On the other hands, nurses with experience more than 11 years had a good knowledge level than those with experience less than 11 years.
Conclusion: Critical care nurses in Benghazi Medical Centre had inadequate knowledge level regarding evidence based guidelines of VAP prevention. This study recommended multifaceted educational and training programs to raise the knowledge level of ICUs medical staff.

Keywords: Nurses; VAP; ICU; EBG; Prevention and control.

1. INTRODUCTION

Hospital acquired pneumonia (HAP) is the second most prevalent nosocomial infection in the United States [1]. Patients who are mechanically ventilated are at a high risk of getting this infection, which is also called Ventilator-Associated Pneumonia (VAP), and it is defined as pneumonia occurring 48 hours after endotracheal intubation in mechanically ventilated patients, with the first day being ventilator placement [2].

VAP has become a significant issue in many Intensive Care Units (ICUs) around the world. It has considerable as a negative impact on patient outcomes [3], in that it causes the mortality and morbidity rates for ventilated patients to rise [4], the increase in the cost of hospitalization, as well as increases in the length of stay in the hospital [5][6].

The crude mortality rate associated with VAP has been estimated to range from 16% to 94% [3]. However, the mortality rate attributed to VAP is expected to be 9% [7]. Additionally, the risk of death among ventilated patients with VAP is 2-fold to 10-fold higher than for those ventilated patients without pneumonia [8].

Regarding the economic impacts of VAP, increasing hospital services due to VAP will lead to a significant financial burden on hospitals. The estimated median total charge is about $198,200 for each patient's case [9]. In addition, several studies estimate VAP cost, and the average cost for a patient has been estimated to be between $11,897 [6] and $25,072 [10]. Furthermore, the treatment cost in low-income developing countries has increased and is estimated to be $5,200 [11]. What is more, the prolongation of the stay in hospital is estimated to be 10 days [12], while the median ICU duration is 18.5 days, and median hospitalization duration is 26.5 days [9].

According to several studies, the incidence rate of VAP has been estimated to range from 8% to 28% [13]. In developing countries, it is estimated from 10 to 41.7 per 1000 ventilator days [3], while it is estimated to be from 3.6 to 10.2 per 1000 ventilator days in the CDC national healthcare safety network [14]. In France, it is estimated to be about 9.4 per 1000 ventilator days [15] and in Germany, it is about 23 per 1000 ventilator days [16].

Therefore, the education and awareness of ICU staff plays an essential role in VAP prevention. Consequently, this research will focus on the evaluation of knowledge levels of ICU staff (nurses'), with regard to evidence-based guidelines aimed at preventing VAP.

1.1 Aim

The study aims to measure the level of the nurse's knowledge regarding Evidence Based Guidelines (EBG) of VAP prevention in ICUs of Benghazi Medical Centre (BMC) in Benghazi, Libya.

2. MATERIALS AND METHODS

2.1 Study site

This study was conducted in the medicine and surgical Intensive Care Units (ICUs) of the Benghazi Medical Centre (BMC) in Benghazi, Libya.

2.2 Study Design

This study involves descriptive research that adopts a quantitative and cross-sectional approach. It was based on validated multiple choice questionnaires developed to evaluate the knowledge of ICU medical staff on the evidence-based guidelines for VAP prevention.

2.3 Methods of Data Collection

The data was gathered through the use of a multiple-choice questionnaire. And it was collected between 1st July and December, 2019.

2.4 Questionnaire Design

The questionnaire was developed by Dodek et al. [17] with the aim of evaluating the knowledge of EBG with regard to VAP prevention. It includes nine multiple choice questions, each of which has four options. One is correct, two are alternative answers which are wrong, while the last option was 'I don't know'.

Three demographic questions were added to collect general information about the nurses involved, including the respondent's experience in terms of years, gender, job type and level of education.

2.5 Target Population and Sample Size

The sample included all nurses who are currently working in the surgical and medicine ICUs in the Benghazi Medical Centre, which the total sample size is 45 nurses.

2.6 Statistical Analysis

The IBM SPSS version 22 software was used to analyze the collected data. In addition, the percentage of correct answers for each question was determined and compared. Furthermore, means, median, standard deviation and frequency were calculated, In addition, Mann-Whitney tests and Kruskal-Wallis tests were used as appropriate.

