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# Critical Care Nurses' Knowledge and Compliance with Ventilator Associated Pneumonia Bundle at Cairo University Hospitals

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**Abstract**
Ventilator-associated pneumonia (VAP) continues to be a common and potentially fatal complication of ventilator care and often encountered within intensive care units (ICUs). Ventilated and intubated patients present critical care nurses the unique challenge to incorporate evidence-based practices surrounding the delivery of high-quality care. Bundled practices approach is composed of individual preventive measures for preventing the incidence and prevalence of VAP and improving outcomes of patients. The aim of this study is to assess the critical care nurses' knowledge and compliance with ventilator associated pneumonia bundle. A descriptive exploratory study design was utilized. A sample of convenience of 45 critical care nurses was recruited from different critical care units at Cairo university hospital for this study. Data were collected between March 2010 and September 2011. The participants initially, were instructed to complete a demographic data sheet and a validated 20- items questionnaire; 15 items multiple-choice and 5 true/ false items covered the knowledge about pathophysiology , risk factors and preventive VAP bundle practices. Then, direct observation of nurses who provided nursing care to mechanically ventilated patients was carried out utilizing VAP bundle compliance checklist that consisted of ventilator bundled practices for preventing VAP. The main bundle items were infection control measures, patient positioning, endotracheal suctioning care, peptic ulcer prophylaxis, oral care, weaning & extubatoin trials ,and ventilator care measures .The results of 20- items questionnaire revealed unsatisfactory knowledge scores (mean= 7.46 + 2.37) and most of the nurses were not compliant with ventilator associated pneumonia bundle practices (average mean = 8.62 + 7.9 out of 29) and there is no specific protocol to follow for VAP prevention. The findings of the study recommended the need for developing and implementing a protocol for VAP prevention in ICUs. Moreover, there is also a need for training programs for nurses on infection control and VAP bundle preventive measures to lessen the prevalence of ventilator associated pneumonia.
**Key Words:** Critical care nurses' knowledge, compliance, ventilator associated pneumonia bundle

Ventilator associated pneumonia (VAP) is defined as nosocomial pneumonia in ventilated patients that develop more than 48 hours after initiation of mechanical ventilation (MV). VAP is the second most common nosocomial infection after urinary tract infection in intensive care unit patients accounting for 20% of nosocomial infection in this population. VAP can be of two types. Early onset VAP which develops within 5 days of mechanical ventilation and late onset VAP which develops 5 days or more after mechanical ventilation. (Tripathi ,2012).

Traditional signs and symptoms of VAP are chest X-ray showing new or progressive diffuse infiltrate which is not attributable to any other causes, onset of purulent sputum, fever greater than $38.5^0$C, leucocytosis, and positive sputum or blood cultures. The single largest risk factor for VAP is the presence of endotracheal tube. Patient related risk factors include underlying chronic illness, immunosuppression, depressed consciousness, thoracic or abdominal surgery, previous antibiotic therapy and previous infection. Devise, treatment and personnel related risk factors include nasogastric tube placement, bolus enteral feeding, gastric over distension, stress ulcer treatment, supine patient position, nasal intubation route, instillation of normal saline, understaffing, non-conformance to hand washing protocol , indiscriminate use of antibiotics and lack of training in VAP prevention (Hoosre,. 2002 )

Risk factors for development of VAP can be classified in to modifiable and non modifiable conditions. Risk factors can be patient related or treatment related. Modifiable risk factors are obvious targets for improved management and prophylaxis in the comprehensive Guidelines for preventing Health care associated pneumonia, published by centre for disease control. Effective strategies include strict infection control, alcohol based hand disinfection, monitoring and early removal of invasive devices and programs to reduce or alter antibiotic prescribing practices (Michael, 2005) . In addition, VAP occurs in up to 15% of patients receiving mechanical ventilation. Risk factors include tracheostomy, multiple central line insertions, reintubation, and the use of antacids. The hospital mortality rate of ventilator patients who develop VAP is 46%, compared to 32% for ventilator patients who do not develop VAP ( Ibrahim, 2001)

Interventions to prevent VAP begin at the time of intubation and should be continued until extubation. Nurses need to understand the pathophysiology of VAP, risk factors and strategies that may prevent VAP. Use of study

education modules on nursing care of patients at risk of VAP and use of ventilator pathways or protocols with pre-printed order sets and monitoring tools can lead to improved outcome for patients. (Augustyn , 2007) .

Critical care nurses have an important role in preventing VAP by decreasing risk factors, recognizing early symptoms, and assisting in diagnosis (Myrianthefs et al (2004) .Centres for Disease control and Prevention (CDC), 2003 guidelines for the prevention of VAP recommends hand washing, elevation of head end of bed, suctioning of subglottic secretions, use of hand gloves and implementation of comprehensive oral hygiene programme. The guidelines specify that an antiseptic agent be used as part of the oral care programme and oral chlorhexidine gluconate rinse is solely recommended for adults undergoing cardiac surgery.