3. RESULTS AND DISCUSSION

Part 1: nurses' knowledge regarding EBG of VAP prevention

Fig. 1 shows that more than half of the sample were female, which were (68.9%) and 31.1% were male.

Also, Fig. 2 reported that largest proportion of the sample (91.1%) hold a diploma degree, while the lowest number of post graduate (2.2%).

Furthermore, Fig. 3 represent the respondent experience, the large proportion of the sample had 0 to 5 years' experience (5.5%); however least proportion were nurses who had experience from 21 to 25 years (4.4%).

Part 2: Analysis of the nurses' knowledge on *EBG* of *VAP* prevention

According to Table 1, the Knowledge level of nurse about VAP prevention is 45%, the highest proportion of correct percent was observed in Q4 (82.2%), while less proportion of correct answer was reported in Q9 (8.9%).

Besides, Table 2 shows knowledge level of males and females were 45% separately; both of them had high percentage of correct answer for Q4. On the other hand, less correct answers of females and males were observed in Q9 and Q7.

Furthermore, Table 3 reported that there is no statistical relationship between gender and knowledge level because *P* value was more than 0.05.

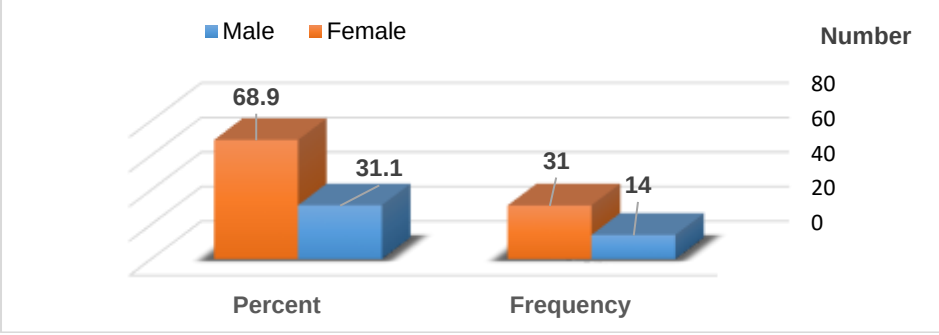

Fig. 1. Nurses' frequency and percentage of gender distribution

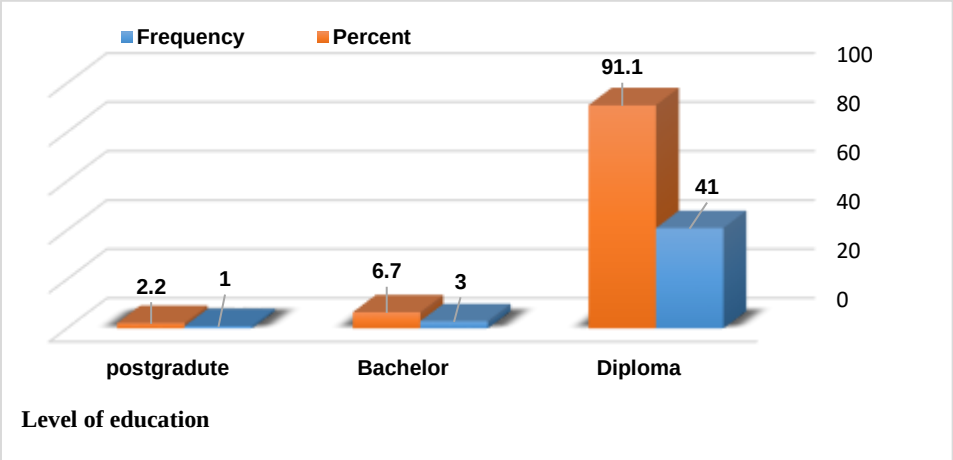

Fig. 2. Nurses' Frequency and Percentage of level of education Distribution

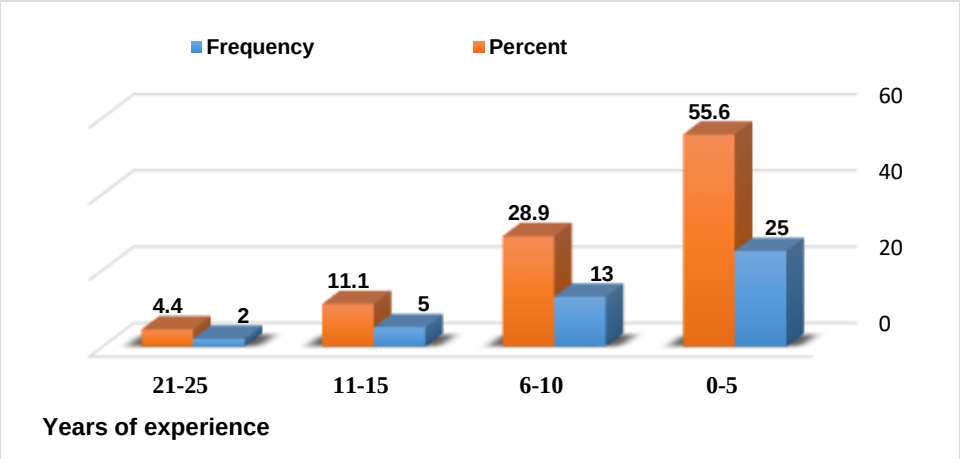

Fig. 3. Nurses' frequency and percentage of years of experience distribution

Table 1. Respondent s' frequency and percentage distribution to questions of evaluating *EBG* of *VAP* prevention

Questions	Options	No.	%
Q4. Oral vs. nasal route for endotracheal intubation	Incorrect answers	8	17.8
	Correct answer (Oral intubation is recommended)	37	82.2
	Total	45	100.0
Q5. Frequency of ventilator circuit changes	Incorrect answers	24	53.3
	Correct answer (Recommended to change circuits for every new patient (or when clinically indicated)	21	46.7
	Total	45	100.0
Q6. Type of airway humidifier	Incorrect answers	34	75.6
	Correct answer (Heat and moisture exchangers are recommended)	11	24.4
	Total	45	100.0
Q7. Frequency of humidifier changes	Incorrect answers	38	84.4
	Correct answer (Recommended to change humidifiers every week (or when clinically indicated)	7	15.6
	Total	45	100.0

Questions	Options	No.	%
Q8. Open vs closed suction systems	Incorrect answers	24	53.3
	Correct answer (Closed suction systems are recommended)	21	46.7
	Total	45	100.0
Q9. Frequency of change in suction systems	Incorrect answers	41	91.1
	Correct answer (Recommended to change systems for every new patient (or when clinically indicated)	4	8.9
	Total	45	100.0
Q10. Endotracheal tubes with extra lumen for drainage of subglottic secretions	Incorrect answers	15	33.3
	Correct answer (These endotracheal tubes reduce the risk for VAP)	30	66.7
	Total	45	100.0
Q11. Kinetic vs. standard beds	Incorrect answers	19	42.2
	Correct answer (Kinetic beds reduce the risk for VAP)	26	57.8
	Total	45	100.0
Q12. Patient positioning	Incorrect answers	19	42.2
	Correct answer (Semi-recumbent positioning is recommended)	26	57.8
	Total	45	100.0
Mean of correct answers	**45**		

Table 2. Respondents' frequency and percentage distribution to questions on evaluating *EBG* of *VAP* prevention based on gender

Questions	Options	Gender		Total
		Male	Female	
Q4. Oral vs. nasal route for endotracheal intubation	Incorrect answers	1	7	8
	Correct answer	13	24	37
	Total	14	31	45
Q5. Frequency of ventilator circuit changes	Incorrect answers	6	18	24
	Correct answer	8	13	21
	Total	14	31	45
Q6. Type of airway humidifier	Incorrect answers	11	23	34
	Correct answer	3	8	11
	Total	14	31	45
Q7. Frequency of humidifier changes	Incorrect answers	13	25	38
	Correct answer	1	6	7
	Total	14	31	45
Q8. Open vs closed suction systems	Incorrect answers	7	17	24
	Correct answer	7	14	21
	Total	14	31	45
Q9. Frequency of change in suction systems	Incorrect answers	13	28	41
	Correct answer	1	3	4
	Total	14	31	45
Q10. Endotracheal tubes with extra lumen for drainage of subglottic secretions	Incorrect answers	6	9	15
	Correct answer	8	22	30
	Total	14	31	45
Q11. Kinetic vs. standard beds	Incorrect answers	7	12	19
	Correct answer	7	19	26
	Total	14	31	45

Q12. Patient positioning	Incorrect answers	5	14	19
	Correct answer	9	17	26
	Total	14	31	45
Mean		**45.2**	**45.1**	

Table 3. Knowledge level and gender, result of Mann-Whitney test

	Mann-Whitney U	**Wilcoxon W**	**Z**	***P* value**
Gender	205.5	310.5	-0.288	**0.77**

Additionally, the following Table 4. shows that most nurses who work for more than 11 years had a good knowledge level than others, besides, nurse with years of experience 0-5 years answered Q4 correctly, On the other hand, and nurses with working experience between 6 to 10, 11 to 15 and 21 to 25 years had the highest proportion of correct answers in Q4 and Q11. Conversely, most nurse with experience between 11 to 25 had least proportion of correct answers in Q9 and Q7.