The prevention of ventilator Assisted Pneumonia (VAP), a hospital acquired infection, among intensive care patients is a major clinical challenge. It is a condition that is associated with high rates of morbidity, mortality, length of stay and hospital costs. Throughout empirical observation ,Nurses' lack of knowledge may be a barrier to adhere to evidenced based guidelines for preventing ventilator-associated pneumonia and translating evidence based findings into consistent delivered care at the bedside remains a challenge. However, many studies have shown that, educational interventions, staff development programmes and multi – module programmes led to a substantial reduction of ventilator associated pneumonia. Therefore this study aimed at examining critical care nurses' knowledge and compliance to the ventilator associated pneumonia bundle.

## 2. Material and Methods

### 2.1 Aim of the study:

To assess the critical care nurses' knowledge and compliance with ventilator associated Pneumonia bundle at Cairo university hospitals.

### 2.2. Research questions

1-what do the nurses know about ventilator associated pneumonia bundle practices at Cairo university hospitals?
2-How do the critical care nurses comply with ventilator associated pneumonia bundle practices at Cairo university hospitals?

### 2.3. Subjects:

A sample of convenience of 45 critical care nurses was recruited for this study. It included nurses working at different concerned critical care units. The inclusion criteria were nurses who provided direct care to mechanically ventilated patients regardless of their demographic characteristics**.** The exclusion criteria were the nurses whose years of experience less than 6 months and didn't accept to participate in the study.

### 2.4. Research Design:

A descriptive exploratory design was utilized in the current study. Polit & Beck, (2006) mentioned that descriptive research provides an accurate account of characteristics of a particular individual, event or group in real-life situations. Exploratory research examines the relevant factors in detail to arrive at description of the reality of the existing situation.

### 2.5. Setting:

The study was conducted at three critical care units (medical, coronary and surgical critical care units) at Cairo university Hospitals in Egypt

### 2.6. Tools:

**2.6.1 Tool (1): Self administered questionnaire sheet:** it was designed and utilized by the researcher. It included two parts:

**Part 1:** Socio demographic and background data: it included data related to subjects' characteristics namely; age, sex, years of experience, and educational level.

**Part 2: 20- items knowledge Questionnaire**: was developed by the researcher based on the CDC guideline (Centers for Disease Control and Prevention 2003; Tablan et al 1994 in addition to Some items were adopted from a reliable questionnaire developed by Blot, Labeau, Vandijick, Claes, and Van Aken , 2007. It included 15 multiple choice and 5 true/ false questions that covered pathophysiology (4 items), risk factors (3 items) and preventive bundled practices (13 items) of ventilator associated pneumonia. The Scoring system for the questionnaire was as follows; the correct answer was given the score of "ONE" and the wrong answer was given the score of "ZERO. Based upon scoring system utilized, the knowledge level was categorized as follows: satisfactory level is ≥ 60% and unsatisfactory level was < 60%..

**2.6.2 Tool (2): VAP bundle compliance checklist** was adapted based on CDC evidence based guidelines, 2003; Tablan et al 1994) .The adapted ventilator bundled practices checklist covered 8 main areas including infection control measures(5 items), positioning strategies(1 item), Endo tracheal Suctioning care(10 items), ventilator circuit care(5 items), Oral care(2 items), testing of enteral feeding &Peptic ulcer prophylaxis(3 items), Weaning trials and extubation (2 items), and DVT prophylaxis(1 item). Each area has sub items. The Scoring system for the developed observational checklist had two responses, ' comply ' response was given the score of "ONE" and 'not comply ' response was given the score of "ZERO". Based upon scoring system utilized,

the performance level was categorized as follows: satisfactory level is ≥ 60% and unsatisfactory level was < 60%.

**2.7 Content validity:**

Face, content and concurrent validity for the previously mentioned tools were revised and ensured by five experts in infection control , critical care medicine and critical care nursing. Based on the experts' opinions responses, the researchers developed the final validated form of the tools.

**2.8. Pilot study**

A pilot study was carried out on 10 subjects to obtain information regarding clarity of the wording and presentation of the questionnaire, and time needed for completing the revised tools. No further alterations were needed according to participants' responses in the pilot study. The subjects included in the pilot study were included in the study sample.

**2.9. Reliability assessment:**

The developed and validated tool for the knowledge questionnaire was tested for reliability on a sample of 10 subjects. Test retest results using Alpha Cronbach revealed that all items are significantly differed and has a correlation coefficient above the threshold of significance (r=0.87). On the other hand, the alpha value for the performance checklist in the sample was (r=0.85).which indicating strong reliability of both tools.

**3-Procedure:**

Once permission was granted to proceed with the current study from responsible and authoritative parties at El-Manial university hospital, the researcher initiated data collection and contacted each potential nurse to explain the purpose and nature of the study. The researcher emphasized that participation in the study is entirely voluntary, the anonymity and the confidentiality of their responses were assured. Nurse participants were asked to sign a consent form .The socio demographic and knowledge questionnaire sheet was administered, the total time allowed to fulfill it by each nurse was 45 to 60 minutes. The time for collecting data through this tool lasted 2 weeks. After that, VAP bundle compliance checklist was utilized to observe each individual nurse who is caring for mechanically ventilated patient throughout shift (morning and afternoon) for three consecutive times, one week apart.

**4-Ethical consideration**

Permission to conduct the study was obtained from the administrative authorities. All the nurses were assured that participation in the study was voluntary. Verbal consent was obtained from nurses who accepted to take part in the study. In order to maintain the confidentiality of the participants, the responses were collected anonymously, data were coded, and the name of the hospital from which data were collected was not being referred to in any published work.

**5-Results:**

**5.1. Table (1) Shows Subjects' demographic characteristics**. As can be seen from, the majority of studied sample (75.6%) was females. Their age ranged between 20 to more than 30 years with mean age of 27.26 ± 5.69.In reference to the level of education; the subjects were mostly internship (44.4%). Related to the years of experience, the studied sample varied between less than one year (44.4%). and more than 10 years (33.39%). The highest percentage of subjects (44.4%) was working in medical critical care unit.

**5.2. Figure (1) shows percentage distribution of knowledge level about VAP bundle among studied sample.** It is apparent from fig. (1) That the majority of studied sample (90%) had unsatisfactory knowledge, while approximately 10% from internship category got satisfactory level.

**5.3. Table (2) presents Comparison of means of knowledge scores about VAP Bundle among studied sample by their educational level.** As can be seen from table 2, that there is no significant statistical difference among studied samples (f= 0.22, p=0.80).

**5.4 Table (3): presents responses to knowledge questions regarding ventilator associated pneumonia and preventive bundle practices**. As can be seen from table 3, the nurses got incorrect responses in the majority of questions. The only questions which obtained the high frequencies of correct answer were (Q1, Q6 and Q7).

**5.5 Table (4): presents average mean performance scores of compliance with elements of ventilator bundle practices among studied sample**. It is apparent from table 4 that all nurses at different work areas (Medical ICU, coronary ICU, surgical ICU) didn't comply with VAP bundle elements. Out of 29 items ,Their means were as follows; 9.40 ± 8.10, 9.72 ± 9.2 & 5.99 ± 7.13 respectively. In addition, it shows that there is no significant statistical difference between means of three work areas regarding compliance with elements of ventilator bundle practice (f= 0.82; p= 0.44).

**5.6 Table (5): presents average percentage distribution of nurses' compliance with VAP bundle practices in different ICUs.** Observations showed that there is no significant differences among ICU

 

nurses regarding washing hands between patients (x2 =28.42 ,p=6.7), maintaining patient's position in semi-recumbent (x2=3.12,p=0.20), replacing the saline solution used for suction (x2=28.42 , p=6.7), However, minimal significant statistical difference was noted among the studied ICUs regarding Ventilator care measures, endotracheal suctioning care. As the as most nursing staff of medical ICU nurses were compliant than coronary and surgical ICU nurses with some of the VAP bundle practices .On the other hand, closed suctioning, sub-glottic suctioning ,extubation & weaning trials and Peptic ulcer prophylaxis practices were not done by nurses.

**6.Table (6): illustrates the relationship between knowledge and selected variables.** As can be seen from the table 6 that there is no significant correlation what so ever between knowledge and practice (r= 0.02) and between knowledge and age and years of experience (r= - 0.02, r= -0.09 respectively).

## 7-Discussion

The following discussion focus upon the findings related to the stated research questions of the study. Discussion is presented in the following sequence: (a) nurses ' knowledge about VAP bundle, (b) nurses' compliance with VAP bundle practices c) Relationship between the nurses' knowledge and nurses' compliance with VAP bundle practices.

### 7.1. Nurses ' knowledge about VAP bundle

The present study findings revealed that all critical care nurses with different educational levels, irrespective of their years of experience or area of work had unexpectedly unsatisfactory knowledge scores about ventilator associated pneumonia and VAP bundle preventive measure. It has been suggested by a study that nurses usually lack knowledge of the research and evidence for the prevention of VAP. Majority of the nurses in this part acquire their knowledge of taking care of critically ill patients from their basic educational programs, or from hospital policies and procedures. Moreover, the demographic profiles of the participants also mentioned that majority of the nurses in the study group were diploma holders, and internship nurses who had less than 2 years of nursing experience. The present study finding is consistent with Blot & Labeau (2007) & Gomes (2010) who conducted a study about knowledge among intensive care nurses on Evidence-based guidelines for the prevention of ventilator-associated pneumonia and the results revealed Overall knowledge results were poor. As regards, nurses responses to knowledge questions regarding ventilator associated pneumonia and preventive bundle practices , it showed that all the nurses gave correct answer regarding the preference of Oral to nasal route for end tracheal intubation. The possible factor that may explain this finding is that Oral intubation route is most common in the studied ICUs. As they acquired that knowledge from work experience and knowing this is an evidence based guideline. This finding is consistent with Kollef( 2004) that emphasized based on evidence based studies that oral intubation is preferable to nasal route as it prevents aspiration of contaminated secretions, hence reduces the incidence of VAP.