Also, according to Table 5, there is a significant relationship between years of Experience and knowledge level because *P* value was less than 0.05.

Table 4. Respondents' frequency and percentage distribution to questions on evaluating *EBG* of *VAP* prevention based on years of experience

Questions	**Options**	**years of experience**				
		0-5	**6-10**	**11-15**	**21-25**	**Total**
Q4. Oral vs. nasal route for endotracheal intubation	Incorrect answers	6	2	0	0	8
	Correct answer	19	11	5	2	37
	Total	25	13	5	2	45
Q5. Frequency of ventilator circuit changes	Incorrect answers	15	7	2	0	24
	Correct answer	10	6	3	2	21
	Total	25	13	5	2	45
Q6. Type of airway humidifier	Incorrect answers	21	11	2	0	34
	Correct answer	4	2	3	2	11
	Total	25	13	5	2	45
Q7. Frequency of humidifier changes	Incorrect answers	23	8	5	2	38
	Correct answer	2	5	0	0	7
	Total	25	13	5	2	45
Q8. Open vs closed suction systems	Incorrect answers	11	11	2	0	24
	Correct answer	14	2	3	2	21
	Total	25	13	5	2	45
Q9. Frequency of change in suction systems	Incorrect answers	24	10	5	2	41
	Correct answer	1	3	0	0	4
	Total	25	13	5	2	45
Q10. Endotracheal tubes with extra lumen for drainage of subglottic secretions	Incorrect answers	10	2	1	2	15
	Correct answer	15	11	4	0	30
	Total	25	13	5	2	45
Q11. Kinetic vs. standard beds	Incorrect answers	13	6	0	0	19
	Correct answer	12	7	5	2	26
	Total	25	13	5	2	45
Q12. Patient positioning	Incorrect answers	11	7	1	0	19
	Correct answer	14	6	4	2	26
	Total	25	13	5	2	45
Mean		40.4	45.2	60	66.6	

Table 5. Knowledge level according to years of experience (Kruskal-Wallis Test)

	Chi-Square	Degree of freedom	*P* value
Years of experience	9.462	3	0.02

Table 6. Respondents' frequency and percentage distribution to questions on evaluating *EBG* of *VAP* prevention based on qualification level

		Educational level			
Questions	**Options**	**Diploma**	**Bachelor**	**Postgraduate**	**Total**
Q4. Oral vs. nasal route for endotracheal intubation	Incorrect answers	7	0	1	8
	Correct answer	34	3	0	37
	Total	41	3	1	45
Q5. Frequency of ventilator circuit changes	Incorrect answers	22	2	0	24
	Correct answer	19	1	1	21
	Total	41	3	1	45
Q6. Type of airway humidifier	Incorrect answers	32	1	1	34
	Correct answer	9	2	0	11
	Total	41	3	1	45
Q7. Frequency of humidifier changes	Incorrect answers	34	3	1	38
	Correct answer	7	0	0	7
	Total	41	3	1	45
Q8. Open vs closed suction systems	Incorrect answers	21	3	0	24
	Correct answer	20	0	1	21
	Total	41	3	1	45
Q9. Frequency of change in suction systems	Incorrect answers	39	1	1	41
	Correct answer	2	2	0	4
	Total	41	3	1	45
Q10. Endotracheal tubes with extra lumen for drainage of subglottic secretions	Incorrect answers	14	0	1	15
	Correct answer	27	3	0	30
	Total	41	3	1	45
Q11. Kinetic vs. standard beds	Incorrect answers	17	2	0	19
	Correct answer	24	1	1	26
	Total	41	3	1	45
Q12. Patient positioning	Incorrect answers	18	1	0	19
	Correct answer	23	2	1	26
	Total	41	3	1	45
Mean		44.7	51.8	44.4	

Besides, the Table 6 shows that nurses who hold bachelor degree had a slight high in their knowledge level regarding VAP prevention and control than those who hold diploma and postgraduate degree.