The current evidence based guidelines mentioned in VAP bundle by Labeau (2007) that Heat and moisture exchangers are recommended, and must change humidifiers every week (or when clinically indicated). When comparing these guidelines with nurse's answers, the finding showed that more than half of the studied ICU nurses reported that they don't recommend heat moisture and change humidifiers every 48 hours as it contradict with evidence based guidelines. This study finding is in accordance with Sierra et al. (2005) who found that in 75% of the ICUs ventilator circuits were changed every 72 h or later . As well, this finding is in accordance with Blot & Labeau (2007) who indicated to change ventilator circuits weekly or later in 76% of respondents. on the other hand, the present study finding contradicted with Heyland et al (2002), Ricart et al(2003), and Sierra et al.(2005) respectively, who mentioned that 80%, 84%, and 96% of the respondents used heat and moisture exchangers.

The present study finding revealed that less than half of the nurses recognized closed systems as recommended and the rest of nurses reflect unfamiliarity with closed systems. This finding is in accordance with Heyland (2002) & Sierra (2005) who mentioned in their studies that In Canada, closed suction systems are used in 88% of the ICUs, whereas in Spain open tracheal suctioning was reported in 96% of the ICUs and added that closed suction systems are not commonly used, and thus the results reflected nurses' unfamiliarity with those systems.

More than half of the nurses in the present study knew that frequent change in suction systems, and kinetic beds decrease the risk and occurrence of pneumonia. While only 48% of nurses knew that semi-recumbent positioning help in prevention of pneumonia. This finding agreed with Heyland (2002) & Sierra (2005) who mentioned that the beneficial effect of kinetic beds was recognized by about half of the nurses. While semi-recumbent positioning was well acknowledged to prevent VAP.

Finally, The study finding revealed that more than three fourth of nurses had low knowledge regarding predisposing, risk factors, signs and symptoms, diagnosis , treatment and components of ventilator bundle practices in ventilator associated pneumonia

 

**7.2. Nurses' compliance with VAP bundle practices**

The findings of Nurses' compliance with VAP bundle practices indicate that a large percentage of critical care nurses implemented some preventive measures for VAP while didn't comply with most VAP bundle practices.

Although an infection control measure is not a component of ventilator bundle practices, it plays an important role in reducing the risk of ventilator associated pneumonia. Hand Hygiene is considered a cornerstone of all infection control practices. The Center for Disease Control strongly recommends hand washing before and after direct patient care or when handling articles that could be contaminated with respiratory secretions (Tablan et al.& CDC, (2004). Hand Hygiene is an effective way of removing transient bacteria from the hands; however, nurses' compliance with hand hygiene in the current study has been poor .Moreover, the nurses were not compliant with changing gloves between patients, not disinfecting the Ambu-bag before and after contact with patient and some ICU nurses use the Ambu-bags between patients. There are several reasons may explain this phenomenon; may due to the frequency of patient care contact, heavy workload, understaffing, overcrowding, poor access to hand washing facilities, inadequate institutional commitment to good hygiene practice All these reasons may adversely affect hand hygiene compliance. This finding is consistent with Augustyn (2007) who mentioned that Failure to wash hands and change gloves between patients has been associated with an increased incidence of VAP. Moreover, the study finding is supported by a study done by Bingham et al., in 2010 who revealed that that no differences was observed in hand hygiene behavior even after the implementation of a unit-level interventions to reduce VAP .

According to the evidence based guidelines (EBG's) on prevention of VAP, semi- recumbent positioning is recommended to prevent VAP. Amongst all participants of nurses in medical critical care units, coronary care units and surgical critical care units in the current study; only 50%, 38.4%, 33.3% respectively showed compliance to maintaining head of bed elevation .This finding is consistent with Jiménez & Vega (2009) in pre-education component , they found that 14% of evaluated cases were compliant with the elevation of the bed at or more than 30º from the horizontal plane and following the educational strategies 74% of the cases were compliant to HOB elevation with an increase in 60%.

According to the EBG's on prevention of VAP & Grap et al (2012), a cuffed endotracheal tube with at least 20 cm of H2O should be maintained to reduce the chance that the patient will aspirate secretions that accumulate above the cuff. Secretions are common in the upper airways of intubated patients and pool above the endotracheal tube cuff, allowing for leakage of contaminated secretions into the lower airway. The effect of using an endotracheal tube that has a separate dorsal lumen, which allows continuous aspiration of the subglottic secretions in those patients receiving mechanical ventilation for more than 48 hours, reduced the incidence of ventilator-associated pneumonia as well as ICU stay, duration of mechanical ventilation and antibiotic consumption.

The results of this study in relation to maintaining a cuffed endotracheal tube with at least 20 cm of H2O and continuous aspiration of the subglottic secretions showed that all the studied ICUs nurses did not maintain adequate pressure in endotracheal tube (ETT) cuff in those patients receiving mechanical ventilation for more than 48 hours which reflects their inadequate knowledge about the importance of this action in prevention of VAP. This finding is in congruent with Gonçalves & Brasil (2012) who studied Nursing actions for the prevention of ventilator-associated pneumonia in an Intensive Care Unit of a teaching hospital in Goiania that revealed an important precaution was not properly done by the team concerning the calibration of intra cuff pressure of endotracheal tube, drawing attention for its low frequency (18.1%) and recommended that this pressure should be measured at least three times per day.

Care related suctioning including wearing sterile gloves with open suction system, using sterile technique when applying tracheal suctioning, replacement of suction systems, replacing suction tubes, replacing the solution used for suction are not part of the ventilator bundles , however, the lack of asepsis during suctioning care predominated among nurses . This finding could be due to lack of training surveillance on infection control measures. This study finding agreed with Kandeel and Tantawy (2012) who Studied Nursing Practice for Prevention of Ventilator Associated Pneumonia in ICUs and Observations illustrated that most nurses did not implement infection control measures when applying tracheal suctioning or when dealing with suction equipment and indicated the need for infection control training programs for all critical care nurses working the studied ICU.

Another way of preventing VAP is performing frequent mouth care. It is a critical measure to inhibit bacterial growth in the oral cavity, which increases the risk of developing VAP (Pruitt & Jacobs, 2006). Maintaining the patient's oral hygiene is important because contaminated oral secretions would flow to the sub-glottic area, where small amounts of these secretions might be aspirated causing VAP (Pruitt & Jacobs, 2005). Adequate suctioning is recommended as it prevents oral secretions from pooling and maintaining good oral hygiene which reduces oropharyngeal colonization (Schleder, 2004). The findings of nurses' observations in the current study showed that there was no oral care protocol available in all the studied ICUs. In the current

 

study, most nurses in medical critical care unit (61.5%) use Saline as a mouth wash solution while the coronary care unit (35%) and surgical critical care (33.3%) used tap water and not on a regular base. This may be due to unavailability of written oral care protocols in the studied ICUs in addition to the loss of nurses' awareness about the benefit of delivering timely oral care and its relation to the incidence of VAP. This is similar to the findings of a study conducted in Alexandria Main University Hospital in Egypt which reported absence of oral care protocol in the ICUs who found that oral care is carried out without the use of tooth brushing or antiseptic solutions. (Alhirishi, 2010 , O'Keefe-McCarthy ,2006& Scott &Vollman, 2011)).

Another recommended care for prophylaxis of VAP is checking the gastric residual volume (GRV) every 4 to 6 hours; administer intermittent rather than continuous enteral feeding and performing Routine acidification of gastric feeding. In the current study, all the nurses in studied critical care units did not comply and follow what is recommended in evidence based guidelines in this issue. The possible explanation for this finding may due to lack of knowledge and absence of protocol to follow in these units. This finding agreed with Tolentino - DelosReyes & Ruppert (2007) & Oliveira & Burgos (2010) who stated that verification of the amount of residual volume occurred in less than half of the observations, with suspension of the diet in case of vomiting and GRV between 50 and 300 mL. This shows that the team did not follow what is recommended for routine or proposals from other studies that, in case of GRV> 150 mL, one must suspend the diet.

Using daily "sedation vacations" and assessing the patient's readiness to extubate are an integral part of the ventilator bundle and have been correlated with reduction in the rate of ventilator-associated pneumonia (Kunis & Puntillo ,2003). Sedation and NMBA impede the patient's ability to swallow effectively, which prevents effective clearance of saliva from the oral cavity and can migrate via micro aspiration into the lungs. Measures such as daily interruption of sedation and pursuing a protocol for early extubation are associated with shorter duration of mechanical ventilation and prevention of ventilator associated pneumonia (Wood et al. 2007) In this study, it is these important measures were not done by all nurses in the studied units. the possible explanation for non adherence to these guidelines that nurses in most critical care unit never initiates weaning trials , and the physician is the only one who is responsible for initiation of weaning trials and interruption in sedation utilizing sedation scale.

However it is unclear if there is any association between DVT prophylaxis and decreasing rates of ventilator-associated pneumonia, our experience is that when DVT prophylaxis is applied as part of a package of interventions for ventilator care, the rate of pneumonia decreases precipitously. The intervention remains excellent practice in the general care of ventilated patients. However, the results of this study in relation to DVT prophylaxis by nurses in the form of Applying anti-embolic stockings or sequential compression showed that less than half of the nurses didn't comply with this guideline. The possible interpretation for this finding is that nurses apply these measures only in the case of DVT in addition to initiation of this measure is prescribed by the physician.

**7.3. Relation between nurses' knowledge and selected variables**

The researcher examined the relationship between the total knowledge and total performance scores. The present study findings revealed no correlation what so ever between knowledge and practice. Lack of association between the total knowledge scores and performance scores may be partially interpreted in the light of lack of training courses, updating pre-existing knowledge, lack of time, workload, and lack of equipment as the reasons for non compliance ventilator bundle practices.