Furthermore, it shows that the most correct answers for Q 4 were for nurses who had diploma, bachelor's degrees and Postgraduate, while the least correct answers for nurses with a diploma was for Q9. On the other hand, nurses with bachelor's degree had low knowledge about Q7 and Q8, and nursed who had Postgraduate level had high proportion of incorrect answer in Q5.

Furthermore, Table 7 shows no a statistical difference between qualification level and nurses' knowledge regarding *VAP* prevention because *P* value more than 0.05.

Table 7. Knowledge level according to educational level (Kruskal-Wallis Test)

	Chi-Square	Degree of freedom	*P* value
Level of education	0.561	2	0.75

3.1 Nurses' knowledge level regarding EBG of VAP prevention in surgical and medicine ICUs at BMC

The current study found that the knowledge level of nurses regarding EBG of VAP prevention was poor in the intensive care units of BMC, which was 45%, and this level is considered to be very low when compared to other studies. The main reasons for the low level could be a lack of education and training regarding VAP preventive measures and intervention programmes. However, a poor level of expertise was observed among nurses in various hospitals, the majority of which were located in developing nations, which there are several studies reported knowledge level below 50%, Al-Sayaghi found a poor nurses' knowledge level regarding prevention measures of VAP among nurses in 37 ICUs of 23 hospitals in Yemen, which was 47.3% [18]. Alongside, Blot et al. indicated that the total mean score in terms of nurses' knowledge level was 41.2% in Belgium [19]. Similarly, a study reported by Labeau et al. in ICUs of 22 European countries found that the average score of ICU nurses was 45.1% [20]. Also, Gomes evaluated the knowledge level of critical care nurses in two private hospitals and one public hospital in Gauteng and reported a very poor the knowledge level at 21.69%, they suggested that nurses did not search for further knowledge and updated their research, and this posed risk for ventilated patients in ICUs [21]. In the same way, Llauradó et al. evaluated the knowledge of six Southern European ICU nurses; they found that their knowledge level was 46.6% [22].

On the other hands, Nesami & Amiri reported low nurses' knowledge level regarding VAP prevention in three intensive care units at university hospitals of Sari, which the level was 51.92% [23]. Also, The knowledge level of nurses in two large hospitals in Makkah, Saudi Arabia were evaluated after perform VAP courses to health care workers, the percentage of participants attendance were 56%, and the nurses' knowledge level of VAP prevention was 7.13 for 11 questions [24]. Furthermore, Jansson et al. found nurses knowledge level in a single academic centre in Finland in the autumn of 2010 was acceptable, which was 59.9% [25].

Besides, another study found poor knowledge level of nurses in seven universities in Jordan, which were 6.4 out of 20, on the other hand, it evaluated the levels of some nurses after attending course, and it found their levels were higher than others and that reflect the importance of educational and training programs [26].

However, there are several possible explanations for the difference in the awareness levels among these studies. These could be for several reasons. There could be lack of EBG for VAP prevention, training deficiencies, routine duties of critical care nursing and policy consistency [20] and differences in the ICU health care delivery module [27]. In addition, Jansson et al. indicated that the main barriers to adherence on the part of nurses to EBG for VAP prevention were insufficient time (14.3%), barriers related to patients (14.3%), skills deficiency (11.9%), knowledge, forgetfulness, guidance and unnecessary procedures (7.1% each) and lack of staff (4.8%) [25]. Similarly, Ricart et al. found that the barriers to adherence were 37% due to resource unavailability, 8.2% due to the discomfort felt by patients, 7.8% did not agree with the reported findings related to EBG, 5.8% feared side effects, and 3.4% for cost reasons [28].

3.2 The Relationship between Nurses' Knowledge Level and Gender

The results of current study showed no significant difference between the gender and knowledge level of nurses regarding EBG of VAP prevention in the medicine and surgical intensive care units of BMC, and this result comes in agreement with another study conducted by Al-jaradi, which Al-jaradi did not observe any correlation between the gender and nurses' knowledge regarding VAP prevention in ICUs of public hospitals in Sana'a City in Yemen [29]. Besides, the findings of the present study are consistent with the findings of studies reported by Blot et al. and El-khatib et al., both found that the knowledge level did not differ between ICU male and female staff [19][27].