It has been postulated that years of experience is directly proportional to the level of education, i.e.; the higher the level of education the more the years of experience. The finding of this study didn't support this postulation and showed that there is no correlation what so ever between knowledge and practice irrespective of their years of experience and educational level. This study finding is contrary to Geri (2005) who concluded that more experience increase the cognitive resources available for interpretation of data resulting in increased knowledge.

In the present study findings Significant differences were found among the studied ICUs nurses concerning some aspects of care, such as Ventilator care measures, endotracheal suctioning care ,as the as most nursing staff of medical ICU nurses were compliant than coronary and surgical ICU nurses with some of the VAP bundle practices .On the other hand, no significant differences were found among ICU nurses regarding closed suctioning, sub-glottic suctioning , extubation & weaning trials and Peptic ulcer prophylaxis practices as these practices were not done by ICU nurses. The possible interpretation for this finding could be due to the absence of a unified protocol for VAP prevention in the studied ICU, and lack of nurses' training in this area. This finding is agreed with Babcock et al (2004) & Augustyn (2007) who mentioned that Variations in nursing practice among ICUs, and not implementing all evidences into practice could be due to the absence of protocol for VAP prevention in the studied ICU and Gallagher's (2012) study findings emphasized that education of nurses can improve mechanically ventilated patient outcome, and improve the quality of care.

 

**8-Conclusion and recommendations**

Nurses' knowledge regarding VAP bundle was inadequate and they did not implement the latest evidenced VAP bundle practices as reported CDC recommendations (CDC, 2004) in their current practice and the study illustrated an absence of a uniform protocol for prevention of VAP in the studied ICU. Based on the results of the present study, the following recommendations were made:

-The need for in- service education and integration of evidence based guidelines regarding prevention of ventilator associated pneumonia.

- The need for developing a unified protocol for VAP prevention based upon current evidence based guidelines.

-The need for establishing a system to ensure that VAP prevention protocol will be implemented consistently in all ICUs.

-There is a need implement all the individual elements of a bundle evidence-based practices when applied together they result in significantly better outcomes than when implemented individually

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**Table (1) Socio demographic characteristics of the nursing staff of Critical Care Units (n = 45)**

| Variables | N | % |
|---|---|---|
| **Gender** | | |
| - Male | **11** | **24.4** |
| - Female | **34** | **75.6** |
| **Age** | | |
| - 20 - < 25 | **20** | **44.4** |
| - 25 - < 30 | **9** | **20** |
| - ≥30 | **16** | **35.6** |
| **Mean 27.26 SD ± 5.69** | | |
| **Level of education** | | |
| - Internship | **20** | **44.4** |
| - Technical diploma | **14** | **31.1** |
| - Baccalaureate (BSc.N) | **11** | **24.5** |
| **Years of experience** | | |
| - < 1 year | **20** | **44.4** |
| - 1-5 | **4** | **8.88** |
| - 6-10 | **6** | **13.33** |
| - >10 | **15** | **33.39** |
| **Area of work** | | |
| - Medical critical care | **20** | **44.4** |
| - Coronary care unit | **13** | **28.8** |
| - Surgical critical are | **12** | **26.8** |

**Figure (1): percentage Distribution of knowledge level about VAP Bundle among Studied sample (n=45).**

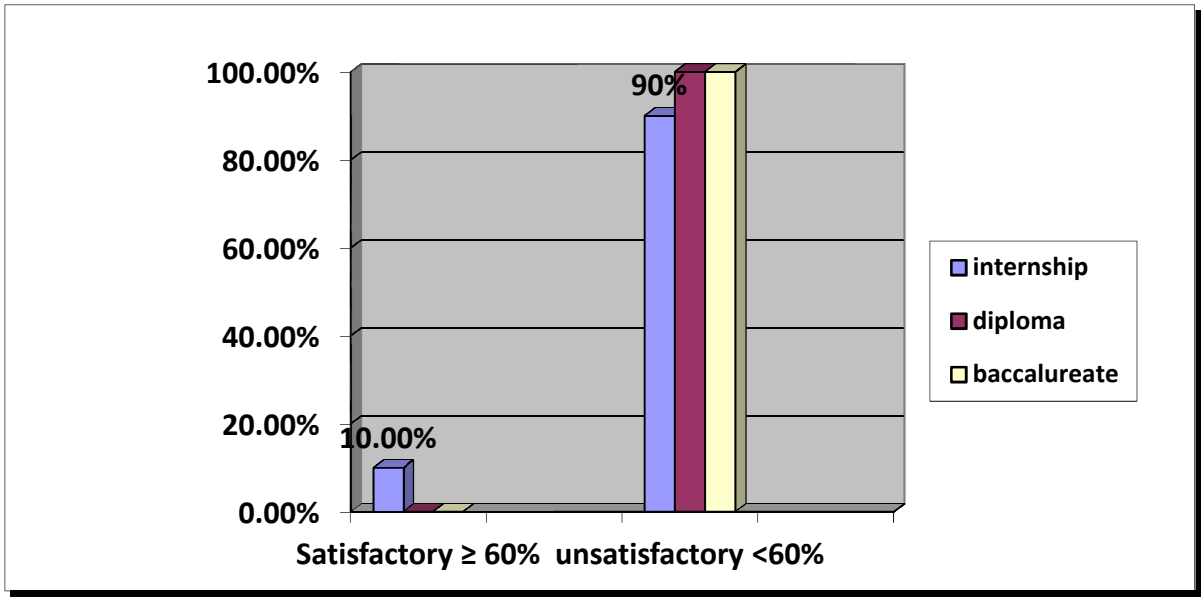

 

**Table 2: Comparison of means of knowledge scores about VAP Bundle by educational level among studied sample (N=45).**

| variable | Educational level | | | | | | F. test | P - value |
|---|---|---|---|---|---|---|---|---|
| | internship | | Post secondary technical diploma | | Baccalaureate (BSc.N) | | | |
| | Mean | SD | Mean | SD | Mean | SD | | |
| Knowledge score | 7.55 | 2.85 | 7.69 | 1.65 | 7.08 | 2.27 | 0.22 | 0.80 NS |

**NS= not significant**

**Table (3): knowledge questions responses regarding ventilator associated pneumonia and preventive bundle practices (N=45).**

| Question item | Correct N (%) | Incorrect N (%) |
|---|---|---|
| **Multiple choice questions** | | |
| 1-Oral vs. nasal route for endotracheal intubation | **45 (100)** | **0 (0)** |
| 2-Frequency of ventilator circuit changes | **15 ( 33.3)** | **30 (66.7)** |
| 3. Type of airway humidifier | **22 (48.8)** | **23 (51.2)** |
| 4. Frequency of humidifier changes | **17(37.7)** | **28 (62.3)** |
| 5. Open vs. closed suction systems | **20(44.4)** | **25 (55.6)** |
| 6. Frequency of change in suction systems | **26(57.7)** | **19 (42.3)** |
| 7. Kinetic vs. standard beds | **25(55.5)** | **20 (44.5)** |
| 8. Patient positioning in (30º-45º) | **22 (48.8)** | **23 (51.2)** |
| 9- statements best describes recommendations for duration of antibiotic therapy for VAP | **12(26.6)** | **33(73.4)** |
| 10- anatomic areas is the primary route for ventilator-associated pneumonia (VAP) | **11(24.4)** | **34 (75.6)** |
| 11-Risk factors for ventilator-associated pneumonia (VAP) | **15 ( 33.3)** | **30 (66.7)** |
| 12- The signs and symptoms of VAP | **25 (55.5)** | **20 (44.5)** |
| 13- Components of VAP care bundle | **7 (15.5)** | **38 (84.5)** |
| 14- VAP (ventilator associated pneumonia) is defined as pneumonia that develops in an intubated patient after _____hours or more of mechanical ventilation support | **15 ( 33.3)** | **30 (66.7)** |
| 15- statements best describes the recommendations for the treatment of VAP | **7 (15.5)** | **38 (84.5)** |
| **True / false questions** | | |
| 1-Positive sputum culture indicate the likelihood of VAP | **9 (20)** | **36 (80)** |
| 2- Peptic Ulcer Disease Prophylaxis help in prevention of VAP | **11(24.4)** | **34 (75.6)** |
| 3-Head of bed elevation prevents aspiration from the stomach into the airways | **17(37.7)** | **28 (62.3)** |
| 4-Endotracheal aspirate with non-quantitative cultures can be used to diagnosis VAP. | **12(26.6)** | **33 (73.4)** |
| 5-Endotracheal tubes with extra lumen for drainage of subglottic secretions increase risk for VAP | **0 (0)** | **45 (100)** |

**Table (4) Average means performance scores of compliance with elements of ventilator bundle practices among studied sample by their areas of work (n=45)**

| practices | Maximum potential score | Area of work | | | F test | P value |
|---|---|---|---|---|---|---|
| | | Medical ICU | Coronary ICU | Surgical ICU | | |
| | | X ±SD | X ±SD | X ±SD | | |
| **Infection control measures** | **5** | 1.8 ± 2.01 | 1.61 ± 2.21 | 0.69 ±1.18 | 1.35 | 0.26 |
| **Maintaining patient's position in (30º-45º)** | **1** | 0.50 ± 0.51 | 0.38 ± 0.50 | 0.2 ±0 .45 | 1.39 | 0.25 |
| **Ventilator care measures** | **5** | 3.2 ± 2.16 | 2.46 ±2.29 | 1.75 ± 2.30 | 1.61 | 0.21 |
| **End tracheal Suctioning care** | **10** | 2.90 ± 2.61 | 3.84 +2.76 | 2.75 ± 2.30 | 0.70 | 0.50 |
| **Peptic ulcer prophylaxis practices** | **3** | 0.00 | 0.00 | 0.00 | - | - |
| **Oral care practices** | **2** | 0.7 ± 0.9 | 1.2 ± 1.01 | 0.6 ± 0.9 | 1.57 | 0.2 |
| **Weaning and extubation trials** | **2** | 0.00 | 0.00 | 0.00 | - | - |
| **DVT prophylaxis practices** | **1** | 0.25 ± 0.44 | 0.23 ± 0.43 | 0.00 | 1.84 | 0.17 |
| **Total** | **29** | **9.40 ± 8.10** | **9.72 ± 9.2** | **5.99 ± 7.13** | **0.82** | **0.44** |