On the other hand, the findings of this study are contrary to some studies, Yaseen and Salameh reported that the knowledge levels regarding VAP prevention were higher among females more than males in the main two large hospitals in Makkah, Saudi Arabia, which average of females' knowledge level was (7.22, ±1.4) and male was (6.9,±1.2) [24].

3.3 The relationship between Nurses' Knowledge Level and Years of Experience

The present study found that nurses' knowledge regarding VAP prevention in medicine and surgical care units at the Benghazi medical center (BMC) has a significant relationship with years of experience, which it was clear that nurses with experience more than 11 years had a good knowledge level more than 60%. Along similar lines, Ahmed & Abosamra found a strong relationship between nurses' years of experience and their knowledge level, as well as previous training on VAP prevention guidelines [30]. Similarly, Akın Korhan et al. indicated that there was a significant relationship between the work duration of nurses and their knowledge level with regard to VAP prevention guidelines. However, knowledge levels do not correspondingly increase with increases in the nurses' experience in terms of years. They suggested that the reasons for this could be because nurses have different roles to play when their time in ICUs increased, when they had a decrease in their working hours, when there were decreases in treatment and in patient numbers for whom they provide care in ICUs, and decreases in their participation in in-service training programmes [31]. Along similar lines, Jansson et al. concluded that there was a significant difference between nurses with more than 5 years' experience (60.4%) and those with less than 5 years' experience (53.8%) [25].

Moreover, Labeau et al. indicated that more experienced nurses (those with more than 5 years) had higher knowledge levels than less experienced nurses (less than 5 years) [19]. Alongside this, Blot et al. assessed the nurses' knowledge level during the annual conference of the Flemish Society of Disease in November 2005 and it found that nurses with years' experience more than one year experience had high knowledge level regarding VAP prevention, which the knowledge level of the more experienced participants was 43% while that of the less experienced ones was 17.4% [19].

In contracts to the previous studies, El-khatib et al. reported no significant differences in the knowledge levels of EBG for VAP between physicians with ICU experience of more than 5 years and those with less than 5 years' experience. However, there was a slight difference between nurses' knowledge levels of those with more than 5 years' experience and those with less than 5 years - 81.9% for nurses with more than 5 years' experience and 76.2% for the other group [27]. Besides, another study conducted at General Kuala lumper Hospital (GKLH) in Malaysia city in 2011, it found that nurses in all categories of experience years had a good knowledge level regarding VAP prevention [32].

3.4 The Relationship between Nurses' Knowledge Level and Qualification Level

According to the results of the present study, there is no association between nurses' knowledge regarding VAP prevention and their qualification level, however, it found that nurses who had bachelor degree had a slight knowledge level higher than diploma and postgraduate levels. And this comes in agreement with Abusaad & Tantawey study on nurses' knowledge in Neurology and Surgical ICUs at Egypt Hospital in 2009, which they found that nurses' knowledge had a positive relationship with their qualification level, in more details, they found that nurses who had bachelor degree had a good knowledge level compared to others, which were 56.9%, then comes diploma 37.3% [33]. Furthermore, another study was conducted in Sanaa Hospital, Yemen, it indicated that the level of knowledge has a significant relationship with the nurse's qualification level, which it reported that the high knowledge level regarding VAP prevention among nurses' who had bachelor's degree [18]. Similarly, Akın Korhan et al. (2014) found that the knowledge level increases with the increase in the educational level [31]. This is dissimilar to the findings of Said who reported that there was no correlation between nurses' knowledge levels and their level of education [34].

4. CONCLUSION

Nurses in ICUs of BMC had low knowledge level regarding EBG of VAP prevention, most of them did not have knowledge regarding airway humidification and its changing frequency and the times of changing suction system. Furthermore, no statistical differences in the knowledge level between male and female, however, it found a significant relationship between years of experience and knowledge level, on the other hand, there is no statistical relationship between nurses' qualification level and their knowledge. Therefore, educational and training programmes are needed to improve the nurse's knowledge in order to decrease

the level of VAP infection among ventilated patients.

CONSENT

It is not applicable.

ETHICAL APPROVAL

This study was carried out after approval had been obtained from the manager of Benghazi Medical Centre, following the sending of a preliminary request letter to the manager of the BMC to obtain permission to carry out this study among ICU staff. He provided a preliminary agreement by signing the letter of request.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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