 

**Table (5) Average percentage distribution of Nurses' compliance with bundled preventive practices for ventilator associated pneumonia in different units (n=45).**

| practices | | Area of work: Medical ICU N=20 % | Coronary ICU N=13 % | Surgical ICU N=12 % | Tests of significance: X2 | P |
|---|---|---|---|---|---|---|
| **Infection control measures** | | | | | | |
| 1 | wash hands before and after patient contact | 40 | 38.46 | 25 | 6.45 | 0.03* |
| 2 | wash hands between patients | 15 | 23 | 0.0 | 28.42 | 6.7 |
| 3 | change gloves between patients | 50 | 38.46 | 16.6 | 7.52 | 0.02* |
| 4 | Use sterile ambu bag/ disinfect it before use | 25 | 23 | 0.0 | 23.56 | 0.00* |
| 5 | Change ambu bag between patients | 50 | 38.46 | 0.0 | 13.12 | 0.001* |
| **Patient positioning** | | | | | | |
| 1 | maintain continuously patient's position in (30º-45º) if not contraindicated | 50 | 38.46 | 33.3 | 3.12 | 0.20 |
| **Ventilator care measures** | | | | | | |
| 1 | drain and discard Periodically any condensate that collects in the tubing of a mechanical ventilator | 50 | 38.46 | 25 | 5.12 | 0.07 * |
| 2 | humidify respiratory circuit using humidity and heat exchange filter | 60 | 61.5 | 33.3 | 5.8 | 0.05 * |
| 3 | Replace humidifiers | 65 | 38.46 | 33.3 | 7.14 | 0.02 * |
| 4 | replace the ventilator circuit regularly | 65 | 46 | 41.6 | 5.85 | 0.05 * |
| 5 | Change a heat moisture exchanger that is used by a patient when it becomes visibly soiled | 80 | 61.5 | 41.6 | 38.37 | 0.000 * |
| **End tracheal Suctioning care** | | | | | | |
| 1 | Maintain adequate pressure in endotracheal tube cuff | 25 | 38.46 | 33.3 | 9.792 | 0.007 * |
| 2 | Wear clean gloves with Closed suctioning | NA | NA | NA | - | - |
| 3 | Wear sterile gloves with an open suction system | 25 | 38.46 | 25 | 11.79 | 0.002 * |
| 4 | Using sterile technique when applying tracheal suctioning. | 10 | 15.38 | 0.0 | 33.58 | 0.000 * |
| 5 | Use sterile suction equipment. | 25 | 38.46 | 16.6 | 14.19 | 0.002 * |
| 6 | Replacement of suction systems | 40 | 61.5 | 33.3 | 5.13 | 0.076 * |
| 7 | Replace suction tubes | 60 | 69.2 | 25 | 12.25 | 0.002 * |

**Con. of Table (5)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **End tracheal Suctioning care** | | | | | | |
| 8 | use Saline/ distilled water prior to suctioning | 90 | 100 | 100 | 128 | 0.0 |
| 9 | replace the solution used for suction | 15 | 23 | 0.0 | 28.42 | 6.7 |
| 10 | -continuous aspiration of sub glottic secretions if ventilator more than 48 hours | -- | NA | NA | - | - |
| **Oral care** | | | | | | |
| 1 | perform oral hygiene with antiseptic mouth wash | 35 | 61.5 | 33.3 | 6.56 | 0.03* |
| 2 | use topical antimicrobial agents for oral decontamination regularly | 35 | 61.5 | 33.3 | 6.56 | 0.03* |
| **Peptic ulcer prophylaxis** | | | | | | |
| 1 | check the gastric residual volume (GRV) every 4 to 6 hours | 0 | 0 | 0 | 0 | - |
| 2 | administer intermittent rather than continuous enteral feeding | 0 | 0 | 0 | 0 | - |
| 3 | Perform Routine acidification of gastric feeding | 0 | 0 | 0 | 0 | - |
| **Extubation and Weaning trials** | | | | | | |
| 1 | interruption in sedation utilizing sedation scale | 0 | 0 | 0 | 0 | - |
| 2 | Perform daily assessments of readiness to wean and extubate | 0 | 0 | 0 | 0 | - |
| **DVT prophylaxis** | | | | | | |
| 1 | Apply anti-embolic stockings or sequential compression | 25 | 23 | 0 | 23.56 | 0.00 |

*** Significant**

 

**Table (6): Relationship between total knowledge and total average performance scores and selected demographic variables**

| Variables | R value | P value |
|---|---|---|
| **Total knowledge &Performance** | -0.02 | ns |
| **Total knowledge & Age** | -0.02 | ns |
| **Total knowledge & Years of experience** | -0.09 | ns |

**NS = not significant**

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